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ASSESSMENT OF PROCEDURAL PARAMETERS RECORDED FOLLOWING SPINAL ANAESTHESIA FOR CAESAREAN SECTION AT THREE ACADEMIC HOSPITALS IN GAUTENG

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree

of

Master of Medicine in the branch of Anaesthesiology

Johannesburg, 2015

DECLARATION

I, Joubert Casper Steynberg, declare that this research report is my own work.

It is being submitted for the degree of Master of Medicine in the branch of Anaesthesiology at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

.....

Joubert Casper Steynberg

Signed on this 17th day of February 2015 at Johannesburg

DEDICATION

To my wife, family and friends who are always supporting me in everything I do.

ACKNOWLEDGEMENTS

I would like to thank the following people and institutions for their invaluable input, advice and assistance:

Mrs Helen Perrie

Mrs Juan Scribante

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ABSTRACT

Currently spinal anaesthesia is widely considered as the safest technique for caesarean section because the increased risk of failed intubation and aspiration associated with pregnant patients is avoided. In South Africa the latest confidential enquiry into maternal mortality for the triennium 2008 – 2010 showed that the maternal mortality rate due to anaesthesia is approximately 5 per 100 000 live births, and the majority (79%) occurred under spinal anaesthesia. This represents a high rate of maternal mortality due to anaesthesia, and particularly spinal anaesthesia, when compared to developed countries. Good anaesthetic records are vital in understanding why the maternal mortality rate due to anaesthesia is so high, and the parameters that are recorded following spinal anaesthesia has not been investigated in South Africa.

The primary objectives of this study were to describe the demographics, essential procedural parameters, additional procedural parameters and the clinical parameters recorded following spinal anaesthesia for caesarean section.

The secondary objectives of this study were to compare whether surgery being performed during the week or over the weekend, surgery being performed during the day or during the night, surgery being routine or an emergency or the category of anaesthetist influenced the parameters recorded.

The research design used in this study was that of a retrospective, contextual, descriptive study. The study population was the anaesthetic records completed following spinal anaesthesia for caesarean section in the maternity theatres of Chris Hani Baragwanath Academic Hospital, Charlotte Maxeke Johannesburg Academic Hospital and Rahima Moosa Mother and Child Hospital. Consecutive convenience sampling was used to select 300 anaesthetic records to be enrolled into the study.

Anaesthetic records at each hospital were reviewed from 30 June 2013 backwards until the required sample size for each hospital was reached. Records were enrolled into the study proportionally to the average number of caesarean sections performed at each hospital per month.

The majority of records were completed during the week and during the night, most of these anaesthetic records were for emergency surgeries and most were completed by registrars.

The study revealed that demographic data and identifying parameters were recorded thoroughly. Eight of the twelve essential procedural parameters were recorded adequately. From the twelve additional procedural parameters identified from the records only two were recorded adequately and from the five clinical parameters reviewed four were recorded acceptably.

Records were found to be more comprehensive when completed during the week, when completed during the night, when completed for emergency surgery and when completed by a registrar.

TABLE OF CONTENTS

DECLARATION i
DEDICATION. ii
ACKNOWLEDGEMENTS iii
ABSTRACT iv
TABLE OF CONTENTS vi
LIST OF TABLES ix
LIST OF APPENDICES x
LIST OF FIGURES xi
CHAPTER 1 1
1.1 INTRODUCTION 1
1.2 BACKGROUND TO THE STUDY 1
1.3 PROBLEM STATEMENT 4
1.4 AIM OF THE STUDY 5
1.5 OBJECTIVES OF THE STUDY 5
1.6 RESEARCH ASSUMPTIONS 6
1.7 DEMARCATION OF THE STUDY FIELD 8
1.8 ETHICAL CONSIDERATIONS 8
1.9 RESEARCH METHODOLOGY 9
1.9.1 STUDY DESIGN 9
1.9.2 STUDY POPULATION 9
1.9.3 STUDY SAMPLE 9
1.9.4 DATA COLLECTION 10
1.9.5 DATA ANALYSIS 10
1.10 SIGNIFICANCE OF THE STUDY 11
1.11 VALIDITY AND RELIABILITY 12
1.12 PROJECT OUTLINE 12
1.13 SUMMARY 12
CHAPTER 2 13
2.1 INTRODUCTION 13
2.2 ANAESTHESIA-RELATED MATERNAL DEATHS 13
2.3 OBSTETRIC ANAESTHESIA 15

2.3.1 PHYSIOLOGICAL CHANGES OF PREGNANCY AND THE ASSOCIATED ANAESTHETIC IMPLICATIONS 15
2.3.2 CHOICE OF ANAESTHETIC TECHNIQUE FOR CAESAREAN SECTION 20
2.4 ANAESTHESIA RECORDS 22
2.4.1 HISTORY AND PURPOSE OF ANAESTHESIA RECORDS 22
2.4.2 MEDICOLEGAL IMPLICATIONS OF ANAESTHESIA RECORDS 23
2.4.3 DESIGN OF ANAESTHESIA RECORDS 25
2.4.4 GUIDELINES FOR THE STANDARDS OF RECORD KEEPING FOLLOWING REGIONAL ANAESTHESIA 27
2.4.5 ACCURACY AND COMPLETENESS OF ANAESTHESIA RECORDS 31
2.5 SPINAL ANAESTHESIA 32
2.5.1 INTRODUCTION 32
2.5.2 ANATOMY OF THE VERTEBRAL COLUMN, SPINAL CORD AND MENINGES 32
2.5.3 TECHNIQUE OF SPINAL ANAESTHESIA 36
2.5.4 COMPLICATIONS OF SPINAL ANAESTHESIA 40
2.6 SUMMARY 43
CHAPTER 3 44
3.1 INTRODUCTION 44
3.2 PROBLEM STATEMENT 44
3.3 AIM OF THE STUDY 45
3.4 OBJECTIVES OF THE STUDY 45
3.5 ETHICAL CONSIDERATIONS 46
3.6 RESEARCH METHODOLOGY 46
3.6.1 STUDY DESIGN 46
3.6.2 STUDY POPULATION 47
3.6.3 STUDY SAMPLE 47
3.6.4 DATA COLLECTION 48
3.6.5 DATA ANALYSIS 52
3.7 VALIDITY AND RELIABILITY 52
3.8 SUMMARY 53
CHAPTER 4 54
4.1 INTRODUCTION 54
4.2 SAMPLE REALISATION 55
4.3 RESULTS 55

4.3.1 PRIMARY OBJECTIVES 55
4.3.1.1 Describe the demographics recorded following spinal anaesthesia for caesarean section 55
4.3.1.2 Describe the essential procedural parameters recorded following spinal anaesthesia for caesarean section 56
4.3.1.3 Describe the additional procedural parameters recorded following spinal anaesthesia for caesarean section 57
4.3.1.4 Describe the clinical parameters recorded following spinal anaesthesia for caesarean section 58
4.3.2 SECONDARY OBJECTIVES 59
4.3.2.1 Generation of parameter scores 59
4.3.2.2 Compare whether surgery being performed during the week or over the weekend influenced the parameters recorded 60
4.3.2.3 Compare whether surgery being performed during the day or during the night influenced the parameters recorded 62
4.3.2.4 Compare whether surgery being routine or an emergency influenced the parameters recorded 65
4.3.2.5 Compare whether the category of anaesthetist influenced the parameters recorded 67
4.4 DISCUSSION 71
4.5 SUMMARY 75
CHAPTER 5 76
5.1 INTRODUCTION 76
5.2 STUDY SUMMARY 76
5.3 LIMITATIONS 79
5.4 RECOMMENDATIONS 81
5.4.1 RECOMMENDATIONS FOR CLINICAL PRACTICE 81
5.4.2 RECOMMENDATIONS FOR FURTHER RESEARCH 82
5.5 CONCLUSION 82
5.6 SUMMARY 83
REFERENCES. 84
APPENDICES 94

LIST OF TABLES

Table 1.1 Current guidelines and requirements for record keeping of regional anaesthesia 29

Table 4.1 Essential procedural parameters recorded..... 56

Table 4.2 Additional procedural parameters recorded 57

Table 4.3 Clinical parameters recorded 58

Table 4.4 Generated parameter scores 59

Table 4.5 Essential procedural parameters recorded during the week and over the weekend..... 60

Table 4.6 Additional procedural parameters recorded during the week and over the weekend... 61

Table 4.7 Clinical parameters recorded during the week and over the weekend 61

Table 4.8 Essential procedural parameters recorded during the day and the night..... 63

Table 4.9 Additional procedural parameters recorded during the day and the night 63

Table 4.10 Clinical parameters recorded during the day and the night 64

Table 4.11 Essential procedural parameters recorded during routine and emergency surgery 65

Table 4.12 Additional procedural parameters recorded during routine and emergency surgery.... 66

Table 4.13 Clinical parameters recorded during routine and emergency surgery..... 66

Table 4.14 Essential procedural parameters recorded by each category of anaesthetist 68

Table 4.15 Additional procedural parameters recorded by each category of anaesthetist 69

Table 4.16 Clinical parameters recorded by each category of anaesthetist..... 69

LIST OF APPENDICES

Appendix A: Anaesthetic record used at CHBAH 94

Appendix B: Anaesthetic record used at CMJAH 95

Appendix C: Anaesthetic record used at RMMCH 96

Appendix D: Data collection form 97

Appendix E: Approval to conduct the study from Postgraduate Committee of the University of the Witwatersrand..... 98

Appendix F: Approval to conduct the study from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand..... 99

Appendix G: Approval to conduct the study from the CEO of CHBAH 100

Appendix H: Approval to conduct the study from the CEO of CMJAH 101

Appendix I: Approval to conduct the study from the CEO of RMMCH 102

Appendix J: Permission from the gatekeeper granting access to anaesthetic records..... 103

LIST OF FIGURES

Figure 2.1 Anatomy of the lumbar vertebrae and lumbar vertebral column 33

Figure 2.2 A sagittal section through the vertebral column, spinal cord and meninges 35

CHAPTER 1

OVERVIEW OF THE STUDY

1.1 INTRODUCTION

In this chapter, a brief overview regarding this research report will be presented. Topics covered include the background to the study, problem statement, aim and objectives, research assumptions, demarcation of the study field, ethical considerations, research methodology, significance of the study, validity and reliability and a project outline. A more in-depth review of these topics will be presented in subsequent chapters.

1.2 BACKGROUND TO THE STUDY

Neuraxial anaesthesia has been in use for more than a hundred years and has endured much controversy during this time (1). Currently spinal anaesthesia is widely considered as the safest technique for caesarean section because the increased risk of failed intubation and aspiration associated with pregnant patients is avoided (2).

Various physiological changes of pregnancy predispose the parturient to possible failed intubation and aspiration. Large breasts are often associated with pregnant patients and may make laryngoscopy difficult. Airway oedema associated with pre-eclampsia also makes intubation more challenging in pregnant patients. The time available for intubation before profound desaturation is decreased due to reduction in functional residual capacity and increased oxygen consumption in pregnancy. Increased levels of progesterone lower smooth muscle tone and the lower oesophageal sphincter relaxes, increasing the possibility of reflux and aspiration of gastric contents. Delayed gastric emptying and increased intra-abdominal pressure, caused by the gravid uterus, further increase the risk of aspiration. (2, 3)

Single-shot spinal anaesthesia is the most popular method of anaesthesia, unless contra-indicated by maternal or foetal factors (2). This preference stems from the fact that spinal anaesthesia provides a quicker onset as well as a denser, more

predictable sensory and motor blockade than epidural or combined spinal-epidural techniques (4).

In 2009, confidential enquiries into neuraxial anaesthesia in the United Kingdom (UK) found that approximately 325 000 spinal anaesthetics are administered each year in this country, with approximately a third being performed for obstetric patients. Death following spinal anaesthesia was found to be a rare occurrence. (5) No sources were identified describing the general use and rate of complications of spinal anaesthesia in South Africa.

Confidential reports into maternal mortality in the developed world show low rates of maternal mortality directly attributable to anaesthesia. In the UK (2006 – 2008) it was 0.31 per 100 000 pregnancies (6, 7). In France (2001 – 2006) the maternal mortality rate attributed to anaesthesia was 0.14 per 100 000 live births. In the Netherlands (1993 – 2005) the rate was 0.1 per 100 000 live births and in the United States of America (USA) (1991 – 2002) it was also 0.1 per 100 000 live births. (6) In both the UK and the USA, most of these deaths occurred under general anaesthesia (7, 8).

In South Africa the latest confidential enquiry into maternal mortality for the triennium 2008 – 2010 paints a different picture. In this report the maternal mortality rate due to anaesthesia is approximately 5 per 100 000 live births, and the majority (79%) occurred under spinal anaesthesia. (9) This represents a high rate of maternal mortality due to anaesthesia when compared to developed countries.

In consideration of this knowledge a standardised approach to the patient requiring spinal anaesthesia is necessary as there are numerous, and potentially life-threatening, complications associated with it (1, 2, 4, 5, 10). These include severe hypotension, cardiovascular collapse, neurological injury, vertebral canal hematoma and infections. Deaths occur rarely. (5, 11) Most of these complications can be minimised by ensuring anaesthetists have the appropriate levels of competence and knowledge to reduce their occurrence (12).

Various aspects of the technique such as needle gauge and shape, number of attempts made at locating the subarachnoid space, blood noted in the needle, strict asepsis, use of barbotage, specific gravity of the solution and speed of injection are generally accepted to affect the occurrence of complications (1, 4, 11, 13). It has

also been shown that the technique used influences the level of the block obtained (1, 4, 5, 11).

Good medical records can be characterised as contemporaneous, comprehensible, accurate and attributable (14-16). It is important that accurate records are kept not only of the vital signs and drugs administered during the anaesthetic, but also of the technique used to administer spinal anaesthesia. Studies in France (17, 18), Canada (19) and the USA (20, 21) found anaesthetic records in general to be of substandard quality. Raff et al. (22) and Olivier et al. (23) showed that the same is true for South Africa, concluding that the general standard of record keeping is poor.

The American Society of Anesthesiologists, American Association of Nurse Anesthetists, Australian and New Zealand College of Anaesthetists, Royal College of Anaesthetists and the Canadian Anesthesiologists' Society all have detailed guidelines on the standards for anaesthetic records (24-30). However, the parameters that are required to be recorded following regional anaesthesia are not that comprehensive in all these guidelines, and differ between them. The most comprehensive guidelines with regards to the anaesthetic record requirements for regional anaesthesia are from the Royal College of Anaesthetists and the American Association of Nurse Anesthetists. (24, 27, 31, 32)

Locally the South African Society of Anaesthetists does not provide specific guidance with regards to details of record keeping. In the latest practice guidelines it is simply stated that the anaesthetist must document the execution of tasks "in as much detail as is practical and useful". In the section regarding major regional anaesthesia it does state that the anaesthetist should make comprehensive records following regional anaesthesia, but makes no specific recommendations. (33) Guidelines by the Health Professions Council of South Africa (HPCSA), although aimed at medical records in a broader sense, also contain no minimum requirements for the recording of an episode of regional anaesthesia. (34)

Weaver (35) states that medical records, and anaesthesia records in particular, serve more than one purpose. These include audit and review of clinical practice where anaesthetic technique or service provision might be altered to improve the level of care rendered to patients (14, 35, 36). With detailed records all aspects of peri-operative care can be truthfully reconstructed. A good example of this is the

most recent confidential enquiry into maternal mortality in South Africa, where gross deficiencies in anaesthetic service provision were identified. (37)

To the individual anaesthetist a more ominous use of anaesthetic records is as defence in case of litigation (38, 39). According to the Medical Protection Society there has been an alarming rise in cases of medico-legal litigation in South Africa over the last five years, in both public and private sectors. The value of reported claims has more than doubled during this period. (40) The old saying that “if it wasn’t written down, it wasn’t done” holds true now more than ever. Good medical records are of paramount importance to defend a claim of negligence successfully. (35)

1.3 PROBLEM STATEMENT

Generally, anaesthetic records have checkboxes and designated prompt areas to guide the anaesthetist in recording extensive details regarding certain aspects of the anaesthetic. These usually apply to general anaesthesia and include details of airway assessment and management, ventilation settings and intra-operative monitoring. (41)

When a regional technique, or more specifically spinal anaesthesia, is employed as sole anaesthetic the records usually do not have checkboxes or prompts to record details of the spinal anaesthetic. The attending anaesthetists have to use their own judgement to record what they consider important details regarding the spinal anaesthetic administered. (41-44)

Currently, there are few international guidelines with detailed requirements for recording regional anaesthesia. The most comprehensive guidelines specifically for regional anaesthesia are from the Royal College of Anaesthetists in the UK and the American Association of Nurse Anesthetists in the USA (24, 27). The South African Society of Anaesthetists currently have no detailed guidelines on the requirements for recording an episode of regional anaesthesia (33).

Seen in the light of the most recent confidential enquiry into maternal mortality, and considering the high association of spinal anaesthesia with maternal deaths directly related to anaesthesia, it is important to investigate the parameters recorded on the anaesthetic records for spinal anaesthesia (9).

The standard of record keeping following spinal anaesthesia for caesarean section at Chris Hani Baragwanath Academic Hospital (CHBAH), Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) and Rahima Moosa Mother and Child Hospital (RMMCH) are not currently known and need to be determined.

1.4 AIM OF THE STUDY

The aim of this study was to describe the parameters being recorded following spinal anaesthesia for caesarean section in the maternity theatres of CHBAH, CMJAH and RMMCH in Johannesburg, and to evaluate whether day or night, week or weekend, routine or emergency surgery or category of anaesthetist influence the parameters recorded following spinal anaesthesia for caesarean section.

1.5 OBJECTIVES OF THE STUDY

The primary objectives of this study were to:

- describe the demographics recorded following spinal anaesthesia for caesarean section
- describe the essential procedural parameters recorded following spinal anaesthesia for caesarean section
- describe the additional procedural parameters recorded following spinal anaesthesia for caesarean section
- describe the clinical parameters recorded following spinal anaesthesia for caesarean section.

The secondary objectives of this study were to:

- compare whether surgery being performed during the week or over the weekend influenced the parameters recorded
- compare whether surgery being performed during the day or during the night influenced the parameters recorded
- compare whether surgery being routine or an emergency influenced the parameters recorded
- compare whether the category of anaesthetist influenced the parameters recorded.

1.6 RESEARCH ASSUMPTIONS

The following definitions were used in this study.

Anaesthetist: a qualified doctor who was working in the Department of Anaesthesiology and included interns, medical officers, registrars and consultants.

Intern: a qualified doctor who has not yet completed their internship, and who was busy completing the required training in the Department of Anaesthesiology.

Medical Officer (MO): a qualified doctor who was registered with the HPCSA as an independent practitioner practicing anaesthesia under specialist supervision. There was distinguished between junior medical officers and career medical officers. Career medical officers were regarded as consultants.

Registrar: a qualified medical doctor who was registered with the HPCSA as a registrar in the specialty of anaesthesiology.

Consultant: any anaesthetist who has completed the required South African College of Medicine examinations, and fulfilled all other criteria to become a specialist in anaesthesiology. Career medical officers were included in this category.

Anaesthetic record: the three pre-printed documents used at the respective hospitals that are completed manually for each anaesthetic administered. Each hospital included in this study uses a different site-specific anaesthetic record (Appendices A - C).

Demographics: included the presence of the patient's name and hospital number, presence of the anaesthetist's name, actual date and time of surgery and whether surgery was routine or an emergency.

Procedural parameters:	parameters that are recorded following the administration of spinal anaesthesia and describe the specific technique used to administer spinal anaesthesia.
Essential procedural parameters:	procedural parameters that were deemed essential to be recorded following the administration of spinal anaesthesia. These were identified from a review of current literature on the subject.
Additional procedural parameters:	procedural parameters that described additional details regarding the technique used for administration of spinal anaesthesia, but were not deemed essential to be recorded following the administration of spinal anaesthesia after a review of literature on the subject.
Clinical parameters:	parameters that are not related to the specific technique used to administer spinal anaesthesia, but which are important to consider prior to any anaesthetic. These were identified from a review of the literature.
Week:	was defined as being from Monday 08:00 until Friday 16:00.
Weekend:	was defined as being from Friday 16:00 until Monday 08:00.
Day:	was defined as being from 08:00 until 16:00.
Night:	was defined as being from 16:00 until 08:00 the following day.
Demographic score:	score generated from all the demographic and identifying parameters investigated adding to a total out of six.
Essential procedural parameter score:	score generated from all the essential procedural parameters investigated adding to a total out of twelve.

