A survey of current practice in anaesthesia for caesarean delivery in a Department of Anaesthesiology

Benjamin David Watermeyer

A research report submitted to the Faculty of Health Sciences,

University of the Witwatersrand, Johannesburg,

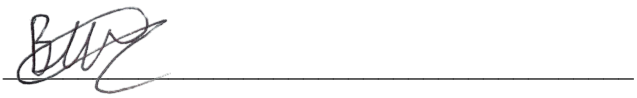
in the partial fulfilment of the requirements for the degree of

Master of Medicine in the branch of Anaesthesiology

Johannesburg 2022

Declaration

I, Benjamin David Watermeyer, herewith declare that this research report is my own, unaided work. It is being submitted for the degree of Master of Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other university.



Signed

On this 7th day of November 2022

Dedication

This project is dedicated to my loving wife who has supported me on this journey with both the ups and downs. I also wish to thank my family and those friends who have encouraged me to keep going and take just one more step.

Abstract

Background

South Africa has an increasing caesarean delivery (CD) rate and as such anaesthesia for CD has become a fundamental skill for all levels of anaesthetists. The Essential Steps in the Management of Obstetric Emergencies (ESMOE) guidelines provide a framework for practitioners with specific focus on dosage in neuraxial anaesthesia, perioperative fluids and management of hypotension.

Aims

The aim of this study was to describe the current practices of anaesthesia for patients requiring CD, including the management practices of common complications, within the University of the Witwatersrand Department of Anaesthesiology.

Methods

A prospective, contextual and descriptive study design was followed using an anonymous, self-administered online questionnaire. Descriptive statistics were used to assess adherence to guidelines and comparison made between senior and junior anaesthetist's practices.

Results

Junior anaesthetists performed significantly more CD anaesthetics per month and had more training in ESMOE guidelines compared to senior anaesthetists. Senior anaesthetists were more likely to use a higher dose of bupivacaine. Phenylephrine as a first line anti-hypotensive agent was used by 99.4% of participants. The considered safe minimum platelet count for spinal anaesthesia was 75 x $10^{\wedge 9}$/l by 61.3% of participants. A significant difference between junior and senior anaesthetists was found where senior anaesthetists were more likely to accept a lower platelet count. A sensory level post administration of spinal anaesthetic was assessed by all participants with 53.1% using an ice brick and 35.0% requesting the surgeon to pinch the patient.

Conclusion

In the Witwatersrand Department of Anaesthesiology anaesthetists do follow the ESMOE guidelines of clinical practice for CD. While there are some differences in practice approaches, these were found to be within internationally accepted practice. There would be a benefit of improved awareness of the ESMOE guidelines within the department as well as further training on the different approaches to CD anaesthesia. (299 Words)

Acknowledgements

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List of abbreviations

CD	Caesarean Delivery
ESMOE	South African Essential Steps in the Management of Obstetric Emergencies
GA	General Anaesthesia
Wits	The University of the Witwatersrand
ASA	Standard American Society of Anesthesiologists

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Statement

The Research Report consists of a draft article and appendices. A literature review and study proposal are included as appendices for background reference and are not for examination.

The formatting of this Research Report complies with the University of the Witwatersrand's Style Guide for Thesis, Dissertations and Research Reports. The formatting of the draft article may differ from the Research Report in order to comply with the author guidelines of the Southern African Journal of Anaesthesia and Analgesia, the journal to which it is intended to be submitted.

Draft article

A survey of current practice in anaesthesia for caesarean delivery in a Department of Anaesthesiology

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Keywords:

ESMOE guidelines, spinal anaesthesia, obstetrics, caesarean delivery

Abstract

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Junior anaesthetists performed significantly more CD anaesthetics per month and had more training in ESMOE guidelines compared to senior anaesthetists. Senior anaesthetists were more likely to use a higher dose of bupivacaine. Phenylephrine as a first line anti-hypotensive agent was used by 99.4% of participants. The considered safe minimum platelet count for spinal anaesthesia was 75 x $10^{\wedge 9}$/l by 61.3% of participants. A significant difference between junior and senior anaesthetists was found where senior anaesthetists were more likely to accept a lower platelet count. A sensory level post administration of spinal anaesthetic was assessed by all participants with 53.1% using an ice brick and 35.0% requesting the surgeon to pinch the patient.

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In the Witwatersrand Department of Anaesthesiology anaesthetists do follow the ESMOE guidelines of clinical practice for CD. While there are some differences in practice approaches, these were found to be within internationally accepted practice. There would be a benefit of improved awareness of the ESMOE guidelines within the department as well as further training on the different approaches to CD anaesthesia.