Additional procedural parameter score: score generated from all the additional procedural parameters investigated adding to a total out of ten.

Clinical parameter score: score generated from all the additional procedural parameters investigated adding to a total out of five.

Total parameter score: score generated from essential procedural parameter score, the additional procedural parameter score and the clinical parameter score adding to a total out of twenty-seven.

Total anaesthetic record score: score generated from the demographic score and total parameter score adding to a total out of thirty-three.

1.7 DEMARCATION OF THE STUDY FIELD

This study was conducted in the maternity theatres of CHBAH, CMJAH and RMMCH.

CHBAH is a central hospital located in Soweto, Gauteng, and is a referral centre for a number of smaller hospitals. It has two maternity theatres that both operate 24 hours a day. CMJAH is also a central hospital located in Parktown, Gauteng. It has two maternity theatres during the day and at night there is one dedicated maternity theatre. RMMCH is a regional hospital located in Coronationville, Gauteng. It has two dedicated maternity theatres during the day and one maternity theatre at night.

All of these hospitals are affiliated to the University of the Witwatersrand.

1.8 ETHICAL CONSIDERATIONS

Approval was obtained from the relevant authorities to conduct the study. This study was done retrospectively and the name of the patient as well as the name of the anaesthetist for each case remained anonymous, as this was not recorded. Informed consent from the patient or anaesthetist was thus not required (45).

This study was conducted by adhering to good clinical research practice as set out in the South African Good Practice Guidelines (46) and the Declaration of Helsinki (47).

1.9 RESEARCH METHODOLOGY

1.9.1 STUDY DESIGN

The research design used in this study was that of a retrospective, contextual, descriptive study.

1.9.2 STUDY POPULATION

The study population was the anaesthetic records completed following spinal anaesthesia for caesarean section in the maternity theatres of CHBAH, CMJAH and RMMCH.

1.9.3 STUDY SAMPLE

Previous international studies evaluating the quality of anaesthetic records used between 50 and 850 records (18, 21, 115, 116). In South Africa Raff and James (22) analysed a total of 284 records. The percentage of records considered to be adequate in these studies were consistently low, with only 29.9% considered complete in the study by Raff and James (22) and only 32% in the study by Elhalawani et al. (115).

The average number of caesarean sections performed monthly at CHBAH, CMJAH and RMMCH were 600, 300 and 300, respectively. The total number of caesarean sections performed during one month at all three hospitals was used to calculate a representative sample of all the anaesthetic records completed for caesarean sections in one month. This was 1200 anaesthetic records.

The sample size was determined in consultation with a biostatistician, using the Epi InfoTM program. It was assumed that 40% of the records would contain all the essential procedural parameters as identified by a review of the literature, and that in a worst-case scenario only 30% would contain all of these. A sample size of 280 anaesthesia records, with confidence levels of 95%, was calculated to be adequate for this study.

Due to the difference in total number of caesarean sections performed at each hospital, the sample was divided proportionately with150 records taken from CHBAH, and 75 records were taken from CMJAH and RMMCH each.

The following inclusion criteria were applied before enrolling records into the study:

- Records of patients presenting to maternity theatre for caesarean section.
- Records where spinal anaesthesia was used as an anaesthetic technique.
- Records of patients who had general anaesthesia following failed spinal anaesthesia were included.

Records that were illegible were excluded from the study.

1.9.4 DATA COLLECTION

Anaesthetic records prior to 30th June 2013 were reviewed, until the required sample size for each hospital was achieved. Records were selected based on the inclusion criteria and a consecutive convenience sampling method was used to include records in the study. As records are stored chronologically, all records were reviewed from 30th June 2013 in a retrograde manner. Each record that fulfilled the inclusion criteria was used until the predetermined sample size for each hospital was achieved.

Records were enrolled into the study proportionally to the average number of caesarean sections performed at each hospital per month.

An extensive review of current literature was used to compile a data collection sheet (Appendix D). The data collection sheet was used to collect data from the records and to enter them into a Microsoft Excel™ spreadsheet with the same format. The data collection sheet was divided into four sections: demographics, essential procedural parameters, additional procedural parameters and clinical parameters.

1.9.5 DATA ANALYSIS

All data recorded was captured on a Microsoft Excel™ spreadsheet. The data was analysed in consultation with a bio-statistician using the Stata™ version 13.1 statistical analysis program. Descriptive statistics were used to analyse the data.

1.10 SIGNIFICANCE OF THE STUDY

Spinal anaesthesia remains the most popular anaesthetic technique used for caesarean section (2, 48). It is generally considered safe, but is not without risks. This has been highlighted by the latest confidential enquiry into maternal mortality in South Africa, where 72% of maternal deaths directly attributable to anaesthesia occurred under spinal anaesthesia (9). It should be noted that denominator data is not known for maternal deaths occurring as a result of anaesthesia, and that the large number of deaths occurring in association with spinal anaesthesia might reflect the increased use of spinal anaesthesia.

Lamacraft et al. (49) postulates that this is due mainly to the inexperience of doctors providing spinal anaesthesia for caesarean section, and they are often unsupervised. Farina and Rout (50) also commented on the increased rates of maternal death related to spinal anaesthesia, speculating that there is a misconception amongst doctors that spinal anaesthesia is safer than general anaesthesia

The quality of record keeping following spinal anaesthesia for caesarean section in CHBAH, CMJAH and RMMCH was not known, and the recent rise in maternal deaths due to anaesthesia in South Africa necessitated an investigation into this matter (37).

The parameters recorded following administration of spinal anaesthesia could reflect the anaesthetist's understanding of the potential risks and complications involved. The results from this study will help to identify particular aspects of spinal anaesthesia for caesarean section that are inadequately recorded. This will help to identify important perceptions regarding spinal anaesthesia, facets that are poorly understood as well as aspects of which the importance are underestimated.

This could guide teaching and skills development in the Department of Anaesthesiology across all levels of capability, which would ultimately lead to safer and more efficient patient care.

The results will also be useful for reviewing the current anaesthetic records used at the three hospitals being investigated, and could possibly be used to guide the

creation of a new uniform anaesthetic record that will optimise record keeping following spinal anaesthesia.

1.11 VALIDITY AND RELIABILITY

Measures were put in place to ensure the validity and reliability of the study.

1.12 PROJECT OUTLINE

An outline of this research report will now be presented. Chapter one represents an overview of this research report. Chapter two includes an in-depth literature review of various subject matter regarding anaesthetic related maternal deaths, obstetric anaesthesia, anaesthetic record keeping and spinal anaesthesia. In chapter three, a comprehensive discussion of the research methodology is offered. Chapter four includes the presentation of the results and the discussion thereof. The final chapter provides the conclusion of the study as well as further recommendations.

1.13 SUMMARY

This chapter provided a brief overview and summary regarding this research report. Topics covered included the background, problem statement, aim and objectives, research assumptions, demarcation of the study field, ethical considerations, research methodology, significance of the study, validity and reliability and the project outline.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will provide an overview of anaesthesia-related maternal deaths in South Africa and internationally, highlighting important differences. Anaesthesia for obstetric patients will be discussed followed by a review of the various aspects related to anaesthesia records and the requirements for record keeping following anaesthesia. Lastly spinal anaesthesia will be deliberated.

2.2 ANAESTHESIA-RELATED MATERNAL DEATHS

According to the United Nations there is a global aim to reduce the maternal mortality ratio by three-quarters between 1990 and 2015 (51). A 2012 report on trends in maternal mortality has shown a 47% reduction worldwide, with a 41% reduction for Sub-Saharan Africa (52). Although there is marked improvement, it is still a long way from the target and few countries will likely reach the goal for maternal mortality (51, 53, 54). A recent article by Pillay (55) states it has become a human right's imperative to improve maternal mortality, and it also highlights the fact that monitoring and data collection are important aspects of accountability.

Various factors have been associated with high maternal mortality rates. Sepsis, haemorrhage, embolic incidents, hypertensive diseases of pregnancy, complications of induced abortion, cardiomyopathy and human immunodeficiency virus have been implicated as major risk factors. (8, 9, 52, 56-62)

However, anaesthesia-related maternal mortality has also been identified as a risk factor of concern since the start of these surveys (8, 63-65) and despite the decrease in deaths related to anaesthesia in developed countries (7, 8, 58, 60, 64, 66-69), in recent reports from developing countries it is still considered a major preventable cause of maternal mortality (12, 37, 61, 70-72).

When anaesthesia-related deaths in developed countries are reviewed in more detail there are certain trends that emerge. In the USA there has been progressive reduction in deaths related to anaesthesia, with maternal mortality rate due to

anaesthesia of 0.1 per 100 000 live births for the period 1998-2005 (8, 56, 64). Of concern, it was noted that although overall anaesthesia-related deaths were reduced, the rate of maternal mortality associated with general anaesthesia has remained relatively unchanged despite increased use of regional techniques (65, 66). Historically deaths occurring during general anaesthesia were associated with high incidences of failed intubation and aspiration (8, 56, 64, 65). During the past two decades there has been increased focus on improving management of difficult airway and failed intubation scenarios, and introduction of the laryngeal mask and other airway devices have helped reduce the deaths due to failure to secure the airway (8). Mhyre (64) found that although deaths related to general anaesthesia remained relatively unchanged, none were associated with failure to intubate and most occurred during emergence or during recovery and were associated with airway obstruction or hypoventilation. This drew attention to the changing patient population and risks posed by obesity, advanced maternal age and associated illness (64, 66, 73).

The UK has shown a relatively constant maternal mortality rate due to anaesthesia, with the latest figure of 0.31 per 100 000 pregnancies stated for the period 2006-2008. This is in keeping with the relatively unchanged total mortality rate since 1990. (6, 7, 52) As in the USA, the vast majority of deaths due to anaesthesia occurred during the administration of a general anaesthetic (6, 7). Most of the deaths under general anaesthesia were still related to issues with securing the airway at induction, unlike the USA where more deaths seem to be occurring during emergence and recovery from general anaesthesia (7, 64).

In South Africa, there has been an increase in maternal deaths attributed to anaesthesia, being responsible for 5.4% of all deaths for the period 2008-2010 (9). As is the trend in developed countries, most anaesthetics for caesarean sections are spinals. (9, 49, 74) In stark contrast to the UK and the USA, in South Africa almost two thirds of maternal deaths due to anaesthesia occur during the administration of spinal anaesthesia. (9)

The causes for this have been extensively debated since the inception of confidential enquiries into maternal mortality in 1996 (9). Lamacraft (49) concluded that this was due mainly to the inexperience of doctors providing spinal anaesthesia for caesarean

section, and they are often unsupervised. Farina and Rout (50) also commented on the increased rates of maternal death related to spinal anaesthesia, speculating that there is a misconception amongst doctors that spinal anaesthesia is safer than general anaesthesia. They also agreed that some doctors are not appropriately trained to provide spinal anaesthesia, and it is often used inappropriately because doctors attempt to avoid giving general anaesthetics as they are seen as more dangerous to perform (50).

This could lead to situations where spinal anaesthetics are administered in clinical scenarios where they are actually contra-indicated, such as patients with hypovolemic shock, low platelet counts or other clotting disorders. This will inevitably lead to a higher incidence of complications associated with spinal anaesthesia than is seen in other countries. (49, 50, 74, 75)

2.3 OBSTETRIC ANAESTHESIA

2.3.1 PHYSIOLOGICAL CHANGES OF PREGNANCY AND THE ASSOCIATED ANAESTHETIC IMPLICATIONS

Pregnancy is responsible for marked anatomic and physiologic changes, which necessitate alterations in anaesthetic technique (76). It also carries increased risk for airway complications such as failed intubation and aspiration (2, 3, 76-78).

Mean body weight increases by 17%, with enlargement of the breasts (76). The thorax enlarges in the anteroposterior as well as lateral diameters, with a decrease in the vertical height (3, 76). Progesterone mediated capillary engorgement of the nasal and oropharyngeal mucosae occur early, and swelling of the pharyngeal structures can be exaggerated by disease states such as pre-eclampsia and the HELLP syndrome (3, 78). Epistaxis and mucosal bleeding secondary to minor trauma is also more common (2, 77). All these factors impair direct laryngoscopy and visualisation of the vocal cords when attempting tracheal intubation and it may also necessitate the use of smaller endotracheal tubes (78).

Due to the higher resting position of the diaphragm (caused by the enlarged uterus) and limitation of thoracic expansion (caused by the expanded resting position), inspiration is almost totally attributable to diaphragmatic excursion (76, 77). The tidal

volume increases by 45%, with an associated decrease in the functional residual capacity (FRC) (3, 76-78). There is a further reduction in the FRC when the patient assumes the supine position (3, 77). The closing capacity does not change significantly during pregnancy and airway conductance increases due to dilation of larger airways below the larynx (3, 76-78). Minute ventilation increases by 50%, largely due to the increased tidal volume, as respiratory rate remains relatively unchanged (2, 3, 78). The combination of a decreased FRC and increased minute ventilation will result in faster uptake of inhalational agents (78). This, combined with the fact that the minimum alveolar concentration for inhalational agents is reduced in pregnant women, can lead to deep levels of anaesthesia rapidly, with cardiopulmonary depression and uterine atony following suit (2, 76-78).

The partial pressure of carbon dioxide ($paCO_2$) decreases by 25% as a result of the increased minute ventilation (76, 78). This in turn is caused by increased levels of progesterone and the increase in carbon dioxide production. Progesterone sensitises the respiratory centre to carbon dioxide and also acts as a direct respiratory stimulant. (2, 76-78) The reduced maternal paCO2 facilitates excretion of fetal carbon dioxide across the placenta (77).

Oxygen consumption increases by more than 20% during pregnancy due to the increased metabolic demands of the mother and growing fetus, whilst the decreased FRC lowers oxygen reserves in the lungs (76-78). This leads to a very precipitous decrease in oxygen saturation following apnoea and significantly reduces the amount of time available for intubation before the patient needs to be ventilated (3, 77, 78). The rapid decrease in oxygen saturation is exacerbated in the supine position, when dependent airway closure is liable to occur during tidal ventilation due to decreased FRC. Furthermore, aorta-caval compression in the supine position reduces cardiac output and increased oxygen extraction must occur to compensate (76-78). Turning the patient to the left lateral position will improve the oxygen saturation (76).

During pregnancy there is a 50% increase in plasma volume and a 30% increase in red cell volume. The increase in plasma volume is mediated by increased levels of renin and aldosterone with fluid retention, and the increased red cell volume by elevated erythropoietin levels. This leads to an increase in the total blood volume of

1000 – 1500 ml, but the relatively larger increase in plasma volume causes a decrease in haemoglobin concentration of about 15%. (76) There is an increase in concentration of most clotting factors and enhanced platelet turnover and fibrinolysis. Thus pregnancy is a state of accelerated but compensated intravascular coagulation. (76-78) The relative anaemia of pregnancy aids the patency of the uteroplacental bed in the face of this enhanced coagulation. However, a haemoglobin concentration of less than 11g/dl in pregnancy presents maternal anaemia and a haemoglobin concentration above 14g/dl should alert the anaesthetist to a possible low-volume state with hemoconcentration. (78)

Most of the increased blood volume perfuse the gravid uterus and is necessary to meet the increased excretory demands of the kidneys (77, 78). It also compensates for the blood loss during delivery, which is usually well tolerated (77). After delivery about 300 – 500 ml of blood is autotransfused from the evacuated uterus to the maternal circulation, mainly as a result of alteration of uterine hemodynamics post-delivery. The intravascular volume also decreases by the same amount as the uterus contracts. (76, 78) This usually makes the need for transfusion post-delivery rare unless blood loss exceeds 1500 ml (78).

In pregnancy there is a significant increase in cardiac output by 50% (2, 76, 77). This is largely attributable to an increase in stroke volume of 25% and an increased heart rate of 25%. Left ventricular end-diastolic volume increases while left ventricular end-systolic volume remains constant. (76, 77) Central venous pressure, pulmonary artery diastolic pressure and pulmonary capillary wedge pressure remain unchanged. Thus increased left ventricular end-diastolic volume occurs without a change in cardiac filling pressures, and this discrepancy is explained by hypertrophy and dilatation of the ventricle enabling it to accommodate more blood without increased pressure. (76) This can however predispose pregnant women with cardiac or pulmonary disease to cardiac failure, and it remains a risk post-delivery (78).

There is a significant reduction in both systemic and pulmonary vascular resistance during pregnancy (3, 76-78). The reduction in systemic vascular resistance is driven by the development of the low-resistance utero-placental bed and vasodilation, mediated by progesterone and prostacyclin (76, 77).

These changes improve oxygen delivery and dissipate heat generated by increased maternal and fetal metabolism. Despite the decrease in vascular tone, however, there is greater maternal dependency on vasomotor tone to maintain hemodynamic stability. This explains the drop in blood pressure noted with sympathectomy following spinal anaesthesia and emphasises the importance of adequate fluid administration prior to neuraxial blocks. (76, 78)

Due to the decreased vascular resistance there is a gradual decrease in blood pressure during pregnancy. Systolic blood pressure falls on average by 5 – 10 mmHg, whilst the fall in diastolic pressure is slightly more in the order of 10 – 15 mmHg. (77) The increase in stroke volume limits the decrease in systolic pressure brought on by increased aortic size and compliance (76). Despite the natural decrease in blood pressure, systolic pressures below 90 – 95 mmHg during anaesthesia should be treated aggressively as they are associated with proportional decreases in uterine blood flow (78).

Compression of the aorta and inferior vena cava by the gravid uterus starts as early as 20 weeks gestation, and the severity depends on the position of the pregnant woman (2, 3, 76). It is stated that up to 15% of pregnant patients near term develop signs of shock when they assume the supine position (78). In the supine position there is almost complete occlusion of the inferior vena cava (79), and the compression decreases significantly in the left lateral position due to displacement of the uterus to the left side (77, 78). In case of occlusion of the inferior vena cava, venous return occurs primarily by diversion of blood through intraosseous vertebral veins, paravertebral veins, ovarian veins and the epidural venous plexus draining into the azygos system. Despite the collateral drainage, right atrial pressure falls due to a decreased venous return to the heart. (2, 76, 78) This reduction in preload to the heart leads to a 15 – 20% reduction in stroke volume in the supine position (76). The reduced stroke volume, combined with compression of the aorta, can lead to arterial hypotension in the lower extremities and uterine arteries without maternal signs of hypotension. Increased venous pressure and decreased arterial pressure leads to a reduction in the uterine perfusion pressure with a subsequent reduction in delivery of oxygenated blood to the fetus. (78)

Signs of shock may manifest when a pregnant patient is allowed to assume the supine position (78). This includes arterial hypotension, pallor, sweating, nausea, vomiting and anxiety and is known as the aortocaval syndrome (76-78). Drugs causing vasodilation, such as propofol and volatiles, and sympathetic blockade, such as spinal or epidural anaesthesia, will further reduce venous return to the heart in the face of inferior vena cava obstruction. The sympathetic blockade from neuraxial techniques also further impair the pregnant patient's ability to compensate for reduced venous return by vasoconstriction. (78)

Pregnant patients have lower anaesthetic requirements for volatiles and intravenous induction agents. The minimum alveolar concentration can be reduced up to 40% for pregnant patients. This is attributed to activation of the endorphin system, the sedative effects of high progesterone levels and increased central nervous system serotonergic activity. (76-78) These central nervous system changes elevate the threshold to pain during late pregnancy and labour, reducing analgesic requirements (76).

The dose of local anaesthetic used for spinal anaesthesia in pregnant patients is typically reduced because of the enhanced spread of hyperbaric local anaesthetic in the subarachnoid space (2, 3, 76-78). This results in a 25% reduction in segmental dose requirements in term pregnant women (76). In the past this has been attributed solely to the decrease in cerebrospinal fluid (CSF) volume secondary to engorgement of the epidural veins. More recently it has been suggested that acid-base and protein changes in the CSF and high progesterone levels may also increase sensitivity to local anaesthetics and necessitate the use of a lower dose. (76-78) Inward displacement of the intervertebral foraminal tissue caused by increased abdominal pressure also reduces CSF volume, enhancing cephalic spread. The widened pelvis in pregnancy results in a head-down position when the patient is placed laterally, and can enhance cephalic spread. Similarly, in the supine position the heightened position of the thoracic kyphosis in pregnancy enhances cephalic spread. (76)

Pregnancy is associated with a shift in the position of the stomach caused by the enlarged uterus (78). The stomach is displaced upwards and toward the left side, and its axis is rotated to the right from the normal vertical position. This altered

position displaces the intra-abdominal portion of the esophagus into the thorax. The effect of this is two-fold: it causes a reduction in the tone of the lower esophageal sphincter and prevents the rise in lower esophageal sphincter tone that accompanies an increase in intragastric pressure. High levels of progesterone cause relaxation of smooth muscle, further reducing the tone of the lower esophageal sphincter. (2, 3, 76) It may also exert indirect effects on gastrointestinal motility by reducing levels of motilin. The decrease in lower esophageal sphincter tone caused by all these factors lead to an increased incidence of reflux of gastric contents in pregnant patients (76). There is no decrease in gastric motility during pregnancy but there is agreement that the pregnant uterus pushes the pylorus upward and backwards (76, 78). Increased production of gastrin by the placenta leads to raised hydrogen and chloride levels in the stomach (78). All pregnant patients should be considered high risk for the aspiration of gastric contents (2, 76, 78).

2.3.2 CHOICE OF ANAESTHETIC TECHNIQUE FOR CAESAREAN SECTION

The role that anaesthetists play in the management of obstetric patients is well established, and recent surveys estimate that they are involved in the care of over 60% of pregnant patients (80). This is divided between the provision of analgesia for labour and the administration of anaesthesia for caesarean section and other operative procedures during pregnancy (2, 81-84).

At the turn of the century caesarean section as mode of delivery was considered dangerous because of the high mortality rate associated with it, and avoided if at all possible (76). This remained the norm until well into the 1970's, where the caesarean section rate in the USA remained below 7% (76).

With the advent of novel anaesthetic agents and the increased use of regional anaesthesia techniques, this has changed dramatically (85, 86). Caesarean section rates in the UK were estimated to be around 21% in 2002, and as high as 24% in the USA in 2004. (58, 76) No specific caesarean section rates are available for South Africa, as denominator data is not very accurate. The latest maternal mortality report has however shown a significant and sustained rise in the total number of caesarean sections performed at public hospitals, and similarly high rates can be expected. (9)

In choosing the anaesthetic technique to be used, the anaesthetist should consider the mother's desires, indication for the caesarean section, maternal comorbidities, health of the fetus and urgency of the procedure. (2, 76, 77)

Currently general anaesthesia, spinal anaesthesia, epidural anaesthesia and combined spinal-epidural anaesthesia (CSE) are all acceptable techniques for caesarean section. (2, 76, 87) The use of local anaesthetic infiltration as primary anaesthetic is described in the literature, but there are very few indications for this in modern obstetric anaesthesia. It may be applicable only to the rare parturient who is in extremis. (76)

Spinal anaesthesia is appropriate for most elective and urgent caesarean sections. Making the decision is more difficult in cases of severe fetal distress, as the choice of technique will be influenced by the speed with which the anaesthetist is able to perform a spinal. (76, 77) Most anaesthetists will choose to perform general anaesthesia when time is of absolute essence (3, 76).

It has been shown that general anaesthesia in pregnant patients carries a higher risk for failed intubations and aspiration of gastric contents, mainly due to the physiological changes associated with pregnancy (2, 3, 76, 77). This has led to the increased use of spinal anaesthesia for caesarean section, and general anaesthesia is usually only performed when there is a specific indication (76). An obstetric workforce survey carried out in the USA in 2001 found that general anaesthesia was used in less than 5% of elective caesarean sections, however this increased to about 25% in urgent and emergency cases (85).

Indications for general anaesthesia include:

- Maternal request
- Anatomic abnormalities that make spinal anaesthesia impossible such as severe kyphoscoliosis
- Bleeding disorders, especially platelet count below 75-100 x 10^9/l which is associated with pre-eclampsia and HELLP syndrome
- Hemodynamic instability following severe haemorrhage
- Extreme urgency from obstetric emergencies such as cord prolapse
- Failed regional anaesthesia

- Other contraindications to spinal anaesthesia such as infection at injection site. (1, 2, 4, 76, 88)

Use of epidural anaesthesia has increased due to the increased use of this technique for labour analgesia. It can be titrated to the desired sensory level with incremental doses, but the possible delayed onset of surgical anaesthesia should be kept in mind. (2, 76, 77) CSE techniques are also becoming more popular as they offer the quick onset of a spinal technique combined with the postoperative analgesic advantages of an epidural (76).

However, single-shot spinal anaesthesia currently remains the most widely used technique for caesarean section (48, 85).

2.4 ANAESTHESIA RECORDS

2.4.1 HISTORY AND PURPOSE OF ANAESTHESIA RECORDS

Medical records document the progress of a patient's care, and can take many forms depending on the nature of the care the patient receives. Regardless of the origin, they are considered an essential part of the patient's interaction with a healthcare worker. (89) They record facts about the patient's health with emphasis on current events, and provide a means of communication between healthcare workers (14).

It is believed that the first consistent recording of physiological variables during anaesthesia was the work of Amory Codman and Harvey Cushing at Massachusetts General Hospital in 1895, although John Snow kept accounts of anaesthesia as early as 1850. The Codman-Cushing system of record keeping quickly spread and was adopted in other centres, and by the 1930's custom-made charts were developed in the UK and the USA. (42, 90, 91)

Currently, keeping a detailed anaesthetic record is considered an essential part of the anaesthetist's duties, and it serves a myriad of functions. (36, 80, 90, 91) These records are an important tool in the evaluation of the anaesthetised patient's progress in the theatre, and help to facilitate clinical care (92). They provide concise information which is easily accessible in the event of an emergency, and give a graphic representation of the physiological variables (35). The records also serve to remind the anaesthetist of important details that can easily be missed, for instance

removal of throat packs (92). All of these functions depend on the accuracy of the record, and the quality and detail of the data entered (93).

The anaesthetic records contain the prescription for all fluids and drugs administered during anaesthesia, and these interventions can be correlated to the physiological response due to the temporal nature of the record (35, 92).

Handover between anaesthetists during a case is not ideal but does occur. In this case the anaesthetic record plays an important role in supporting the verbal handover and allows the incoming anaesthetist to continue with minimal risk to the patient. It enables the anaesthetist to reconstruct all intraoperative events accurately up until the time of taking over care of the patient. (35, 92) They are also very useful for informing anaesthetists providing care in the future of any abnormal or unexpected events during previous anaesthesia, such as difficult visualisation of the vocal cords during laryngoscopy (92).

The anaesthetic record provides a wealth of information about peri- operative management of patients and is very useful for data collection for audit and clinical review purposes. In The Royal College of Anaesthetists document, “Raising the Standard: A compendium of audit recipes” a large number are reliant on data provided on the anaesthetic record. (35, 92, 94) Accurate records are also considered essential for analysis of critical incidents and root cause analysis (95). This is reflected in the discussion of vignettes in the most recent South African Maternal Mortality Report, where poor record keeping made it difficult to determine the definitive cause of death in a large number of cases (9, 37).

Lastly, the anaesthetic record serves as an aide memoire and the case of litigation, and can prove or disprove the anaesthetist’s negligence. Accurate and detailed records are invaluable evidence in a court of law, and although ominous this should always be kept in mind when recording the conduct of anaesthesia. (35, 92, 96-99)

2.4.2 MEDICOLEGAL IMPLICATIONS OF ANAESTHESIA RECORDS

In South Africa, professional medical negligence is based on the principle of the reasonable doctor (96, 100, 101). This generic test for negligence compares the actions of the doctor who is accused of negligence against “ the general level of skill and diligence possessed and exercised at the time by the members of the branch of

the profession to which the practitioner belongs" (100). What is required is not the highest possible degree of professional care, but reasonable knowledge, ability, experience, care, skill and diligence. In essence the standard of the reasonable doctor is thus the recognised and accepted practices of the medical profession at the time. (100, 102)

When this test of negligence is applied to a medical specialist, the test is upgraded to that of the reasonable specialist with reference to the field of medical specialisation (100). The more complicated the procedure, the greater the amount of skill and knowledge that is required from the medical specialist (102).

In any given context, professional medical negligence means that a medical doctor failed to foresee the possibility of harm to another in circumstances where the reasonable doctor would have taken steps to prevent it (100).

The courts in South Africa do not accept the "*res ipsa loquitur*" or "the facts speak for themselves" doctrine in cases of medical negligence. This doctrine infers negligence merely from the fact that the incident happened and that the incident would not have happened in the absence of negligence. The onus to prove negligence thus rests with the plaintiff, and likewise the onus to disprove negligence rests with the medical doctor in question. (102-104) Medical procedures are not without risk, and the occurrence of complications does not necessarily constitute negligence (103).

It is here that the anaesthesia record becomes invaluable to the anaesthetist in defending claims of negligence (35). It is considered a legal document, and can thus be used as evidence in a court of law to prove the standard of care practiced by the anaesthetist (105). As evidence, it bears more weight than the anaesthetists stated recollections of the event (42). Although the law does not state what needs to be recorded, it is quite evident that the more thorough the records are the easier it will be to reconstruct the peri-operative events and ascertain whether the anaesthetist was negligent (100).

2.4.3 DESIGN OF ANAESTHESIA RECORDS

A patient's time under anaesthesia results in some of the most detailed documentation of their entire hospital stay, with the anaesthetist recording vital signs every few minutes in addition to drugs and their dosages, fluids administered and all other intraoperative events (35).

Although anaesthesia records have been in use for more than a century, current handwritten records closely resemble the first ones developed (90). There is no universal means of documenting anaesthesia care, and records are usually adopted according to locally agreed standards and recommendations (41, 42). This variation occurs due to different circumstances in which these records are used but the overriding theme is a comprehensive, legible record (42, 106).

Over time patient populations change and anaesthetic knowledge and practice continually advance, notably in the area of monitoring (36). It has been noted that many anaesthesia records are outdated and cumbersome to use, mainly because they have not been revised properly and amendments have been made haphazardly (41). Raymer (42) states that many deficiencies in the documentation are attributable to the design of the record rather than the individual. New technology and change in clinical practice need to be incorporated into the record in a systematic and organized manner to ensure the continued ease of use of the record. A survey of anaesthetic records from different hospitals revealed great variability in the ease of use and the organization for most efficient data entry (41).

Fisher et al. (41) describes the process of designing a de novo anaesthetic record, and use their experience to develop a logical approach to the creation or amendment of such a record.

Both Fisher (41) and Raymer (42) comment on the content that should be included in the anaesthetic record. This may be relatively easily determined from the literature, guidelines from governing bodies and consultation with practising anaesthetists, but incorporating all the possible elements into the anaesthetic record proves to be more difficult. Traditionally anaesthetic records consist of major groups of related demographic or clinical information. This includes identification of patient and staff, pre-operative findings and diagnostic information of the patient, airway management,

ventilation parameters, anaesthesia equipment and technique, physiological variables, drug and fluid administration, peri-operative interventions and immediate postoperative condition of the patient. (41, 42)

The layout utilises a mixture of structured and unstructured data entry fields. A structured field presents a list of items or options and allows the user to select the relevant items. An unstructured field relies on the entry of free text and includes prompts, diagrams and plotting of numeric values on a scale. (42) The structured format has many advantages including increased legibility of data, and research has shown it has a higher degree of completeness than the unstructured format when used in a handwritten anaesthetic record (20). The main drawbacks of structured fields are the amount of space they occupy on the anaesthetic record, most items will not be applicable to any individual patient and the fact that some types of information are not easily communicated in this way (42). For these reasons this format is usually reserved for information considered most vital to be recorded including the evaluation and management of the airway, ventilation parameters and monitoring utilised (44).

Unstructured fields are essentially open spaces for the entry of free text, and can include prompts. They rely on the anaesthetist's judgement to record details that he deems essential with regards to the particular case. (41) As mentioned earlier, this has been shown to have a lower degree of completeness than structured fields (20). Regional anaesthesia, such as peripheral nerve blocks and spinal anaesthesia, are usually recorded in free text areas with few or no prompts other than indicating the type of regional technique utilised (41).

With the advent of newer anaesthesia information management systems, automated systems have been lauded to provide more reliable and better quality records of physiological variables, such as blood pressure and pulse rate, than hand-written records. Automated systems have been proven to eliminate the increase in recording errors noted during critical incidents, and have been shown to improve quality of records with the use of mandatory entry fields. (93, 107-110) However, just like handwritten records, not all types of information can be easily recorded in this way and still requires input from the operator. Examples are demographic information, medication administered and the details regarding regional anaesthesia. (111)

Various methods have been investigated and described in attempts to improve the quality of free text entries in automated records, but it is still dependent on human input. (112)

It is thus evident that regardless of the type of record used, information that needs to be entered as free text can easily be omitted. Information that is entered in this fashion usually applies to a smaller number of patients, but the details that need to be recorded are still important. (41) In the context of this literature review, the omission of details regarding the administration of regional anaesthesia can easily take place. For this reason guidelines are helpful to assist anaesthetists to make comprehensive records all parameters regarded as essential.

2.4.4 GUIDELINES FOR THE STANDARDS OF RECORD KEEPING FOLLOWING REGIONAL ANAESTHESIA

A review of published guidelines reveal a wide range with regards to the parameters that are required to be recorded following the administration of regional anaesthesia.

The following guidelines were reviewed in order to establish which procedural and other parameters are regarded as essential following regional anaesthesia:

- “Information management: Guidance for anaesthetists”
  (Royal College of Anaesthetists) (27)
- “Documenting the standard of care: The anesthesia record”
  (American Association of Nurse Anaesthetists) (24)
- “Statement on documentation of anesthesia care”
  (American Society of Anesthesiologists) (26)
- “The anaesthesia record: Recommendations on the recording of an episode of anaesthesia care”
  (Australian and New Zealand College of Anaesthetists) (25)
- “Guidelines on the keeping of patient records”
  (Health Professions Council of South Africa) (34)
- “Practice guidelines: 2012 Revision”
  (South African Society of Anaesthesiologists) (33).

All of the international anaesthesia guidelines reviewed stipulate comprehensive requirements for record keeping of the pre-anaesthesia consultation as well as record keeping of general anaesthesia (24-27). Only two guidelines make specific mention of requirements for regional anaesthesia, namely the guidelines by the Royal College of Anaesthetists in the UK and the American Association of Nurse Anesthetists in the USA (24, 27).

Table 1 provides a summary of the parameters that are required to be recorded by various international and national guidelines, with specific focus on the technique of regional anaesthesia. It also includes parameters that are not mentioned specifically for regional techniques but are included in the guidelines, and are considered to have clinical importance on the administration of spinal anaesthesia. These are the taking of a medical history and performing a physical examination, as well as review of applicable laboratory investigations (113). It also includes recording whether intravenous access was established and standard monitors attached before starting the procedure. (24-27, 33, 34, 114)

The guideline from the HPCSA does not state any specific record keeping requirements for regional anaesthesia, but makes general recommendations that are applicable to regional anaesthesia (27). The most recent practice guideline from the South African Society of Anaesthetists states specific requirements for the pre-anaesthetic consultation, but does not stipulate specific requirements for regional anaesthesia (33).

From Table 1, it is evident that the most comprehensive list for procedural parameters that need to recorded following spinal anaesthesia is from the American Association of Nurse Anesthetists (24). This incorporates all procedural parameters that need to be recorded as mentioned in the guidelines by the Royal College of Anaesthetists and others, even though they do not specifically mention requirements for recording an episode of regional anaesthesia (24-27, 33).

Table 1.1 Current guidelines and requirements for record keeping of regional anaesthesia

GUIDELINE	PUBLISHED BY	REQUIREMENTS FOR REGIONAL ANAESTHESIA	GENERAL REQUIREMENTS WITH IMPORTANCE FOR SPINAL ANAESTHESIA
Information Management: Guidance for Anaesthetists (27)	Royal College of Anaesthetists	Type of block Name, dose and concentration and of drug Entry site Needle used, aid to location Catheter	Medical history Physical examination Laboratory investigations Patient position Monitoring Intravenous access
Documenting the Standard of Care: The Anesthesia Record (24)	American Association of Nurse Anaesthetists	Type of block Preparation used Use of local anaesthetic Position of patient Needle used Name and dose of drug Site and level Catheter Attempts	Medical history Physical examination Laboratory investigations Monitoring Intravenous access
Practice Guidelines: 2012 Revision (33)	South African Society of Anaesthesiologists	Type of block Name and dose of drug used	Medical history Physical examination Laboratory investigations Intravenous access

Table 1.1 (continued) Current guidelines and requirements for record keeping of regional anaesthesia

GUIDELINE	**PUBLISHED BY**	**REQUIREMENTS FOR REGIONAL ANAESTHESIA**	**GENERAL REQUIREMENTS WITH IMPORTANCE FOR SPINAL ANAESTHESIA**
The Anaesthesia Record: Recommendations on the Recording of an Episode of Anaesthesia Care (25)	Australian and New Zealand College of Anaesthetists	*No specific requirements for regional anaesthesia*	Name and dose of drug used Type of block used Medical history Physical examination Laboratory investigations Patient position Monitoring Intravenous access
Guidelines on the Keeping of Patient Records (34)	Health Professions Council of South Africa	*No specific requirements for regional anaesthesia*	Name and dose of drugs used Medical history Physical examination Laboratory investigations Intravenous access
Statement on Documentation of Anesthesia Care (26)	American Society of Anesthesiologists	No specific requirements for regional	Name and dose of drug used Type of block used Medical history Physical examination Laboratory investigations Patient position Monitoring Intravenous access

2.4.5 ACCURACY AND COMPLETENESS OF ANAESTHESIA RECORDS

Various studies have been conducted internationally to assess the quality of handwritten anaesthesia records, and more recently the use of automated anaesthesia information management systems have also been investigated (18-21, 115).

Falcon et al. (17) reviewed anaesthetic records at a university teaching hospital in France and investigated 38 individual items on each record. These were grouped under identification, pre-anaesthetic and operative parameters. A mean of 72% of all items were completed, but when regional anaesthesia was analysed separately only 52% of items reviewed were completed. (17) Similar studies were conducted by Hubert et al. (18) in France and Elhalawani et al. (115) in Australia. Hubert et al. (18) reviewed only anaesthetic records for general anaesthesia, and found a mean of 57% of all items were completed. Elhalawani et al. (115) found 74% of all records reviewed to be considered complete, but found record keeping was worse for emergency surgery. They found no difference between records for general and regional anaesthesia (115). Devitt et al. (19) investigated the degree of completion and accuracy of anaesthetic records at a Toronto hospital, and found that they were low regardless of the anaesthetists age, level of training or number of years in practice. A mean of only 35% of all records were found to be considered complete. In South Africa, Raff and James (22) reviewed 284 records from a hospital in Cape Town and found only 29.9% met the minimum standards to be considered complete.

The study by Tessler et al. (116) compared attitudes to anaesthetic record keeping with a review of anaesthetic records. They first determined which variables were considered important for recording on the anaesthetic record by faculty members at a university hospital in Quebec, Canada. This was then followed by a review of a random sampling of patient records produced by the same faculty of anaesthetists to determine the extent to which the identified important variables were recorded. (116) It was found that the anaesthetists at this facility listed all variables to be recorded as recommended by the Canadian Anesthesiologists' Society but when the actual records were reviewed, none had complete documentation of all the variables assessed. (29, 116) It was shown that the anaesthetists do not record variables they themselves consider important as often as they imply, and a discrepancy exists

between attitude and practice regarding record keeping. The same phenomenon was shown amongst anaesthetists in the USA by Biddle et al. (21)and amongst nurses in Cape Town by Olivier et al. (23).

These studies revealed an unacceptable standard of anaesthetic record keeping, which is worse in South Africa than in developed countries (17-19, 22, 115, 116). The standard of practice expected by the South African Society of Anaesthetists includes the completion of a comprehensive anaesthetic record, although the details required are not clearly stated (33). Raff et al. (22) revealed deficiencies in the standard of anaesthetic record keeping in South Africa that need to be investigated further and addressed appropriately.