Introduction

Anaesthesia for caesarean delivery (CD) is a fundamental skill for all South African anaesthetists. The most recent Saving Mothers report from 2017 – 2019 showed an average CD rate of 28.1%[1] which has increased from the earlier reports with an average of 23.1% for 2011 – 2013[2] and 25.7% for 2014 – 2016.[3] With the increasing number of deliveries being performed, predominantly under spinal anaesthesia administered by junior practitioners, there is an increasing risk of anaesthesia-related complications.[4] The CD rate at the University of the Witwatersrand (Wits) Academic hospitals is approximately 44% with an average of 460 CD per month.

Spinal anaesthesia for CD is perceived as a safe choice for junior practitioners to administer[4] as it avoids the risks of general anaesthesia (GA) for both the mother and the foetus.[5, 6] There is still, however, a need for proficiency in converting to GA when a spinal anaesthetic fails or complications such as a high (total) spinal occur.[7] The incidence of a partial or failed spinal is 0.5% – 6%,[8] however, a 2017 study by Alabi et al.[9] established a partial or complete failure rate of 11.7% in the Eastern Cape; associated with obesity, bupivacaine dosage of 1.8 ml and more junior practitioners.

The guidelines drafted by the South African Essential Steps in the Management of Obstetric Emergencies (ESMOE)[10, 11] provide a framework for practitioners to follow for both spinal and general anaesthesia for CD, with a focus on clinicians working in district and regional hospitals, but are also suited to higher level facilities. The ESMOE guidelines[10] cover several aspects of obstetric spinal anaesthesia such as preparation of the patient, specific spinal techniques, monitoring, post-delivery management and the recovery period.

Fluid management is a key component of CD. No combination of fluid therapy has been identified to prevent the need for vasopressors when hypotension occurs,[12] but a 500 ml colloid or 1000 ml crystalloid fluid bolus may be administered as a pre-load or co-load[13] to reduce the requirement of vasopressors. The vasopressor recommended by ESMOE is phenylephrine.[10] Intra-operative hypotension must be treated quickly to reduce complications including nausea and vomiting.[10, 12] The use of ephedrine is limited to hypotension associated with a bradycardia.[14]

The platelet count at which the administration of a spinal anaesthetic may safely be performed is debateable.[15, 16] Lower platelet counts increase the risk of the development of a spinal haematoma which may result in permanent neurological damage.[15] The exact risk of serious complications in CD spinal anaesthesia is unknown but in 2014 D'Angelo et al.[17] reported a spinal haematoma incidence of 1 in 251 463 during the establishment of the Serious Complication Repository Project. It is considered safe to administer a spinal anaesthetic if the patient's platelet count is greater than 100 x $10^{\wedge 9}$/l.[15] In 2021, the Society for Obstetric Anaesthesia and Perinatology[16] published a consensus statement that a platelet count of 70 x $10^{\wedge 9}$/l or more is likely to have a very low risk of spinal haematoma complications, provided normal coagulation function is present.

Medication dosages in spinal anaesthesia for CD have a narrow safety range of 9 – 12 mg (1.8 – 2.4 ml) hyperbaric bupivacaine 0.5% and 10 – 20 µg (0.2 – 0.4 ml) fentanyl.[18] ESMOE[10] recommends 9 mg (1.8 ml) hyperbaric bupivacaine 0.5% with 10 µg (0.2 ml) fentanyl as a total mixture of 2.0 ml. CD requires a block of the T10 dermatome level for skin incision, however, a block level up to T4 may be required to cover visceral organ pain.[19] No studies validating the effectiveness of the ESMOE dosage guidelines were found.

In 2014, a doctoral thesis by Chetty[20] assessed the anaesthetic management of patients undergoing CD and its impact on post-operative pain management. This is the only South African of its kind which included a national survey of anaesthetic practices for CD in both the public and private sectors and included a morphine spinal intervention study. Spinal anaesthesia was the preferred method of analgesia for CD. The addition of intrathecal morphine (50 µg and 100 µg) reduced post-operative opioid requirements compared to fentanyl but numerical rating scale scores were not statistically different.[20]

Practice guidelines provide a safe framework for clinicians to follow while allowing for variability for individual cases. CD anaesthesia is a challenging and evolving field which requires practice and skill to master the various techniques. With an increasing number of CDs performed annually by junior practitioners, greater focus is required on the guidelines for CD anaesthesia. No study assessing anaesthetic practices against ESMOE guidelines at Wits could be found.

The aim of this survey was to describe the current practices of anaesthesia for obstetric patients requiring CD, including the management of common complications, among anaesthesia providers at Wits.

Methods

Approval was obtained from the Human Research Ethics Committee (Medical) (M200515) and all other relevant authorities prior to the initiation of the study.