2.5 SPINAL ANAESTHESIA

2.5.1 INTRODUCTION

Spinal anaesthesia remains one of the most simple and effective regional techniques available to the anaesthetist, and is widely used in modern obstetric anaesthetic practice (13, 48, 76, 117). It is considered the safest technique in the obstetric patient population and it has been suggested that neuraxial anaesthesia, including spinal anaesthesia, can lead to enhanced recovery postoperatively (86, 118).

It results in rapid onset of a dense surgical anaesthesia after the injection of the appropriate choice and dose of local anaesthetic agent into the intrathecal space, with a high degree of success (4, 48). Despite the relative simplicity of the technique, a thorough knowledge of the functional anatomy, factors that determine local anaesthetic spread in the intrathecal space as well as the factors affecting the duration of anaesthesia are important to optimize the success and safety of spinal anaesthesia (13). Additionally, an understanding of the physiological effects and potential complications associated with spinal anaesthesia are also paramount to ensure patient satisfaction and safety (10, 13, 119, 120).

2.5.2 ANATOMY OF THE VERTEBRAL COLUMN, SPINAL CORD AND MENINGES

The vertebral column consists of bony vertebrae and ligaments that provide the supporting and protective channel for the spinal cord and spinal nerves (13). Spinal

anaesthesia is typically performed in the lower lumbar region. The typical lumbar vertebra is composed of the anterior vertebral body and posterior bony elements, namely the pedicles and laminae, which form the vertebral arches. The vertebral arches meet in the midline, forming the vertebral foramen. The vertebral foramina of adjoining vertebrae form the longitudinal spinal canal that contains the spinal cord. The adjoining paired pedicles of each vertebra have superior and inferior notches, which form intervertebral foramina through which paired segmental nerves exit the spinal canal. Paired transverse processes project posterolaterally from the junctions of the pedicles and laminae, and a single spinous process projects posteriorly and slightly inferiorly from the posterior aspect at the midline junction of the vertebral arches. (1, 13, 121) The interlaminar spaces are formed by the laminae of adjacent vertebrae posteriorly, and present the entry point into the spinal canal when performing spinal anaesthesia (13).

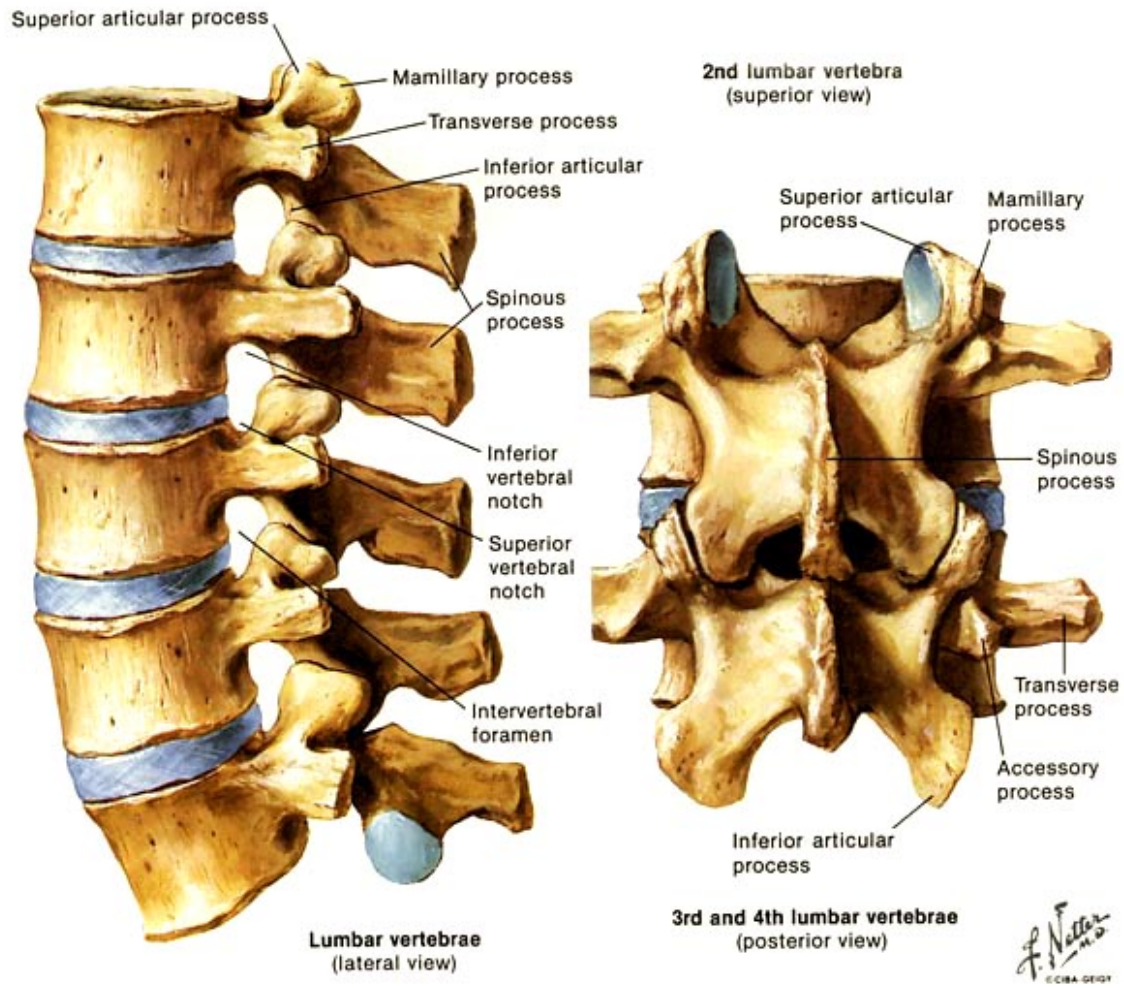

Figure 2.1 Anatomy of the lumbar vertebrae and lumbar vertebral column (122).

The articulating surfaces of adjacent vertebrae are connected by intervertebral discs and ligaments. The intervertebral discs act as shock absorbers to the spinal canal, and consist of an outer fibrous anulus fibrosus and a gelatinous central mass, the nucleus pulposus. The vertebral column is held together and stabilised by five ligaments. The supraspinous ligament connects the tips of the spinous processes. The interspinous ligament connects adjoining spinous processes from the root to the tip. The laminae of adjacent vertebral arches are connected by the broad elastic ligamentum flavum, thereby forming the posterior border of the vertebral spinal canal. The ligamentum flavum has historically been described as a single ligament, but is actually composed of two ligaments. The anterior longitudinal ligament is a strong fibrous band that covers and connects the anterolateral aspects of the vertebral bodies and intervertebral discs. The posterior longitudinal ligament is a narrower ligament attached to the posterior aspects of the vertebral bodies and intervertebral disks. (13, 121)

The vertebral column has characteristic curves in the lumbar and thoracic regions. This lumbar lordosis and thoracic kyphosis influence the distribution of local anaesthetics in the subarachnoid space in patients in the supine position, generally aiding the cephalad spread of hyperbaric local anaesthetic solutions. (1, 13)

The spinal cord is surrounded by three membranes known as the spinal meninges. These membranes, in conjunction with the CSF, protect the spinal cord and nerve roots. (13) The dura mater is the outermost meningeal membrane and is composed mostly of collagen. It forms the dural sac, a long tubular sheath contained within the surrounding spinal canal. It extends from the foramen magnum to the lower border of the second sacral vertebra, where it fuses with the filum terminale. The dura extends laterally along the nerve roots to merge with the epineurium. The arachnoid mater is composed of layers of epithelial cells with tight junctions. It is applied closely to the inner surface of the dura mater, and is responsible for the resistance to drug diffusion due to the tight junctions between the epithelial cells. (121) The pia mater is a very thin layer consisting of three to six layers of cells and is attached to the surface of the spinal cord and nerve roots. The subarachnoid, or intrathecal space, which lies between the pia mater and the arachnoid mater, is the target compartment for spinal anaesthesia. The spinal nerve roots traverse the subarachnoid space allowing for local anaesthetic uptake. (13)

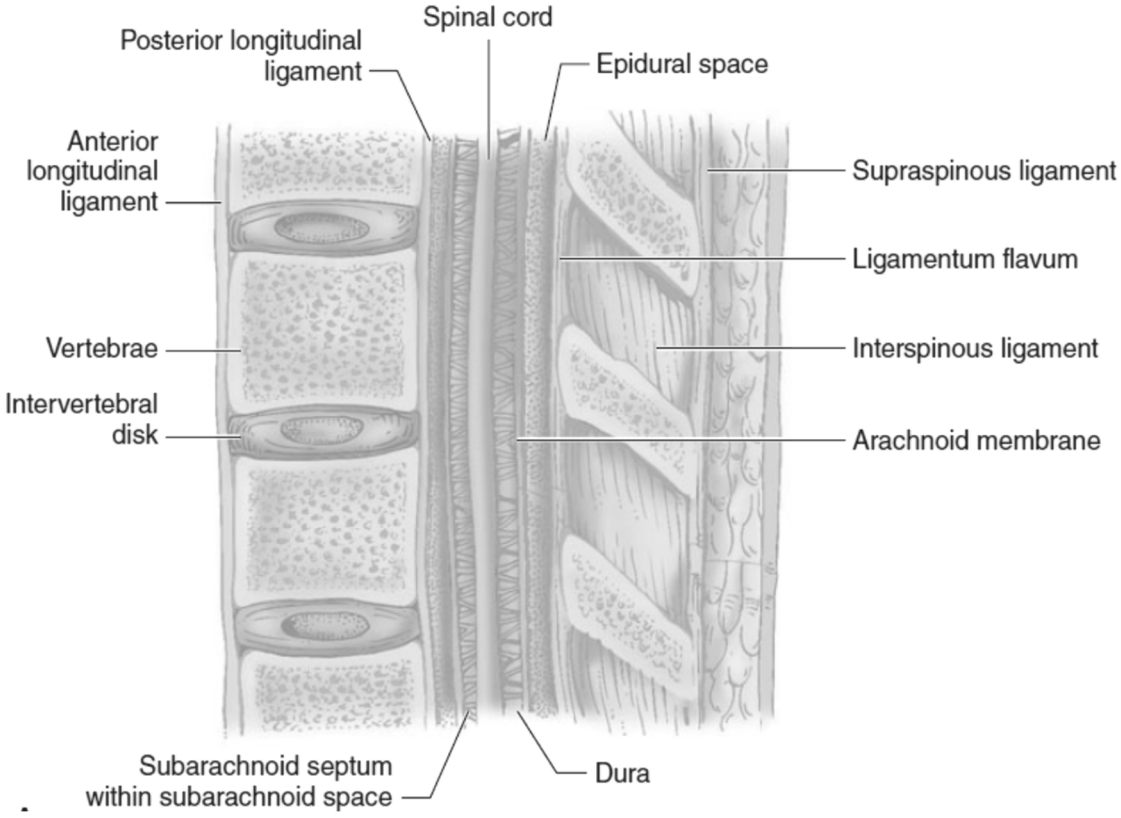

Figure 2.2 A sagittal section through the vertebral column, spinal cord and meninges (3).

The spinal cord is a cylindrical structure that gives rise to 31 pairs of spinal nerves, which arise from segments of the spinal cord specified by the intervertebral foramina through which they exit the spinal canal. Each segment gives rise to paired ventral motor roots and paired dorsal sensory roots. (13, 121) The portion of the spinal cord that gives rise to paired nerve roots and spinal nerves is called a spinal cord segment. The skin area innervated by a specific spinal cord segment is called a dermatome. The dermatomes are considered sensory projections of the spinal cord segments, and loss of afferent sensory functions provides a clinically useful estimate of local anaesthetic spread within the subarachnoid space, and thus an estimate of the extent of surgical anaesthesia. (4, 13)

In adults, the spinal cord is shorter than the vertebral column and the conus medullaris, or caudal extent of the spinal cord, commonly extends to the lower part of the first lumbar vertebral body. However, it may end as high as the upper part of the third lumbar vertebral body in some individuals. For this reason, it is usually

advocated that spinal anaesthesia be attempted at the L3-L4 or L4-L5 intervertebral space to avoid mechanical trauma to the spinal cord. The intercristal line, or Tuffier's line, is an imaginary line connecting the iliac crests that most commonly intersects the vertebral column at the L4-L5 intervertebral space, but there is considerable interpatient variability. (121, 123) This line is usually used to determine the correct intervertebral space to administer spinal anaesthesia at (13).

2.5.3 TECHNIQUE OF SPINAL ANAESTHESIA

2.5.3.1 Preparation

The success of spinal anaesthesia begins with proper preparation well before the procedure is performed. The induction of spinal anaesthesia results in various physiological changes and can lead to complications, and the anaesthetist must be able to detect and respond to these changes rapidly. (2, 13) The anaesthetist must be able to administer general anaesthesia before he induces spinal anaesthesia. The location must thus be equipped with oxygen, a means to administer positive pressure ventilation, airway management equipment as well as immediate access to drugs necessary for resuscitation and intubation. Vasopressors such as adrenaline and phenylephrine should also be diluted and available. (4) The patient must be attached to necessary monitors and intravenous access established before the procedure starts (76).

Spinal anaesthesia is a sterile procedure. A sterile tray must be prepared, and the anaesthetist performing the procedure should wear a surgical mask and scrub before administering the spinal anaesthesia. The equipment should be prepared on the sterile tray, and the correct type and size of needle should be chosen according to the clinical situation. (4) After scrubbing, the anaesthetist should put on a sterile gown and sterile gloves before proceeding. He then cleans the patient in an aseptic fashion and drapes the back of the patient, only leaving the lower lumbar area exposed. (119) All antiseptic solutions are neurotoxic, and care should be taken to ensure that the skin is completely dry to avoid introduction thereof into the intrathecal space (13).

2.5.3.2 Position of the patient

There are three primary patient positions for inducing spinal anaesthesia, namely lateral decubitus, sitting and prone. Each has advantages in certain situations, and a specific position might be preferred by the anaesthetist. (4)

The lateral decubitus position is useful when the patient has been sedated, and is less dependent on a trained assistant than the sitting position. In this position patients are placed with their back parallel to the edge of the bed nearest to the anaesthetist, with their hips and knees flexed. (13)

The sitting position is useful when low lumbar or sacral levels of anaesthesia are required, as it aids the caudal spread of hyperbaric local anaesthetic solutions. A stool can be provided as footrest and a pillow placed on the lap for the patient to lean on. The patient's back should remain in a vertical plane while the head and shoulders are flexed forward. This opens up the lumbar intervertebral spaces. (13)

The prone position is rarely used, and usually only if the patient needs to be in the prone position for surgery. The advantage is that patients can help to position themselves before the procedure, thus minimising the risk for positioning injuries. (13)

2.5.3.3 Projection and puncture

Spinal anaesthesia should be performed in the mid to lower lumbar intervertebral spaces, ideally the L3-L4 or L4-L5 space to avoid direct trauma to the spinal cord (13, 123).

There are two approaches to the subarachnoid space, namely the midline approach and the paramedian approach. For both it is recommended that local anaesthetic be applied to the overlying skin to lessen the discomfort caused by the spinal needle. (13)

Midline approach:

A 25-gauge or 27-gauge needle should be used to inject local anaesthetic over the intended site of puncture. The spinal is inserted at a 10-15 degree cephalad angle to the skin into the subcutaneous tissue, supraspinous ligament en then the interspinous ligament. Local anaesthetic is injected as the needle is pulled back, and

a weal is raised under the skin. (13) The needle used to inject the local anaesthetic may be used to verify the position of the intervertebral space, if bone is encountered the appropriate maneuvers can be made to reposition the needle in the proper orientation (4).

Next, the introducer needle is inserted at the site of skin infiltration with a slight cephalad angulation through the skin, subcutaneous tissue, supraspinous ligament and is then seated in the interspinous ligament. Care should be taken not to insert it too deeply, to avoid accidental puncture of the dura-arachnoid membrane. (119) The introducer needle is then stabilised by grasping it at the hub between thumb and index finger of the non-dominant hand. The hub of the spinal needle is then grasped between thumb and index finger of the dominant hand and inserted through the introducer, following the slight cephalad angulation of the introducer needle. The spinal needle is advanced slowly, and if it is on the correct course two changes in resistance to advancement should be perceived. The firm ligamentum flavum will be encountered first, followed by the dura-arachnoid interface. (4)

After the second change in resistance, advancement of the needle should be stopped as this usually indicates the tip has entered the subarachnoid space. The stylet of the spinal needle is withdrawn to allow for the free flow of CSF. If free flow does not occur, the hub of the needle can be rotated 90 degrees. The stylet may also be reinserted and removed to clear obstruction. If no flow of CSF is obtained, the stylet is replaced and the needle is advanced slightly until a change in resistance is appreciated. The stylet is the removed to check for CSF. These steps can be repeated until CSF is obtained. (4)

Once free flow of CSF is obtained, the syringe of local anaesthetic solution is attached to the hub of the spinal needle. During injection, the hub should remain fixed in position by the non-dominant hand by placing the back of the hand against the patients back whilst grasping the hub. Gentle aspiration of 0.1 – 0.2 millilitres of CSF confirms that the needle is still in the subarachnoid space before injection is started. The local anaesthetic solution is injected slowly until the syringe is emptied, and the spinal needle and introducer is then removed as a unit. A suitable aseptic covering should be place over the puncture site. (13)

Before starting the procedure, the patient should be warned about the possibility of paresthesia. If the patient reports paresthesia at any time, needle advancement is stopped and needle position immobilised. The paresthesia is usually transient, and simply indicates the subarachnoid space has been entered. The stylet is removed and the needle observed for the flow of CSF. The presence of CSF confirms the subarachnoid position of the needle tip, in which case it means the needle encountered part of the cauda equina. If paresthesia has resolved, injection of local anaesthetic may be attempted. If paresthesia recurs with aspiration or injection, no further injection should be made. If paresthesia recurs without injection, the needle should be withdrawn and repositioned. (1)

If bone is encountered, a mental note should be made of the depth at which this happens. The needle should then be withdrawn and advanced in a slightly more cephalad direction. If bone is encountered again, the depth is compared to the first encounter. If it is deeper, the needle is most likely advancing along the superior crest of the spinous process below the intervertebral space. The needle should be withdrawn and angled more cephalad before being advanced. If contact is shallower, it is most likely encountering the inferior surface of the spinous process above the intervertebral space. It should then be withdrawn and angled more caudally before being advanced. If bony contact is repeatedly encountered at the same depth, it is most likely the lamina and indicates the needle is not in the true midline. (13)

Paramedian approach:

In the paramedian approach, the same technique is used to infiltrate the skin over the intended puncture site with local anaesthetic. The initial spinal introducer site is simply 1 to 1.5 cm lateral to the midline while staying in the same intervertebral space. The needle is introduced with a slight medial angulation of 10 to 15 degrees as well as the usual cephalad angulation. From here, the advancement and injection process proceeds as with the midline approach, but the supraspinous and interspinous ligaments have been bypassed. (4, 13)

2.5.4 COMPLICATIONS OF SPINAL ANAESTHESIA

Spinal anaesthesia is associated with numerous potential complications, and these should all be carefully considered when deciding the risk-to-benefit ratio for a specific patient and surgical procedure. Mindfulness of these complications, prevention with the proper technique, vigilance with timely recognition and prompt treatment are indispensable for the safe conduct of spinal anaesthesia. (13)

Complications can develop during the administration of spinal anaesthesia, shortly after the injection of the local anaesthetic and during the postoperative period (124). It is thus essential that patients receiving spinal anaesthesia should be adequately monitored intra-operatively as well as post-operatively to identify any complications that may arise (4).

The frequency of complications vary greatly, but life-threatening and debilitating complications such as permanent nerve damage occur in 1:10 000 to 1:30 000 cases, and spinal hematoma and spinal infections occur in about 1:100 000 to 1:220 000 spinals performed (5, 120). Other more common complications such as hypotension and bradycardia occur in about 1:4 to 1:20 of cases, but can be easily treated if appropriate management is started quickly (125).

Complications that may arise during the administration of the spinal anaesthetic include patient anxiety and distress, which may lead to vasovagal attacks. These can usually be remedied by good communication and reassurance of the patient. There may also be technical complications related to the equipment used such as blocked, bent or blunt needles. (124) Direct damage to the spinal cord or spinal nerves is a serious complication that may arise during administration of spinal anaesthesia. Care should be taken to identify the landmarks correctly and the spinal needle should never be inserted above the level of the L3 vertebra. Any pain or paraesthesia on insertion of the needle or injection should prompt the anaesthetist to stop and re-evaluate the position of the needle. (13)

The most common complication to arise shortly after the administration of spinal anaesthesia is hypotension. This depends on the dose and volume of local anaesthetic used, and can occur in over 80% of cases. (124) Methods commonly used to treat or prevent hypotension include fluid preloading, limiting the volume of

local anaesthetic injected intrathecally, the use of hyperbaric bupivacaine and vasopressors (124). Phenylephrine is usually the first line vasopressor and has been shown to be very effective in the setting of hypotension following spinal anaesthesia (125).

Rarely severe hypotension with bradycardia and loss of consciousness can follow spinal anaesthesia due to activation of the Bezold-Jarisch reflex, and should be managed aggressively with fluids and vasopressors as cardiac arrest may follow. Electrocardiographic changes suggestive of myocardial ischemia or infarction are also common following spinal anaesthesia, and are thought to be due to the hypotension and tachycardia induced by blockade of sympathetic outflow. There is usually no enzymatic or echocardiographic evidence of cardiac injury, and if the is hypotension is treated these changes disappear. (4, 124)

High motor block is often related to high doses and high volumes of local anaesthetic used, but may occur with standard doses when used in pregnant patients (124). This is due to the physiological changes of pregnancy reducing the volume of the intrathecal space and thereby increasing the cephalad spread of the local anaesthetic (77). The standard principles of resuscitation should be followed, keeping in mind necessary changes that need to me made for pregnant patients (126). The airway should be protected by tracheal intubation and the patient ventilated. Cardiovascular depression should be treated with fluid resuscitation and inotropic support. Aortocaval compression should be relieved by tilting the patient 15º to the left lateral side, and delivery of the fetus should be expedited. (125)

Accidental intravenous injection is rarely seen due to the common practice of aspirating before injecting, but can nonetheless still occur. However, local anaesthetic toxicity is unlikely to occur with the small doses of local anaesthetic agents used for spinal anaesthesia. (4, 13, 124)

Other complications that may follow shortly after administration of the spinal anaesthesia include shivering, adverse effects of intrathecal opioids such as nausea and pruritus and failure of the spinal anaesthesia. Failure of the technique necessitates conversion to general anaesthesia. (124)

Postoperative complications arise in the immediate to longterm period following administration of spinal anaesthesia.

Post dural puncture headache has a reported incidence of 0.4% to 1% (120). The incidence has decreased due to the increased use of smaller 25- to 26-guage needles, the use of pencil point needles instead of cutting needles and the use of needle introducers. (13) The postulated mechanism is a large leak of CSF from the puncture site in the dura, leading to decreased CSF volume and subsequent loss of buoyant support, allowing the brain to sag. This causes traction on the meninges, cranial nerves and venous sinuses leading to headache and meningism. (13, 120, 124)

It can usually be treated with bedrest and simple analgesics such as anti-inflammatory agents and paracetamol. Cerebral vasoconstrictors such as caffeine and sumatriptan might also offer temporary relief. If symptoms persists despite conservative management it might make it difficult for the mother to care for her newborn, and an epidural blood patch should be considered. It is the only form of treatment that targets the etiology of the headache and has a reported success rate of 70% to 98%. (11, 13, 124)

Intraspinal hematomas are rare but have potentially devastating consequences. The risk is reduced by avoiding spinal anaesthesia in patients with altered hemostasis such as thrombocytopenia or the use of anticoagulant medication. Patients should be monitored closely after surgery for regression of spinal anaesthesia. If there is any new onset of bladder or bowel dysfunction or any motor or sensory deficit remaining after 12 hours this should prompt further investigation. (13, 125)

Infective complications are also rare, but meningitis and spinal abscesses remain a reality. Strict aseptic technique should be adhered to when spinal anaesthesia is performed to prevent these complications. (124)

Chronic adhesive arachnoiditis might occur when additives or cleaning solutions are introduced into the subarachnoid space. Care should be taken to use preservative free solutions, and to let the area of injection dry before introducing the spinal needle. (124)

Hearing loss might also occur and is usually transient. It has the same etiology and management as post dural puncture headache, and is thought to happen due to the loss of perilymph pressure in the cochlea. (124)

2.6 SUMMARY

This chapter provided an overview of anaesthesia-related maternal deaths, obstetric anaesthesia, anaesthesia records and spinal anaesthesia.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

In this chapter the problem statement, aim and objectives, ethical considerations, research methodology and the validity and reliability of this study will be discussed. Discussion of the research methodology will include the research design, study population, study sample, data collection and data analysis of this study.

3.2 PROBLEM STATEMENT

Generally, anaesthetic records have checkboxes and designated prompt areas to guide the anaesthetist in recording extensive details regarding certain aspects of the anaesthetic. These usually apply to general anaesthesia and include details of airway assessment and management, ventilation settings and intra-operative monitoring. (41)

When a regional technique, or more specifically spinal anaesthesia, is employed as sole anaesthetic the records usually do not have checkboxes or prompts to record details of the spinal anaesthetic. The attending anaesthetist has to use his own judgement to record what he considers important details regarding the spinal anaesthetic administered. (41-44)

Currently, there are few international guidelines with detailed requirements for recording regional anaesthesia. The most comprehensive guidelines specifically for regional anaesthesia are from the Royal College of Anaesthetists in the UK and the American Association of Nurse Anesthetists in the USA (24, 27). The South African Society of Anaesthetists currently have no detailed guidelines on the requirements for recording an episode of regional anaesthesia (33).

Seen in the light of the most recent confidential enquiry into maternal mortality, and considering the high association of spinal anaesthesia with maternal deaths directly related to anaesthesia, it is important to investigate the quality of anaesthetic records for spinal anaesthesia (9).

The standard of record keeping following spinal anaesthesia for caesarean section at Chris Hani Baragwanath Academic Hospital (CHBAH), Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) and Rahima Moosa Mother and Child Hospital (RMMCH) was not known and needed to be determined.

3.3 AIM OF THE STUDY

The aim of this study was to describe the parameters being recorded following spinal anaesthesia for caesarean section in the maternity theatres of CHBAH, CMJAH and RMMCH in Johannesburg, and to evaluate whether day or night, week or weekend, routine or emergency surgery or category of anaesthetist influence the parameters recorded following spinal anaesthesia for caesarean section.

3.4 OBJECTIVES OF THE STUDY

The primary objectives of this study were to:

- describe the demographics recorded following spinal anaesthesia for caesarean section
- describe the essential procedural parameters recorded following spinal anaesthesia for caesarean section
- describe the additional procedural parameters recorded following spinal anaesthesia for caesarean section
- describe the clinical parameters recorded following spinal anaesthesia for caesarean section.

The secondary objectives of this study were to:

- compare whether surgery being performed during the week or over the weekend influenced the parameters recorded
- compare whether surgery being performed during the day or during the night influenced the parameters recorded
- compare whether surgery being routine or an emergency influenced the parameters recorded
- compare whether the category of anaesthetist influenced the parameters recorded.

3.5 ETHICAL CONSIDERATIONS

Approval to conduct this study was obtained from the Postgraduate Committee (Appendix E) and the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (Appendix F). Approval to conduct the study was also obtained from the CEO's of CHBAH, CMJAH and RMMCH (Appendices G - I). Approval to access stored anaesthetic records was obtained from the gatekeeper the Head of Department of Anaesthesiology (Appendix J).

Each record enrolled into the study was assigned a study number. This was recorded together with each patient's hospital number on a separate Microsoft Excel^{TM} spreadsheet to be able to identify specific records at a later stage, if necessary. During data analysis only the assigned study number was used.

This study was done retrospectively and the name of the patient as well as the name of the anaesthetist for each case remained anonymous, as this was not recorded. Informed consent from the patient or anaesthetist was thus not required. Confidentiality was ensured as only the researcher and supervisors had access to the raw data.

All data collected is being kept private and will be stored securely for six years (127).

This study did not involve any drug or therapeutic management, and was conducted by adhering to good clinical research practice as set out in the South African Good Practice Guidelines (46) and the Declaration of Helsinki (47).

3.6 RESEARCH METHODOLOGY

3.6.1 STUDY DESIGN

Burns and Grove (127) describes the research design as the template for a study, which purpose is to set up a situation that maximises possibility of obtaining valid answers to the research questions. The study design determines the methods by which data is collected, analysed and the results interpreted (45, 127).

The research design used in this study was that of a retrospective, contextual, descriptive study.

A retrospective study measures variables that have been recorded in the past, and was applicable to this study as the data was obtained from completed anaesthetic records (45).

The study is contextual as it only examined the records that originated from three hospitals affiliated to the University of the Witwatersrand (128).

A descriptive study defines the characteristics of the sample under investigation, and the researcher does not manipulate any of the variables (45, 129).

This study describes the parameters being recorded following spinal anaesthesia for caesarean section in the maternity theatres of CHBAH, CMJAH and RMMCH. It also describes the influence that day or night, week or weekend, routine or emergency surgery and category of anaesthetist have on the parameters recorded following spinal anaesthesia for caesarean section at these hospitals.

3.6.2 STUDY POPULATION

The study population was the anaesthetic records completed following spinal anaesthesia for caesarean section in the maternity theatres of CHBAH, CMJAH and RMMCH.

3.6.3 STUDY SAMPLE

Sample size

Previous international studies evaluating the quality of anaesthetic records used between 50 and 850 records (18, 21, 115, 116). In South Africa Raff and James (22) analysed a total of 284 records. The percentage of records considered to be adequate in these studies were consistently low, with only 29.9% considered complete in the study by Raff and James (22) and only 32% in the study by Elhalawani et al. (115).

The average number of caesarean sections performed monthly at CHBAH, CMJAH and RMMCH were 600, 300 and 300, respectively. The total number of caesarean sections performed during one month at all three hospitals was used to calculate a representative sample of all the anaesthetic records completed for caesarean sections in one month. This was 1200 anaesthetic records.

The sample size was determined in consultation with a biostatistician, using the Epi Info™ program. It was assumed that 40% of the records would contain all the essential procedural parameters as identified by a review of the literature, and that in a worst-case scenario only 30% would contain all of these. A sample size of 280 anaesthesia records, with confidence levels of 95%, was calculated to be adequate for this study.

Due to the difference in total number of caesarean sections performed at each hospital, the sample was divided proportionately with150 records taken from CHBAH, and 75 records were taken from CMJAH and RMMCH each.

Sampling method

A consecutive convenience sampling method was used until the desired sample size was reached for each hospital (45, 127). Endacott et al. (128) describe convenience sampling as a non-random method that uses the most readily accessible units in a study population, in this study it would refer to the filed copies of the anaesthetic records. Consecutive sampling is a method whereby the researcher attempts to include all accessible subjects into the sample. As the records are filed chronologically, they were included in the study sample consecutively until the calculated sample size was reached. (127)

Inclusion and exclusion criteria

The following inclusion criteria were applied before enrolling records into the study:

- Records of patients presenting to maternity theatre for caesarean section.
- Records where spinal anaesthesia was used as anaesthetic method.
- Records of patients who had general anaesthesia following failed spinal anaesthesia were included.

Records that were illegible were excluded from the study.

3.6.4 DATA COLLECTION

Data collection sheet

An extensive review of current literature was used to compile a data collection sheet (Appendix D). The data collection sheet was used to collect data from the records

and to enter them into a Microsoft Excel^{TM} spreadsheet with the same format. The data collection sheet was divided into four sections: demographics, essential procedural parameters, additional procedural parameters and clinical parameters. The data collection sheet was ratified by three senior anaesthesiologists.

The hospital of origin was entered with an identifying letter (B/C/R). Patient's name, patient's hospital number and anaesthetist's name were not recorded on the data collection sheet, but was only noted as present or not. Category of anaesthetist was entered as intern, medical officer, registrar or consultant by using identifying letters (I/M/R/C). Staff registers from the various departments were used to determine each individual anaesthetist's category at the time that the record was completed. Date was recorded in a year/month/day format and time of surgery in 24-hour format. This information was used to determine whether surgery was performed during the day or night, or during the week or over the weekend. Urgency of the surgery was entered as routine or emergency using identifying letters (R/E). Any data not recorded on the anaesthetic record was noted as absent.

The list of procedural parameters considered essential to be recorded following spinal anaesthesia was compiled from a review of current literature on the subject.

The presence of the following essential procedural parameters on the anaesthetic record was assessed:

- spinal anaesthesia stated on the anaesthetic record
- aseptic technique used for spinal anaesthesia
- use of local anaesthetic to skin before spinal anaesthesia
- position of the patient used for spinal anaesthesia
- type of needle used
- name of drug used
- concentration of drug used
- dose of drug used
- total volume injected in the subarachnoid space
- spinal level of injection
- number of attempts made
- evidence of clear CSF following dural puncture.

Procedural parameters that were not included in this list but that were noted on the records were added to the data collection sheet in a consecutive fashion. If these parameters were noted on subsequent records they were recorded as present.

The presence of the following additional procedural parameters on the anaesthetic record was assessed:

- speed of injection or use of barbotage
- patient position following administration of spinal anaesthesia
- application of a dressing following administration of spinal anaesthesia
- pain or paresthesia on injection
- patient counselling regarding spinal anaesthesia
- use of an introducer before inserting the spinal needle
- administration of acid aspiration prophylaxis prior to spinal anaesthesia
- administration of antibiotic prophylaxis prior to surgery
- administration of a fluid co-load prior to spinal anaesthesia
- level of block achieved following spinal anaesthesia.

Thus after all the records were enrolled the list showed all procedural parameters regarded as essential, as was determined from review of current literature, as well as all other procedural parameters identified and recorded for this sample. This was used to assess the quality of record keeping during data analysis.

Review of current literature was also used to identify clinically significant parameters that are considered important to record when administering spinal anaesthesia.

The presence of the following clinical parameters on the anaesthetic record was assessed:

- evidence that a medical history was taken
- evidence that a physical exam was performed
- evidence that laboratory investigations were noted
- evidence that anaesthetic monitors were attached to the patient
- evidence that adequate intravenous access was established.

Only these clinical parameters were evaluated, and other parameters were not added to the data collection sheet as was done with the additional procedural parameters.

Data collection process

All three academic hospitals included in the study use anaesthetic records that are pre-printed and completed manually by the attending anaesthetist in theatre. Each hospital uses its own version of the anaesthetic record (Appendices A - C).These documents consist of a colour-ink top page and a black-ink bottom page. The top page is carbonated and produces a copy on the second page of the document as it is completed manually.

After surgery is finished, the anaesthetic record is taken with the patient to the recovery room. In the recovery room, the recovery nurses record vital signs on the anaesthetic record until they are satisfied that the patient is alert and stable enough to be transferred back to the ward. They then separate the top and bottom pages of the anaesthetic record. The top page is placed in the patients' hospital folder and taken with them to the ward. The bottom page is placed in a collection box in the recovery room for filing. When a patient needs to be taken directly to the intensive care unit or high care unit, the anaesthetist escorting the patient there is responsible for returning the bottom page of the anaesthetic record and placing it in the collection box.

The collection boxes in each hospital are taken to the departmental secretaries on a daily basis for filing of the carbon copies of the anaesthetic records. These copies are then filed according to date and stored in a secure place in each hospital's Department of Anaesthesiology. They can thus be easily found by the date on which they were created.

Anaesthetic records prior to 30th June 2013 were reviewed, until the required sample size for each hospital was achieved. Records were enrolled into the study proportionally to the average number of caesarean sections performed at each hospital per month.

Each record enrolled into the study was assigned a study number. This was recorded together with each patient's hospital number on a separate Microsoft

Excel™ spreadsheet to be able to identify specific records at a later stage, if necessary. During data analysis only the assigned study number was used.

Data capturing took place in each respective hospital's Department of Anaesthesiology, and records were not removed from the hospital premises.

All data collection sheets are being stored securely for six years, and will be kept strictly confidential by the researcher.

3.6.5 DATA ANALYSIS

All data recorded was captured on a Microsoft Excel™ spreadsheet. The data was analysed in consultation with a bio-statistician using the Stata™ version 13.1 statistical analysis program. Descriptive statistics were used to analyse the data. Categorical data was summarised using frequencies and percentages. Means and standard deviations were used for continuous variables that were normally distributed. Comparisons between groups were made using Chi-square or Fisher's exact tests as appropriate. Missing data was excluded from the specific analysis applicable. A p-value of < 0.05 was considered statistically significant.

3.7 VALIDITY AND RELIABILITY

Botma et al.(129) refers to validity of a study as "the degree to which a measurement reflects a true value" and reliability as the "consistency of the measure achieved".

The validity and reliability of this study was ensured by:

- using an appropriate study design and data gathering techniques
- evaluating records retrospectively thereby ensuring that anaesthetists could not change their record keeping practices during conduct of the study
- collection of data by a single researcher, therefore ensuring consistency of data entry into collection sheets
- using a representative sample size as calculated by a biostatistician
- using inclusion and exclusion criteria to recruit records that are applicable to the aims and objectives of the study.

3.8 SUMMARY

In this chapter the problem statement, aim and objectives, ethical considerations, research methodology and the validity and reliability of this study were discussed. Discussion of the research methodology included the research design, study population, study sample, data collection and data analysis of this study.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

In this chapter the sample realisation, results of the study according to the objectives as well as a discussion of the results are presented. All p-values were rounded to three decimal points and all percentages were rounded to two decimal points. Parameters were deemed to be recorded inadequately when they were recorded on less than 50% of the records. A p-value of < 0.05 was considered statistically significant.

The primary objectives of this study were to:

- describe the demographics recorded following spinal anaesthesia for caesarean section
- describe the essential procedural parameters recorded following spinal anaesthesia for caesarean section
- describe the additional procedural parameters recorded following spinal anaesthesia for caesarean section
- describe the clinical parameters recorded following spinal anaesthesia for caesarean section.

The secondary objectives of this study were to:

- compare whether surgery being performed during the week or over the weekend influenced the parameters recorded
- compare whether surgery being performed during the day or during the night influenced the parameters recorded
- compare whether surgery being routine or an emergency influenced the parameters recorded
- compare whether the category of anaesthetist influenced the parameters recorded.

4.2 SAMPLE REALISATION

As determined with the help of a biostatistician, a total of 280 records would have been sufficient for this study. A total of 300 records were collected consecutively, and none were excluded. These were taken proportionally from the three hospitals included in the study.

A total of 150 records were included from CHBAH, and 75 records from CMJAH and RMMCH respectively.

4.3 RESULTS

4.3.1 PRIMARY OBJECTIVES

4.3.1.1 Describe the demographics recorded following spinal anaesthesia for caesarean section

The following demographic data was recorded on the anaesthetic records following spinal anaesthesia for caesarean section.

Patient name: all 300 (100%) records examined stated the patient's name clearly.

Hospital number: of the records examined, 293 (97.67%) stated the hospital number clearly whilst 7 (2.33%) had no hospital number recorded.

Anaesthetist's name: all 300 (100%) of the records examined stated the anaesthetist's name clearly.

Date: all 300 (100%) of the records examined stated the date clearly. This was used to determine whether they were completed during the week or over the weekend. Of the records examined, 214 (71.33%) were completed during the week and 86 (28.67%) over the weekend.

Time of day: of the records examined 298 (99.33%) stated the time of surgery clearly. This was used to determine whether they were completed during the day or during the night. Only 2 (0.67%) of the records examined stated no time of surgery. Of these records stating the time of surgery, 126 (42.28%) were completed during the day and 172 (57.72%) during the night.

Urgency of surgery: all 300 (100%) of the records examined stated whether the surgery was routine or an emergency. Of the records examined, 52 (17.33%) were completed for routine caesarean sections and 248 (82.67%) for emergency caesarean sections.

Category of anaesthetist: All 300 (100%) of the records examined stated the anaesthetist's name clearly. Staff registers from the various departments were used to determine each individual anaesthetist's category at the time that the record was completed. Interns completed 43 (14.33%) of the records, 61 (20.33%) were completed by medical officers, 177 (59%) by registrars and 19 (6.33%) were completed by consultants.

4.3.1.2 Describe the essential procedural parameters recorded following spinal anaesthesia for caesarean section

The 12 essential procedural parameters that should be recorded, as identified from a review of the literature, and recorded on the anaesthetic records included in this study, are shown in Table 4.1.

Table 4.1 Essential procedural parameters recorded

Essential procedural parameters	Yes n (%)	No n (%)
1. Spinal anaesthesia	289 (96.33%)	11 (3.67%)
2. Aseptic technique	259 (86.33%)	41 (13.67%)
3. Skin anaesthetised	235 (78.33%)	65 (21.67%)
4. Position for spinal	119 (39.67%)	181 (60.33%)
5. Type of spinal needle used	189 (63%)	111 (37%)
6. Name of drug	294 (98%)	6 (2%)
7. Concentration of drug	72 (24%)	228 (76%)
8. Dose of drug	209 (69.67%)	91 (30.33%)
9. Volume of drug	148 (49.33%)	152 (50.67%)
10. Level of spinal injection	250 (83.33%)	50 (16.67%)
11. Number of attempts	67 (22.33%)	233 (77.67%)
12. Evidence of clear CSF	244 (81.33%)	56 (18.67%)

This revealed that 4 of the 12 parameters deemed essential for adequate record keeping following an incidence of spinal anaesthesia were recorded on less than 50% of the anaesthetic records. The parameters were the position for spinal (39.67%), the concentration of drug used (24%), the volume of drug used (49.33%) and the number of attempts made before locating the subarachnoid space (22.33%).

4.3.1.3 Describe the additional procedural parameters recorded following spinal anaesthesia for caesarean section

During examination of the records additional procedural parameters that were also recorded following spinal anaesthesia were identified. These parameters were not deemed essential from a review of the literature, but describe additional details regarding the spinal anaesthesia administered.

The additional procedural parameters recorded following spinal anaesthesia that were identified during examination of the records are shown in Table 4.2.

Table 4.2 Additional procedural parameters recorded

Additional procedural parameters	Yes n (%)	No n (%)
1. Speed of injection or barbotage	27 (9%)	273 (91%)
2. Position post spinal	139 (46.33%)	161 (53.67%)
3. Dressing applied	34 (11.33%)	266 (88.67%)
4. Pain or paresthesia on injection	40 (13.33%)	260 (86.67%)
5. Counselling regarding spinal	79 (26.33%)	221 (73.67%)
6. Needle introducer used	52 (17.33%)	248 (82.67%)
7. Acid aspiration prophylaxis given	68 (22.67%)	232 (77.33%)
8. Antibiotic prophylaxis given	220 (73.33%)	80 (26.67%)
9. Fluid co-load given	216 (72%)	84 (28%)
10. Level of block post spinal	40 (13.33%)	260 (86.67%)

There were 10 additional procedural parameters that were identified during examination of the records and 8 of these parameters were recorded in a low percentage of records.

Infrequently recorded additional procedural parameters of particular concern in pregnant patient's included the patient's position after administration of spinal anaesthesia (46.33%), the absence of pain or paresthesia on injection (13.33%), counselling regarding spinal anaesthesia (26.33%) and the level of the block obtained after administration of spinal anaesthesia (13.33%).

Other parameters that were seldom recorded were speed of injection or use of barbotage (9%), the application of a dressing after administration of the spinal anaesthesia (11.33%), the use of a needle introducer (17.33%) and the administration of acid aspiration prophylaxis (22.67%).

The only 2 additional procedural parameters that were recorded frequently were the administration of antibiotic prophylaxis (73.33%) and the administration of a fluid co-load prior to the administration of spinal anaesthesia (72%).

4.3.1.4 Describe the clinical parameters recorded following spinal anaesthesia for caesarean section

The clinical parameters that were recorded following spinal anaesthesia are shown in Table 4.3.

Table 4.3 Clinical parameters recorded

Clinical parameters	Yes n (%)	No n (%)
1. History taken	298 (99.33%)	2 (0.67%)
2. Examination performed	299 (99.67%)	1 (0.33%)
3. Investigations reviewed	148 (49.33%)	152 (50.67%)
4. Intravenous access established	252 (84%)	48 (16%)
5. Monitors attached	292 (97.33%)	8 (2.67%)

A total of 5 clinical parameters were examined. The only parameter that was recorded poorly was the review of laboratory investigations prior to administration of spinal anaesthesia, with only 49.33% of records examined found to have this recorded.

4.3.2 SECONDARY OBJECTIVES

Chi-squared tests were used for all the analysis, unless otherwise indicated.

4.3.2.1 Generation of parameter scores

Six scores were generated for each record.

The demographic score consisted of the patient name, hospital number, date and time of surgery, urgency of surgery and the anaesthetist's name. The essential procedural parameter score, additional procedural parameter score and clinical parameter score consisted of the parameters as described above. The total parameter score consisted of the essential procedural parameter score, the additional procedural parameter score and the clinical parameter score. The total anaesthetic record score consisted of the demographic score and the total parameter score.

These scores are shown in Table 4.4.

Table 4.4 Generated parameter scores

Parameter score (maximum)	Mean	Standard deviation
Demographic score (6)	4.93	± 0.78
Essential procedural parameter score (12)	7.92	± 1.94
Additional procedural parameter score (10)	3.78	± 1.76
Clinical parameter score (5)	4.29	± 0.66
Total parameter score (27)	15.98	± 4.36
Total anaesthetic record score (33)	20.91	± 3.22

These scores give an overall impression of the comprehensiveness of record keeping with regards to different aspects of the spinal anaesthetic.

4.3.2.2 Compare whether surgery being performed during the week or over the weekend influenced the parameters recorded

A total of 214 (71.33%) of the records were completed during the week and 86 (28.67%) over the weekend.

To compare whether surgery being performed during the week or over the weekend influenced the parameters recorded, Chi-squared or Fisher's exact tests were used.

The results of the essential procedural parameters are shown in Table 4.5, the results of the additional procedural parameters are shown in Table 4.6 and the results of the clinical parameters are shown in Table 4.7.

Table 4.5 Essential procedural parameters recorded during the week and over the weekend

Essential procedural parameters	Week Yes/No	Weekend Yes/No	p-value
1. Spinal anaesthesia*	209/5	80/6	p = 0.053
2. Aseptic technique	185/29	74/12	p = 0.927
3. Skin anaesthetised	172/42	63/23	p = 0.176
4. Position for spinal	69/145	50/36	p = 0.001
5. Type of spinal needle used	131/83	58/28	p = 0.312
6. Name of drug*	210/4	84/2	p = 0.798
7. Concentration of drug	51/163	21/65	p = 0.914
8. Dose of drug	155/59	54/32	p = 0.101
9. Volume of drug	103/111	45/41	p = 0.511
10. Level of spinal injection	171/43	79/7	p = 0.012
11. Number of attempts	54/160	13/73	p = 0.057
12. Evidence of clear CSF	172/42	72/14	p = 0.501

* = Fisher's exact test

Table 4.6 Additional procedural parameters recorded during the week and over the weekend

Additional procedural parameters	Week Yes/No	Weekend Yes/No	p-value
1. Speed of injection or barbotage	20/194	7/79	p = 0.741
2. Position post spinal	94/120	45/41	p = 0.187
3. Dressing applied	22/192	12/74	p = 0.364
4. Pain or paresthesia on injection	25/189	15/71	p = 0.184
5. Counselling regarding spinal	65/149	14/72	p = 0.001
6. Needle introducer used	42/172	10/76	p = 0.098
7. Acid aspiration prophylaxis given	62/152	6/80	p = 0.001
8. Antibiotic prophylaxis given	161/53	59/27	p = 0.240
9. Fluid co-load given	162/52	54/32	p = 0.024
10. Level of block post spinal	31/183	9/77	p = 0.354

Chi-squared test used for all parameters

Table 4.7 Clinical parameters recorded during the week and over the weekend

Clinical parameters	Week Yes/No	Weekend Yes/No	p-value
1. History taken*	213/1	85/1	p = 0.492
2. Examination performed*	214/0	85/1	p = 0.114
3. Investigations reviewed	120/94	28/58	p = 0.001
4. Intravenous access	180/34	72/14	p = 0.933
5. Monitors attached*	211/3	81/5	p = 0.046

* = Fisher's exact test

Whether the records were completed during the week or over the weekend had a statistically significant influence on 7 of the 27 parameters reviewed.

- Position for spinal anaesthesia was stated on significantly less records completed during the week (32.24%) than over the weekend (58.13%) (p = 0.001).
- Level of injection was recorded on significantly less records completed during the week (79.9%) than over the weekend (91.86%) (p = 0.012).

- Counselling regarding the spinal was recorded on significantly more records completed during the week (30.32%) than on records completed over the weekend (16.27%) (p = 0.001).
- Aspiration prophylaxis was recorded on significantly more records completed during the week (28.97%) than on records completed over the weekend (6.97%) (p = 0.001).
- Fluid co-load was recorded on significantly more records completed during the week (75.7%) than on records completed over the weekend (62.79%) (p = 0.024).
- Review of investigations was recorded on significantly more records completed during the week (56.07%) than on records completed over the weekend (32.56%) (p = 0.001).
- Monitors being attached prior to spinal anaesthesia was recorded on significantly more records completed during the week (98.59%) than on records completed over the weekend (94.18%) (p = 0.046).

Of these 7 parameters that showed statistically significant differences between being recorded during the week or over the weekend, 5 were recorded more frequently during the week. Only the positon for spinal anaesthesia and the level of injection were recorded more frequently over the weekend.

4.3.2.3 Compare whether surgery being performed during the day or during the night influenced the parameters recorded

A total of 126 (42%) of the records were completed during the day and 172 (57.33%) during the night. Only 2 (0.67%) of the records had no time recorded and were thus excluded from this analysis.

To compare whether the time of day that surgery was performed influenced the parameters recorded, Chi-squared or Fisher's exact tests were used.

The results of the essential procedural parameters are shown in Table 4.8, additional procedural parameters in Table 4.9 and the clinical parameters in Table 4.10.

Table 4.8 Essential procedural parameters recorded during the day and the night

Essential procedural parameters	Day Yes/No	Night Yes/No	p-value
1. Spinal anaesthesia*	123/3	165/7	p = 0.527
2. Aseptic technique	110/16	147/25	p = 0.649
3. Skin anaesthetised	98/28	135/37	p = 0.883
4. Position for spinal	40/86	77/95	p = 0.023
5. Type of spinal needle used	83/43	104/68	p = 0.341
6. Name of drug*	124/2	169/3	p = 0.917
7. Concentration of drug	28/98	43/129	p = 0.578
8. Dose of drug	85/41	123/49	p = 0.452
9. Volume of drug	60/66	86/86	p = 0.685
10. Level of spinal injection	102/24	146/26	p = 0.370
11. Number of attempts	31/95	36/136	p = 0.453
12. Evidence of clear CSF	93/33	149/23	p = 0.005

* = Fisher's exact test

Table 4.9 Additional procedural parameters recorded during the day and the night

Additional procedural parameters	Day Yes/No	Night Yes/No	p-value
1. Speed of injection or barbotage	12/114	15/157	p = 0.811
2. Position post spinal	60/66	77/95	p = 0.626
3. Dressing applied	11/115	23/149	p = 0.213
4. Pain or paresthesia on injection	17/109	23/149	p = 0.976
5. Counselling regarding spinal	33/93	45/127	p = 0.996
6. Needle introducer used	23/103	28/144	p = 0.655
7. Acid aspiration prophylaxis given	33/93	35/137	p = 0.235
8. Antibiotic prophylaxis given	91/35	127/45	p = 0.756
9. Fluid co-load given	92/34	122/50	p = 0.693
10. Level of block post spinal	23/103	17/155	p = 0.036

Chi-squared test used for all parameters

Table 4.10 Clinical parameters recorded during the day and the night

Clinical parameters	Day Yes/No	Night Yes/No	p-value
1. History taken*	125/1	170/2	p = 0.825
2. Examination performed*	124/2	171/1	p = 0.391
3. Investigations reviewed	71/55	75/97	p = 0.030
4. Intravenous access	98/28	153/19	p = 0.009
5. Monitors attached*	120/6	170/2	p = 0.058

* = Fisher's exact test

Whether the records were completed during the day or night had a statistically significant influence on 5 of the 27 parameters reviewed.

- Position for spinal was recorded on significantly less records completed during the day (31.74%) than on records completed during the night (44.67%) (p = 0.023).
- Evidence of clear CSF was recorded on significantly less records completed during the day (73.8%) than on records completed during the night (86.62%) (p = 0.005).
- Level of block obtained was recorded on significantly more records completed during the day (18.25%) than on records completed during the night (9.88%) (p = 0.036).
- Investigations were recorded on significantly more records completed during the day (56.34%) than on records completed during the night (43.6%) (p = 0.03).
- Establishment of intravenous access was recorded on significantly less records completed during the day (77.78%) than on records completed during the night (88.95%) (p = 0.009).

Two of these parameters were completed more frequently during the day namely the level of the block obtained and review of laboratory investigations. Three of these parameters were completed more frequently during the night namely the position for spinal, evidence of clear CSF and establishment of intravenous access.

4.3.2.4 Compare whether surgery being routine or an emergency influenced the parameters recorded

A total of 52 (17.33%) records were completed for routine caesarean sections whilst 248 (82.67%) of the records were for emergency caesarean sections.

To compare whether routine or emergency surgery influenced the parameters recorded, Chi-squared or Fisher's exact tests were used.

The results of the essential procedural parameters are shown in Table 4.11, the results of the additional procedural parameters are shown in Table 4.12 and the results of the clinical parameters are shown in Table 4.13.

Table 4.11 Essential procedural parameters recorded during routine and emergency surgery

Essential procedural parameters	Routine Yes/No	Emergency Yes/No	p-value
1. Spinal anaesthesia*	50/2	239/9	p = 0.941
2. Aseptic technique	42/10	217/31	p = 0.199
3. Skin anaesthetised	38/14	197/51	p = 0.312
4. Position for spinal	13/39	106/142	p = 0.017
5. Type of spinal needle used	36/16	153/95	p = 0.306
6. Name of drug*	51/1	243/5	p = 0.965
7. Concentration of drug	13/39	59/189	p = 0.853
8. Dose of drug	33/19	176/72	p = 0.284
9. Volume of drug	26/26	122/126	p = 0.916
10. Level of spinal injection	41/11	209/39	p = 0.340
11. Number of attempts	12/40	55/193	p = 0.887
12. Evidence of clear CSF	37/15	207/41	p = 0.038

* = Fisher's exact test

Table 4.12 Additional procedural parameters recorded during routine and emergency surgery

Additional procedural parameters	Routine Yes/No	Emergency Yes/No	p-value
1. Speed of injection or barbotage*	4/48	23/225	p = 0.481
2. Position post spinal	22/30	117/131	p = 0.522
3. Dressing applied*	4/48	30/218	p = 0.259
4. Pain or paresthesia on injection*	4/48	36/212	p = 0.262
5. Counselling regarding spinal	14/38	65/183	p = 0.915
6. Needle introducer used*	3/49	49/199	p = 0.015
7. Acid aspiration prophylaxis given	16/36	52/196	p = 0.125
8. Antibiotic prophylaxis given	34/18	186/62	p = 0.154
9. Fluid co-load given	34/18	182/66	p = 0.243
10. Level of block post spinal	10/42	30/218	p = 0.169

* = Fisher's exact test

Table 4.13 Clinical parameters recorded during routine and emergency surgery

Clinical parameters	Routine Yes/No	Emergency Yes/No	p-value
1. History taken*	52/0	246/2	p = 0.683
2. Examination performed*	52/0	247/1	p = 0.827
3. Investigations reviewed	28/24	120/128	p = 0.474
4. Intravenous access	43/9	209/39	p = 0.777
5. Monitors attached*	49/3	243/5	p = 0.145

* = Fisher's exact test

Whether the records were completed for routine or emergency surgery had a statistically significant influence on 3 of the 27 parameters reviewed.

- The position for spinal anaesthesia was completed on significantly less records for routine surgery (25%) than for emergency surgery (42.74%) (p = 0.017).
- Evidence of clear CSF was recorded on significantly less records for routine surgery (71.15%) than for emergency surgery (83.46%) (p = 0.038).

- Use of an introducer was recorded on significantly less records for routine surgery (5.76%) than for emergency surgery (19.75%) (p = 0.015).

All 3 of these parameters were recorded more frequently during emergency surgery than during routine surgery.

4.3.2.5 Compare whether the category of anaesthetist influenced the parameters recorded

Interns completed 43 (14.33%) of the records, 61 (20.33%) were completed by medical officers, 177 (59%) by registrars and 19 (6.33%) by consultants.

To compare whether the category of anaesthetist influenced the parameters recorded, Chi-squared tests were used.

The results of the essential procedural parameters recorded by each category of anaesthetist are shown in Table 4.14. The results of the additional procedural parameters recorded by each category of anaesthetists are shown in Table 4.15. The results of the clinical parameters recorded by each category of anaesthetist are shown in Table 4.16.

Table 4.14 Essential procedural parameters recorded by each category of anaesthetist

Essential procedural parameters	Consultant Yes/No	Registrar Yes/No	MO Yes/No	Intern Yes/No	Overall p-value
1. Spinal anaesthesia	19/0	167/10	60/1	43/0	p = 0.169
2. Aseptic technique	16/3	156/21	48/13	39/4	p = 0.233
3. Skin anaesthetised	12/7	143/34	49/12	31/12	p = 0.227
4. Position for spinal	5/14	81/96	16/45	17/26	p = 0.033
5. Type of spinal needle used	9/10	128/49	27/34	25/18	p = 0.001
6. Name of drug	19/0	172/5	61/0	42/1	p = 0.518
7. Concentration of drug	4/15	49/128	10/51	9/34	p = 0.313
8. Dose of drug	12/7	126/51	47/14	24/19	p = 0.109
9. Volume of drug	8/11	88/89	31/30	21/22	p = 0.926
10. Level of spinal injection	17/2	158/19	45/16	30/13	p = 0.002
11. Number of attempts	4/15	42/135	15/46	6/37	p = 0.545
12. Evidence of clear CSF	14/5	147/30	51/10	32/11	p = 0.451

Chi-squared test used for all parameters

Table 4.15 Additional procedural parameters recorded by each category of anaesthetist

Additional procedural parameters	Consultant Yes/No	Registrar Yes/No	MO Yes/No	Intern Yes/No	Overall p-value
1. Speed of injection or barbotage	0/19	21/156	2/59	4/39	p = 0.107
2. Position post spinal	8/11	86/91	22/39	23/20	p = 0.265
3. Dressing applied	1/18	19/158	1/60	13/30	p = 0.001
4. Pain or paresthesia on injection	1/18	36/141	0/61	3/40	p = 0.001
5. Counselling regarding spinal	8/11	48/129	47/14	9/34	p = 0.321
6. Needle introducer used	5/14	32/145	10/51	5/38	p = 0.541
7. Acid aspiration prophylaxis given	3/16	37/140	24/37	4/39	p = 0.002
8. Antibiotic prophylaxis given	17/2	134/43	41/20	28/15	p = 0.127
9. Fluid co-load given	14/5	132/45	44/17	26/17	p = 0.328
10. Level of block post spinal	4/15	27/150	6/55	3/40	p =0.296

Chi-squared test used for all parameters

Table 4.16 Clinical parameters recorded by each category of anaesthetist

Clinical parameters	Consultant Yes/No	Registrar Yes/No	MO Yes/No	Intern Yes/No	Overall p-value
1. History taken	19/0	176/1	61/0	42/1	p = 0.503
2. Examination performed	19/0	176/1	61/0	34/0	p = 0.874
3. Investigations reviewed	9/10	96/81	30/31	13/30	p = 0.046
4. Intravenous access	15/4	149/28	52/9	36/7	p = 0.932
5. Monitors attached	15/4	173/4	61/0	43/0	p = 0.001

Chi-squared test used for all parameters

The category of anaesthetists had a statistically significant influence on 8 of the 27 parameters reviewed.

- Position for spinal was recorded more frequently by interns (39.53%) than medical officers (26.22%). Registrars (45.76%) completed it more frequently than both these groups and more frequently than consultants (26.31%) ($p = 0.033$).
- Type of needle was recorded less frequently by interns (62.79%) than registrars (72.31%). Medical officers (44.26%) recorded it less frequently than both these groups and less frequently than consultants (47.36%) ($p = 0.001$).
- Level of injection was recorded less frequently by interns (69.76%) than medical officers (73.33%). Registrars (89.26%) recorded this more frequently than both these groups but less frequently than consultants (89.47%) ($p = 0.002$).
- Application of a dressing was recorded more frequently by interns (30.23%) than by medical officers (1.63%), registrars (10.73%) or consultants (5.26%) ($p = 0.001$).
- Pain or paresthesia on injection was recorded more frequently by interns (6.97%) than by medical officers (0%). Registrars (20.33%) completed this more frequently than both these groups and more frequently than consultants (5.26%) ($p = 0.001$).
- Acid aspiration prophylaxis was recorded less frequently on the anaesthetic records by interns (9.3%) than by medical officers (39.34%), registrars (20.9%) or consultants (15.79%) ($p = 0.002$).
- Review of laboratory investigations was recorded less frequently on the anaesthetic records by interns (30.23%) than by medical officers (49.18%) registrars (54.23%) or consultants (47.36%) ($p = 0.046$).
- Attachment of monitors was recorded more frequently on the anaesthetic records by interns (100%) and medical officers (100%) than by registrars (97.74%) or consultants (78.94%) ($p = 0.001$).

Of these parameters 4 were recorded more frequently on the anaesthetic records by registrars than any other category of anaesthetist. These parameters were the position for spinal, the type of needle used, pain or paresthesia on injection and

review of laboratory investigations. Two of these parameters were recorded more frequently on the anaesthetic records by interns. These parameters were the application of a dressing and the attachment of monitors. The administration of acid aspiration prophylaxis was recorded most frequently by medical officers and the level of injection was recorded most frequently by consultants.

4.4 DISCUSSION

Demographic data and identifying parameters were deemed to be recorded at an acceptable level. Patient's name, anaesthetist's name, date of surgery and urgency of surgery were all recorded on all 300 (100%) of the records included in the study. This is in keeping with a study by Falcon et al. (17) that found all these parameters to be recorded on more than 95% of records. A similar study by Biddle et al. (21) also found the patient's name recorded on 100% of records and the anaesthetist's name on 99% of records. Only 7 (2.33%) of the records did not state the patient's hospital number. Only 2 (0.67%) records did not state the time of the surgery. This was superior to the study by Biddle et al. (21) that found 13.1% of records had no time recorded.

The majority of essential procedural parameters investigated in this study were recorded adequately. Spinal anaesthesia was recorded on 96.33% of records. This was in keeping with the studies by Falcon et al. (17), Marco et al. (44) and Tessler et al. (116) that all found the anaesthetic technique to be recorded on more than 90% of records. It was contrasted by the study by Elhalawani et al. (115) that found the anaesthetic technique was only recorded on 70% of the anaesthetic records.

The use of local anaesthetic agents to anaesthetise the skin was recorded on 78.33% of records in this study. Tessler et al. (116) found that a higher percentage of anaesthetic records (89%) had this parameter recorded.

In studies examining the adequacy of record keeping following general anaesthesia it was found that the frequency with which drug names were being recorded varied widely. The study by Falcon et al. (17) showed that drug names were recorded on 98% of records, the same as in this study. Studies by Hubert et al. (18), Elhalawani et al. (115) and Tessler et al.(116) all showed lower frequencies of drug names being recorded ranging between 64% and 75%. In contrast, the drug doses were recorded

on only 49.33% of records in this study while other studies showed doses were recorded in excess of 90% of the records reviewed (17, 21, 115). This low frequency with which drug doses are recorded could indicate a lack of familiarity with the factors that increase the chance of complications and that affect the eventual level of motor block achieved with spinal anaesthesia.

The majority of additional procedural parameters investigated in this study were inadequately recorded. Studies that examined the adequacy of record keeping following general anaesthesia have found surgical positioning to be recorded on 80% - 82% of anaesthetic records (21, 115). In contrast this study found that the position for surgery after the administration of spinal anaesthesia was only recorded on 46.33% of the anaesthetic records. The poor record keeping regarding the patients position following spinal anaesthesia and the level of the block obtained could indicate a further lack of understanding regarding the specific considerations that should be kept in mind when administering spinal anaesthesia to a pregnant patient.

Hubert et al. (18) found that counselling and consent for the anaesthetic was recorded on 49% of records reviewed while this study found only 26.33% of records had this recorded. Patient counselling and consent being recorded infrequently might be a result of the high workload and depersonalisation experienced by health care workers in training hospitals. This can lead to low importance being attached to counselling and consenting patients and hence it is not recorded, and it might be assumed that it is seldom done.

The study by Biddle et al. (21) found 94.9% of records reviewed to have a record of intravenous fluid administration. This study found that a record of intravenous fluid administration was made on 72% of the anaesthetic records. The only other additional procedural parameter that was recorded adequately was the administration of prophylactic antibiotics prior to surgery, which was recorded on 73.33% of records. This could be a result of the use of the World Health Organization Surgical Safety Checklist (130, 131) being used in all the hospitals included in this study. This checklist prompts the anaesthetist to consider the potential for intra-operative blood loss and to review whether antibiotics were

administered, and these prompts prior to surgery could serve as a reminder for the anaesthetist to record these specific parameters.

The majority of the clinical parameters were adequately recorded.

The patient history (99.33%), clinical examination (99.67%), establishment of intravenous access (84%) and application of monitors (97.33%) were recorded on the majority of records. This was greater than the study by Tessler et al. (116) where the history was only recorded on 62% of records and application of monitors on 80% of records. Falcon et al. (17) found the clinical examination was recorded on 80% of records, also a lower percentage than this study. The laboratory investigations were recorded on only 49.33% of the anaesthetic records in this study. In contrast Elhalawani et al. (115) found 75% of records to have proof that pre-operative investigations were reviewed prior to administration of anaesthesia.

The parameter scores were in keeping with overall levels of completeness in studies by Elhalawani et al. (115), Falcon et al. (17) and Hubert et al. (18), as well as a study conducted by Raff and James (22) in South Africa. It is interesting to note that similar to the study by Falcon et al. (17), demographic parameters were more frequently recorded than procedural parameters or clinical parameters.

Seven parameters showed statistically significant differences when records completed during the week were compared to records completed over the weekend. Most of these were recorded less frequently over the weekend. A recent study investigating patient safety states that it is a commonly held belief that errors and omissions in hospitals occur more frequently over weekends (132). A meta-analysis by Cavalazzi and colleagues (133) supported this by showing an increased risk of mortality for patients admitted over weekends. This phenomenon can probably be explained by the relative increase of emergencies over weekends when clinics and elective theatres are closed. This can lead to an increased workload for the medical staff on duty over weekends and manifest as substandard record keeping amongst other things. (134) Byrne et al. (109) comments that increased workload and mental effort such as is needed in busy units over weekends can lead to an increase in errors and omissions.

Five parameters showed statistically significant differences when records completed during the day were compared to records completed during the night. Most of these parameters were recorded more frequently during the night than during the day. This was in keeping with a study by Donchin et al. (135) that showed a higher frequency of errors on intensive care unit records during the day than during the night. This seems counterintuitive but could be due to the fact that more emergency surgeries are performed at night that require more focus and attention and will keep the anaesthetist alert and vigilant, translated into more thorough records. A study by Olivier and Kyriacos (23) reported a more negative attitude toward record keeping amongst nurses working day duty than night duty, and the same might apply to anaesthetists.

Three parameters showed statistically significant differences when routine surgery was compared to emergency surgery. The parameters were recorded more frequently during emergency surgery than routine surgery, which is in contradiction to the study by Elhalawani et al. (115) that found the anaesthetic records to be less comprehensive when recorded during emergency surgery. In keeping with Elhalawani et al. (115) Byrne et al. (109) also demonstrated that recording errors increased during simulated critical incidents and emergency situations. The reasons for the difference between this study and other studies as mentioned are unclear. It might be due to the heightened stress and vigilance associated with emergency surgery as opposed to routine surgery, leading to an increase in accurate record keeping. There is also a strong emphasis placed on critical incident reporting and regular mortality and morbidity discussions at the department where the study was conducted, which might prompt the anaesthetist to be more thorough when completing an anaesthetic record for a case that might end up being discussed at one of these meetings.

Eight parameters showed statistically significant differences when the categories of anaesthetists were compared. Registrars recorded these parameters more frequently than any other category of anaesthetist. This is in keeping with a study by Devitt et al. (19) that showed anaesthesiologists in training at university hospitals have the highest frequency of complete anaesthetic records when compared to qualified anaesthesiologist and final year medical students. It is also supported by a study by Phillips and Barker (136) that showed an increased frequency of errors

amongst junior doctors. It is suggested that interns and medical officers have limited clinical experience and restricted knowledge, and do not consider every aspect of the spinal anaesthetic that needs to be recorded.

4.5 SUMMARY

In this chapter the sample realisation, results of the study according to the objectives as well as a discussion of the results were presented.

CHAPTER 5

STUDY SUMMARY, LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

In this final chapter a summary of the study, the limitations of the study, recommendations and the conclusion of the study are presented.

5.2 STUDY SUMMARY

Anaesthetists are responsible for recording all relevant information regarding the anaesthetic that they administer. This has to be done in a succinct yet comprehensive way. This is required by law, and will facilitate in cases of review or litigation to prove that the appropriate level of care was adhered to (40, 97-99, 103).

When administering spinal anaesthesia there are a myriad of factors regarding the procedure that can influence the outcome, and although no specific guidelines exist to dictate what should be recorded in South Africa, international literature suggest that there are certain parameters with regards to spinal anaesthesia that are regarded as essential to be recorded by the anaesthetist administering the anaesthetic (28, 29, 31, 33, 43, 80, 94, 137).

Different pre-printed forms exist at all three hospitals investigated in this study, but none of these forms have prompts for the recording of detailed parameters following spinal anaesthesia. The objectives of this study were to describe the parameters that are recorded by anaesthetists following spinal anaesthesia for caesarean section, and determine whether certain factors such as day or night, week or weekend, urgency of surgery and category of anaesthetist influenced the recording of these parameters.

A total of 300 records were reviewed, as determined in accordance with a biostatistician to be adequate for this study.

Demographic data and identifying parameters were recorded thoroughly. Patient's name, anaesthetist's name, date of surgery and urgency of surgery were all

recorded on all 300 (100%) of the records examined. Only 7 (2.33%) of the records did not state the patient's hospital number and only 2 (0.67%) records did not state the time of the surgery.

The majority of records were completed during the week and during the night, as could be expected because the periods defined as week and night were longer than the periods defined as weekend and day. Most of these anaesthetic records were for emergency surgery and most were completed by registrars.

From a review of the literature twelve essential procedural parameters were identified that were deemed to be essential to be recorded (24-27, 33, 34). Additional procedural parameters were identified as they were recorded on individual records and added to the list, with a final list of ten additional procedural parameters being investigated. There were five clinical parameters, also identified form review of the literature, that were investigated (24-27, 33, 34).

From the ten procedural parameters identified as essential, four were not being recorded satisfactorily. These were the position of the patient prior to administration of spinal anaesthesia, the concentration of the drug used, the volume of the drug used and the number of attempts made.

From the twelve additional procedural parameters identified from the records eight were not being recorded satisfactorily, These were the patient's position after administration of spinal anaesthesia, the absence of pain or paresthesia on injection, counselling regarding spinal anaesthesia, the level of the block obtained after administration of spinal anaesthesia, the speed of injection or use of barbotage, the application of a dressing after administration of the spinal anaesthesia, the use of a needle introducer and the administration of acid aspiration prophylaxis.

From the five clinical parameters reviewed only one was not being recorded satisfactorily. This was review of laboratory investigations prior to administration of spinal anaesthesia.

A total of twenty-seven parameters were thus reviewed in this study.

Whether the records were completed during the week or over the weekend had a statistically significant influence on seven of the twenty-seven parameters reviewed.

Of these seven parameters that showed statistically significant differences between being recorded during the week or over the weekend, five were recorded more frequently during the week. These were counselling regarding spinal anaesthesia, aspiration prophylaxis, administration of a fluid co-load, review of laboratory investigations and attachment of monitors prior to administration of spinal anaesthesia. Only the position for spinal and the level of injection were recorded more frequently over the weekend.

Whether the records were completed during the day or night had a statistically significant influence on five of the twenty-seven parameters reviewed.

Of these parameters three were completed more frequently during the night namely the position for spinal, evidence of clear CSF and establishment of intravenous access while two were completed more frequently during the day namely the level of the block obtained and review of laboratory investigations.

Whether the records were completed for emergency or routine surgery had a statistically significant influence on three of the twenty-seven parameters reviewed.

All three of these parameters were recorded more frequently during emergency surgery than during routine surgery. They were the position used for spinal, evidence of clear CSF and the use of an introducer.

The category of anaesthetists had a statistically significant influence on eight of the twenty-seven parameters reviewed.

Attachment of monitors and application of a dressing were recorded most frequently by interns, administration of acid aspiration prophylaxis was recorded most frequently by medical officers and the position used for spinal, type of needle, review of investigations and presence of pain or paresthesia on injection was recorded most frequently by registrars. Only the level of injection was recorded most frequently by consultants.

5.3 LIMITATIONS

Burns and Grove (127) define limitations as restrictions or problems that decrease the assumptions that can be made from a study.

This study was contextual and focused on record keeping following spinal anaesthesia at three hospitals affiliated to the University of the Witwatersrand, making the generalisation of results limited. However, the quality of record keeping following spinal anaesthesia in these three hospitals was not previously known, and it provides an indication of the overall quality of record keeping. It helps to understand where the shortcomings in record keeping in these three hospitals are and makes it easier to target these specific areas of their records that need to be improved.

Retrospective consecutive sampling also creates the risk of collecting records from fewer individual anaesthetists, as it would lead to sampling of records completed by one or two anaesthetist on call on a specific day. A larger sample size could have possibly included a larger number of records from a longer time period, with more records from individual anaesthetists and less records from the same anaesthetist.

The study population was limited to three training hospitals affiliated to the University of the Witwatersrand. Most of the anaesthetists administering spinal anaesthesia at these hospitals were registrars in anaesthesiology and it is reasonable to expect that a high standard of record keeping would have been observed at all three hospitals due to the emphasis on training. The results might not be applicable to other hospitals, such as peripheral hospitals and private hospitals, where the majority of anaesthetists are medical officers or consultants. However these assumptions that a higher standard of record keeping is observed at training hospitals and private hospitals might be unfounded, as Elhalawani (48) and Devitt (19) illustrated poor standards of record keeping in training hospitals, and Raff et al. (22) found poor standards of record keeping in private anaesthetic practice in South Africa.

No association between what was recorded on the anaesthetic record and what was actually done by the attending anaesthetist was investigated. The assumption was made that if a specific parameter was not recorded it was not considered or performed during the administration of the spinal anaesthetic. This does not

necessarily reflect the true level of care rendered and the completeness of the anaesthetic record cannot be used as a reliable surrogate for the level of care. Nonetheless, it is the legal obligation of every anaesthetist to record everything that was done and from a legal perspective if there is no record it implies that it was not done.

The findings of this study can only be used to make recommendations regarding record keeping practices and the layout of the anaesthetic records in use at the three hospitals that were included in the study.

The sample size was calculated based on the primary objectives of the study, which were to describe the parameters recorded following spinal anaesthesia for caesarean section. The sample size was not calculated based on a hypothesis that there would be any difference when the parameters recorded were compared to independent variables, as was done in the secondary objectives. The study sample might not have been adequate to truly reflect these differences as was shown in the secondary objectives, and the results of these comparisons should be interpreted with caution and keeping this fact in mind. Although only simple comparisons were made, the sample size was not calculated with this as the primary objective.

The parameters that were considered essential to be recorded following spinal anaesthesia for caesarean section were determined from a review of the literature and current guidelines on the subject. No specific guidelines for record keeping following spinal anaesthesia could be found. Expert opinions might differ on which parameters should be considered essential to be recorded, and might also include other parameters that are considered essential but which were not identified from a review of the literature and current guidelines. The use of a focus-group technique or Delphi-technique using expert opinion to identify the parameters that are considered essential to be recorded following spinal anaesthesia for caesarean section can be employed in future studies, and might also form the basis for future guidelines on record keeping of spinal or regional anaesthesia.

5.4 RECOMMENDATIONS

5.4.1 RECOMMENDATIONS FOR CLINICAL PRACTICE

It is recommended that the Department of Anaesthesiology at the University of the Witwatersrand redesign the anaesthetic records in use at all the hospitals affiliated to it, and standardize the anaesthetic record so that one record is used at all the hospitals.

Marco et al. (44) as well as Fisher et al. (41) showed that standardized forms that are well designed can have a significant impact on their usability and can improve the standard of recordkeeping. Suggestions in their articles include records that proceed in a simple and intuitive manner, that are easy to read and that prompt anaesthetists for important information. These views are similarly supported by Avidan and Weissman (112).

It is furthermore recommended that the Department of Anaesthesiology at the University of the Witwatersrand define guidelines for the parameters that need to be recorded when neuraxial anaesthesia is administered, based on review of international literature on the subject. It is recommended that a specific section should be added to the anaesthesia record for neuraxial anaesthesia. This section should have checkboxes or prompts to record these parameters, to ensure that all the necessary information is recorded.

Devitt et al. (19) as well as Marco et al. (44) showed that checkboxes and prompts improve the completeness of anaesthetic records.

An additional recommendation is that formal audits of the completeness of anaesthetic records at all three hospitals included in this study be done on a regular basis. All anaesthetists at these hospitals should also be reminded regularly of the importance to complete the record comprehensively for each anaesthetic delivered.

Lastly, although not an objective of this study, it was illustrated that far more caesarean sections are performed during the night than during the day. This should be investigated further and consideration given to possibly increasing staffing during the night to meet the increased demand for theatre during this time.

5.4.2 RECOMMENDATIONS FOR FURTHER RESEARCH

This study only investigated the anaesthetic records completed at three academic hospitals affiliated to the University of the Witwatersrand.

It is recommend that the same study be performed in smaller peripheral hospitals where the majority of the anaesthetists are not in training positions, as well as at private hospitals where the majority of anaesthetist are medical officers or consultants.

The primary objectives of the study were to describe the parameters recorded, and the sample size was calculated on this premise. The secondary objectives investigated the influence of independent variables on the parameters recorded, and showed interesting results. However the sample size might not have been adequate for this purpose, and future research can be conducted with the hypothesis that certain independent variables do in fact influence the parameters recorded.

A focus-group technique or Delphi-technique can be used in a future research to determine the parameters that are considered essentia to be recorded following spinal anaesthesia. This can form the basis for guidelines on record keeping following spinal anaesthesia, as there are currently no clear guidelines on the subject.

5.5 CONCLUSION

This study demonstrated that demographic data and identifying parameters following spinal anaesthesia for caesarean section at CHBAH, CMJAH and RMMCH are recorded very thoroughly by the attending anaesthetists.

The essential procedural parameters that describe the technique and administration of spinal anaesthesia are recorded sufficiently. The additional procedural parameters that describe the technique and administration of spinal anaesthesia are recorded poorly. Clinical parameters considered important when administering spinal anaesthesia are recorded comprehensively.

It was illustrated that the records are completed more thoroughly during the week than over the weekend and they are completed more expansively during the night

than during the day. Records completed by registrars were more comprehensive then records completed by interns, medical officers or consultants.

5.6 SUMMARY

In this final chapter a summary of the study, the limitations of the study, recommendations and the conclusion of the study were presented.

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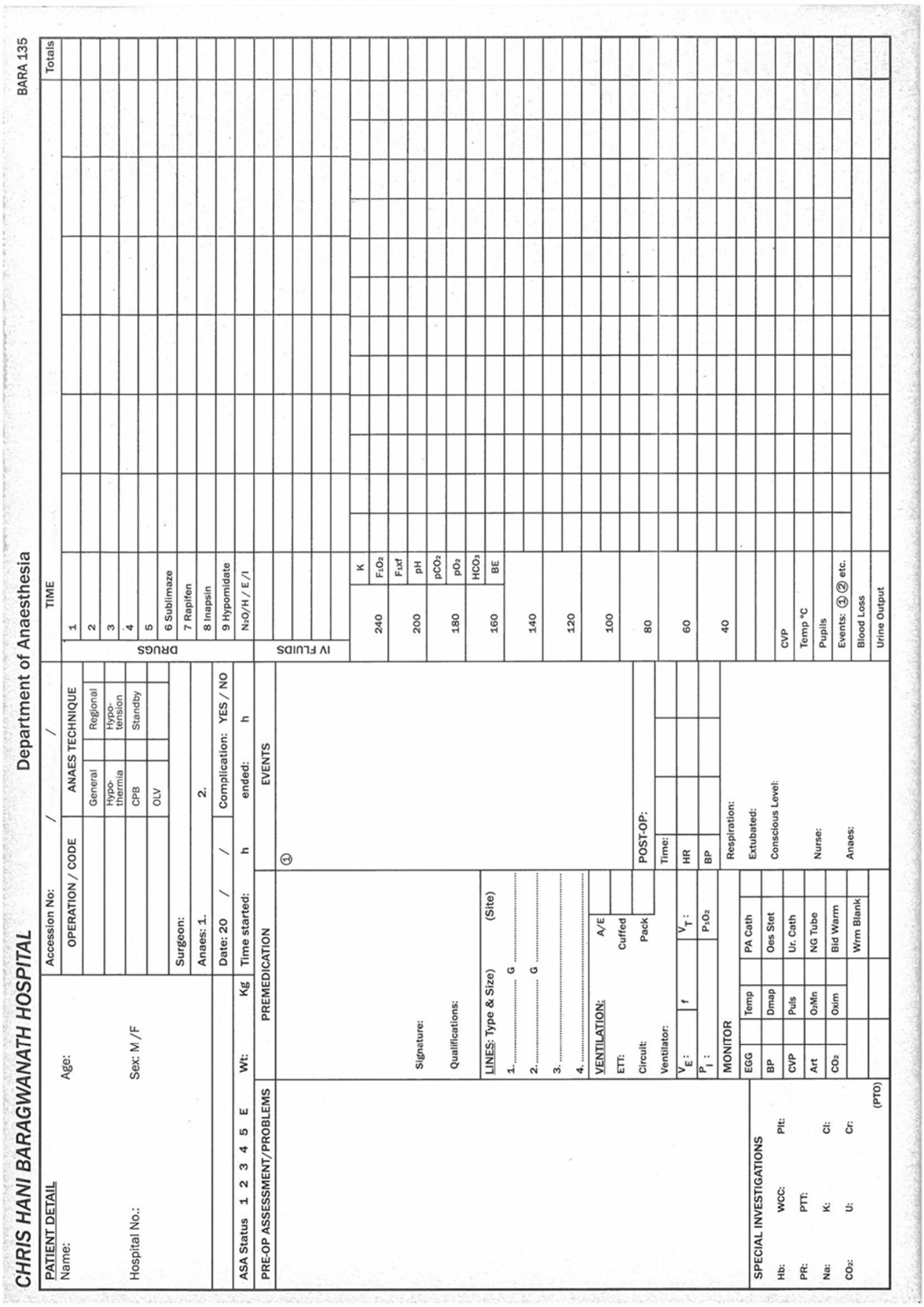
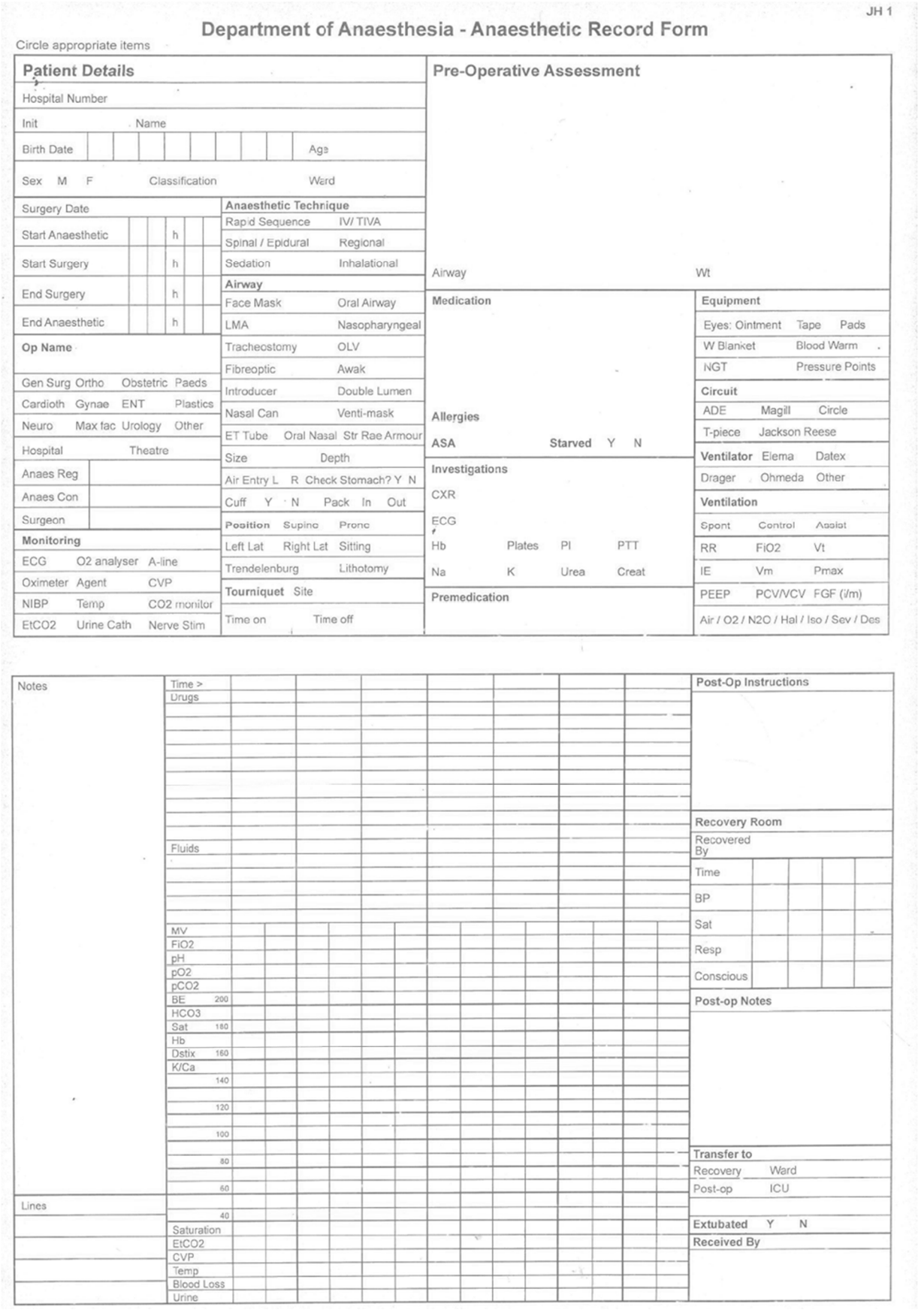
APPENDICES

Appendix A: Anaesthetic record used at CHBAH



Appendix B: Anaesthetic record used at CMJAH



JH 1

Department of Anaesthesia - Anaesthetic Record Form

Circle appropriate items

Patient Details

Hospital Number

Init Name

Birth Date Age

Sex M F Classification Ward

Surgery Date

Start Anaesthetic h

Start Surgery h

End Surgery h

End Anaesthetic h

Op Name

Gen Surg Ortho Obstetric Paeds

Cardioth Gynae ENT Plastics

Neuro Max fac Urology Other

Hospital Theatre

Anaes Reg

Anaes Con

Surgeon

Monitoring

ECG O2 analyser A-line

Oximeter Agent CVP

NIBP Temp CO2 monitor

EtCO2 Urine Cath Nerve Stim

Anaesthetic Technique

Rapid Sequence IV/ TIVA

Spinal / Epidural Regional

Sedation Inhalational

Airway

Face Mask Oral Airway

LMA Nasopharyngeal

Tracheostomy OLV

Fibreoptic Awak

Introducer Double Lumen

Nasal Can Venti-mask

ET Tube Oral Nasal Str Rae Armour

Size Depth

Air Entry L R Check Stomach? Y N

Cuff Y N Pack In Out

Position Supine Prone

Left Lat Right Lat Sitting

Trendelenburg Lithotomy

Tourniquet Site

Time on Time off

Pre-Operative Assessment

Airway Wt

Medication

Allergies

ASA **Starved** Y N

Investigations

CXR

ECG

Hb Plates PI PTT

Na K Urea Creat

Premedication

Equipment

Eyes: Ointment Tape Pads

W Blanket Blood Warm

NGT Pressure Points

Circuit

ADE Magill Circle

T-piece Jackson Reese

Ventilator Elema Datex

Drager Ohmeda Other

Ventilation

Spont Control Assist

RR FiO2 Vt

IE Vm Pmax

PEEP PCV/VCV FGF (l/m)

Air / O2 / N2O / Hal / Iso / Sev / Des

Notes

Time >

Drugs

Fluids

MV

FiO2

pH

pO2

pCO2

BE 200

HCO3

Sat 180

Hb

Dstix 160

K/Ca

140

120

100

80

60

40

Saturation

EtCO2

CVP

Temp

Blood Loss

Urine

Lines

Post-Op Instructions

Recovery Room

Recovered By

Time

BP

Sat

Resp

Conscious

Post-op Notes

Transfer to

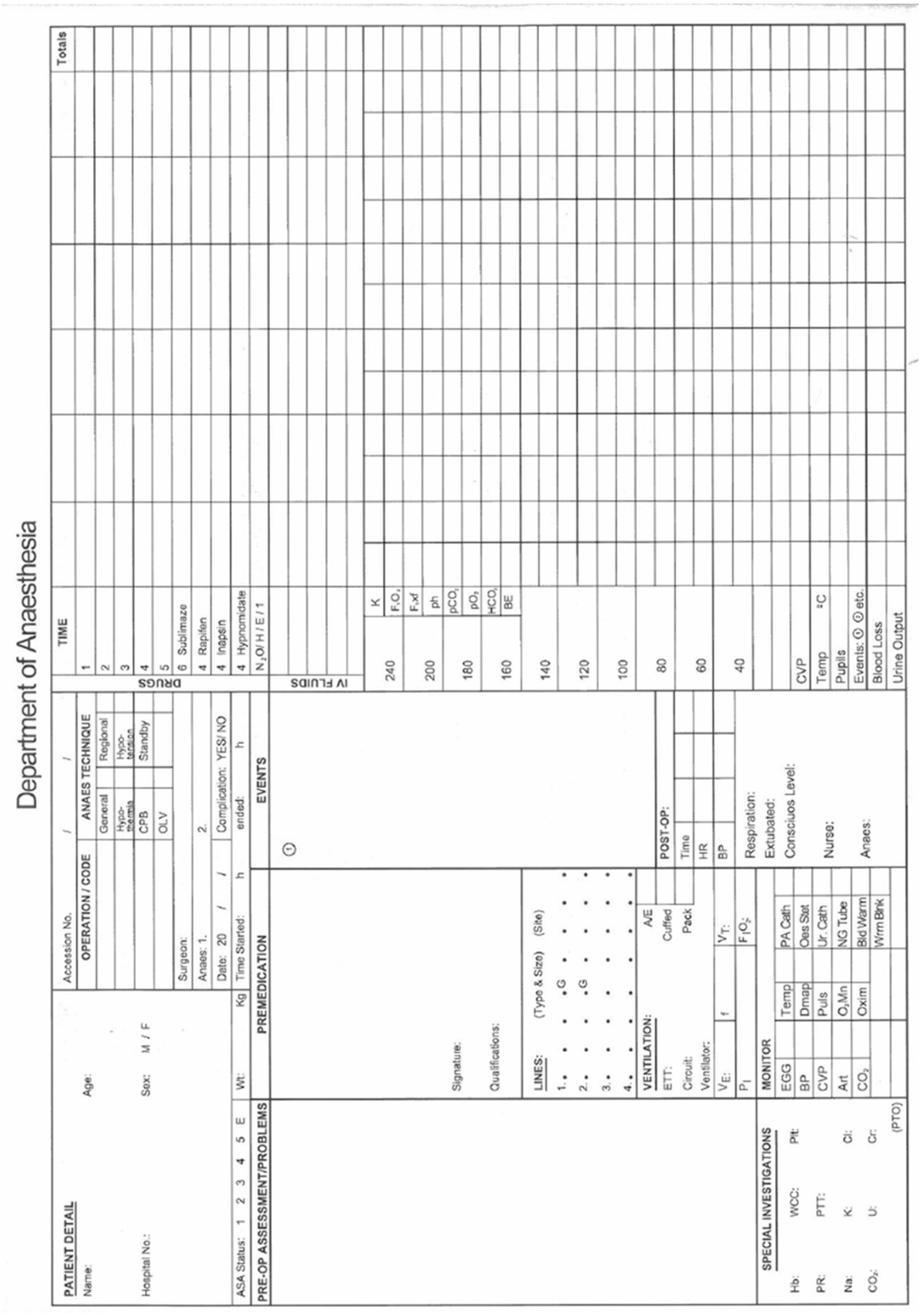
Recovery Ward

Post-op ICU

Extubated Y N

Received By

Appendix C: Anaesthetic record used at RMMCH



Appendix D: Data collection form

STUDY NUMBER	VALUES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
DEMOGRAPHICS									
Hospital of Origin	C/B/R								
Hospital number present	Y/N								
Patient **name present**	Y/N								
Anaesthetists name **present**	Y/N								
Category of anaesthetist	I/M/R/C								
Date	yyyy/mm/dd								
Time	00:00:00								
Urgency of surgery	R/E								
ESSENTIAL PROCEDURAL PARAMETERS									
Spinal anaesthesia stated	Y/N								
Preparation for spinal anaesthesia stated	Y/N								
Use of **local anaesthetic** to skin stated	Y/N								
Position of patient for spinal stated	Y/N								
Type of **needle** used stated	Y/N								
Name of drug used stated	Y/N								
Concentration of drug used stated	Y/N								
Dose of drug stated	Y/N								
Total volume injected stated	Y/N								
Level of injection stated	Y/N								
Number of **attempts** stated	Y/N								
Evidence of **clear CSF** stated	Y/N								
ADDITIONAL PROCEDURAL PARAMETERS									
	Y/N								
	Y/N								
	Y/N								
	Y/N								
CLINICAL PARAMETERS									
Medical History recorded	Y/N								
Physical Exam recorded	Y/N								
Laboratory Investigations recorded	Y/N								
Intravenous access established	Y/N								
Monitors attached	Y/N								

Appendix E: Approval to conduct the study from Postgraduate Committee of the University of the Witwatersrand

Faculty of Health Sciences
Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172040

Reference: Ms Thokozile Nhlapo
E-mail: thokozile.nhlapo@wits.ac.za

15 January 2014
Person No: 695472
TAA

Dr JC Steynberg
PO Box 409
Sunninghill
Sandton
2157
South Africa

Dear Dr Steynberg

Master of Medicine: Change of title of research

I am pleased to inform you that the following change in the title of your Research Report for the degree of **Master of Medicine** has been approved:

From:	**Assessment of procedural parameters currently being recorded following spinal anaesthesia for caesarean section at three academic hospitals in Gauteng**
To:	**Assessment of procedural parameters recorded following spinal anaesthesia for caesarean section at three academic hospitals in Gauteng**

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Appendix F: Approval to conduct the study from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M130709

NAME: (Principal Investigator) Dr Joubert Casper Steynberg/Prof EE Oosthuizen

DEPARTMENT: Anaesthesiology
Chris Hani Baragwanath Academic Hospital

PROJECT TITLE: Assessment of Procedural Parameters Currently Being Recorded Following Spinal Anaesthesia for Caesarean Section at Three Academic Hospitals in Gauteng

DATE CONSIDERED: 26/07/2013

DECISION: Approved unconditionally

CONDITIONS:

SUPERVISOR: Dr Estie Mostert

APPROVED BY: Professor PE Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 14/10/2013

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature M130709Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix G: Approval to conduct the study from the CEO of CHBAH

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Academic & Research)

MEMORANDUM

TO: **Dr JC Steynberg**
Department of Anaesthesiology
E-mail: drsteynberg@gmail.com

FROM: **Ms Zanele Ndlovu**
Administrative Officer: Human Research Ethics Committee (Medical)
Tel: 011 717-1252
e-mail: zanele.ndlovu@wits.ac.za

DATE: 02 August 2013

REF: ***R14/49*** *(This is not your protocol number)*

The protocol below was considered at a meeting of the Human Research Ethics Committee (Medical**) on Friday 26 July 2013.** The Committee requires the following amendments/corrections/information from you before your application can be approved.

Protocol no: **M130709** *(Please quote this reference number in all correspondence relating to this study)*

Project Title: Assessment of procedural parameters currently being recorded following spinal anaesthesia for Caesarean section at three academic hospitals in Gauteng.

Conditions: **Approved subject to:**

- Providing written permission to do the study from the hospital CEOs (CMJAH, CHBAH, RMMCH)

Please let me have the amendments as soon as possible as protocols on which no action has been taken will be removed from the agenda without approval after two months.
Please submit a covering letter, highlight any changes made and send two hard copies to this office

approved

CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL
GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA
CEO, Dr S.B Mfenyane
13/10/01
Date

Appendix H: Approval to conduct the study from the CEO of CMJAH

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

Enquiries:
Ms. L. Mngomezulu
(011): 488-3793
(011) 488-3753
16th September 2013

Dr. J.C. Steynberg
Anaesthesiology Department
CMJAH

Dear Dr. Steynberg

RE: "Assessment of procedural parameters currently being reported following spinal anaesthesia for Cesarean section at Charlotte Maxeke Johannesburg Academic Hospital"

Permission is granted for you to conduct the above research as described in your request provided:

1. Please forward a copy of your ethics clearance certificate as soon as the study is approved by the ethics committee for the CEO's office before you can commence with your study.
2. Charlotte Maxeke Johannesburg Academic hospital will not in anyway incur or inherit costs as a result of the said study.
3. Your study shall not disrupt services at the study sites.
4. Strict confidentiality shall be observed at all times.
5. Informed consent shall be solicited from patients participating in your study.

Please liaise with the Head of Department and Unit Manager or Sister in Charge to agree on the dates and time that would suit all parties.

Kindly forward this office with the results of your study on completion of the research.

Approved / not approved

Ms. G.M. Bogoshi
Chief Executive Officer

Appendix I: Approval to conduct the study from the CEO of RMMCH

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

RAHIMA MOOSA MOTHER AND CHILD HOSPITAL

RAHIMA MOOSA MOTHER AND CHILD HOSPITAL
Enquiries: Mrs. S. Jordaan
Tel: (011) 470 – 9030/4
Fax: (011) 477 4117

UNIVERSITY OF THE WITWATERSRAND
Department of Anaesthesiology
JOHANNESBURG
2001

Re: "Assessment of Procedural Parameters currently being recorded following Spinal Anaesthesia for caesarean section at 3 Academic Hospitals in Gauteng"

Dear Dr. J. C. Steynberg,

Permission is granted for you to conduct the above study as indicated in your request:

1. The Rahima Moosa hospital will not in anyway incur or inherit costs as a result of the said study.
2. Your study shall not disrupt services at the study site.
3. Strict confidentiality shall be observed at all times.
4. Informed consent shall be solicited from patients participating in your study.
5. NO file should leave the records department and/or the hospital premises.

Arrangement will be made with recordkeeping clerks so that you could occupy space in their department.

Kindly forward this office with the results of your research on completion of it.

I JC Steynberg accept the terms and conditions set-in this document

sign _____ date 8/10/2013

Yours sincerely,

CHIEF EXECUTIVE OFFICER
SJ/cj. 2013-10-03

Appendix J: Permission from the gatekeeper granting access to anaesthetic records

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL
DIRECTORATE - ANAESTHESIA
Enquiries: Prof AC Lundgren
Tel. number: (011) 933-9334
Fax number: 086 553 2529
Email: chris.lundgren@wits.ac.za

9th July 2013

TO WHOM IT MAY CONCERN

RE: ACCESS TO ANAESTHETIC RECORDS.

This is to confirm that **Dr. J.C. Steynberg** has been granted permission to access anaesthetic records for his study from the three following hospitals; Chris Hani Baragwanath Academic, Charlotte Maxeke Johannesburg Academic and Rahima Moosa Mother and Child Hospitals.

Kind regards.

PROF A.C. LUNDGREN
CHIEF SPECIALIST AND HEAD
DEPARTMENT OF ANAESTHESIA
CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL
AND
UNIVERSITY OF THE WITWATERSRAND

ACL/st