A prospective, contextual and descriptive study design was followed using an anonymous, self-administered online questionnaire. The study population consisted of all the anaesthetists and interns working in the Wits Department of Anaesthesiology at the time of data collection, between October 2020 and January 2021. This comprised of 257 staff (39 medical officers, 114 registrars, 74 consultants and 30 interns). Questionnaires were distributed to the entire accessible population with a minimum response rate of 60% (155 completed questionnaires) established to be acceptable.[21]

A comprehensive literature review identified two South African published questionnaires by Theron et al.[22] and Jones et al.[19] Written permission was obtained from the authors to use and adapt the questionnaires for the local setting. The adapted questionnaire was reviewed by three senior anaesthesiologists within the Wits Department of Anaesthesiology and following their recommendations, the questionnaire was amended to ensure face and content validity. Only practice was assessed with no minimum score requirement for participants. The 23 questions consisted of demographics, fluid management choices, specific spinal anaesthesia medications and volumes, considered safe platelet levels and scenarios analysing practice choices.

Data collection was via an online self-administered questionnaire through SurveyMonkey®. A link to the questionnaire was sent to all members working in the Wits Department of Anaesthesiology. Upon clicking the link, an information letter was first provided prior to continuing with the questionnaire.

All data from questionnaires were captured on Microsoft® Office 365 Excel® spreadsheets. The statistical program STATA® version 15 was used to process and analyse the data in consultation with a biostatistician. This survey consisted of only categorical data which was summarised as frequencies and percentages. To analyse differences between senior and junior anaesthesia providers a Chi squared test was used. A p-value of less than 0.05 was considered statistically significant.

Results

Of the 257 email links sent, 160 completed questionnaires were received, representing a response rate of 62.3%. There were no incomplete or partially completed responses received. The demographic data of respondents is summarised in Table 1.

Table1: Demographics of participants

Professional designation	N (%)
Intern	19 (11.9)
Medical Officer	21 (13.1)
Registrar	71 (44.4)
Consultant or career medical officer in anaesthesia	49 (30.6)
Experience level	
Junior (1-3 years training)	57 (35.6)
Senior (>3 years training)	103 (64.4)
Years of experience in Anaesthesia	
< 1 year	28 (17.5)
1 − 3 years	29 (18.1)
4 − 9 years	71 (44.4)
≥ 10 years	32 (20.0)
Average number of caesarean delivery anaesthetics per month	
0	9 (5.6)
< 10	39 (24.4)
10 - 20	64 (40.0)
21 - 30	37 (23.1)
>30	11 (6.9)
Training in Obstetric Guidelines	
Yes	112 (70.0)
No	48 (30.0)
Training in ESMOE Guidelines	
Yes	105 (65.6)
Other	7 (4.4)

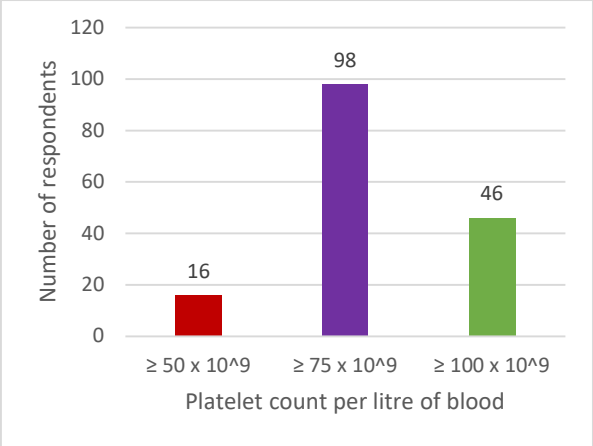
Junior anaesthetists (practitioners with up to three years' experience) performed significantly more CD anaesthetics per month compared to senior anaesthetists (practitioners with more than three years' experience) (p=0.003), with significantly more having had training in ESMOE compared to senior anaesthetists (p=0.009).

Seventy-five (46.9%) participants preferred administering crystalloid fluids prior to the administration of a spinal anaesthetic, while 45 (28.1%) preferred a colloid fluid and 40 (25.0%) preferred giving both fluids. Administration was given as a preload only in 14 (8.8%) responses, a co-load only in 19 (11.9%) and a combined preload and co-load in 127 (79.4%) responses.

Standard American Society of Anesthesiologists (ASA) monitors – electrocardiogram (ECG), pulse oximetry and non-invasive blood pressure (NIBP) – were selected by 150 (93.8%) participants and 10 (6.3%) used ECG and NIBP. Temperature was checked by 7 (4.4%) participants in addition to standard ASA monitors. Following the administration of the spinal anaesthetic, blood pressure was checked every minute by 118 (73.8%) participants, every 2 minutes by 36 (22.5%) participants and after 3 minutes or longer by 6 (3.8%) participants. After delivery of the foetus, the blood pressure interval was not changed by 49 (30.6%) participants, changed immediately by 10 (6.3%) participants, after 5 minutes by 74 (46.3%) participants and after 10 minutes by 27 (16.9%) participants.

Methods of uterine displacement were reported by 144 (90.0%) participants; 19 (11.9%) participants used an obstetric wedge, 121 (75.6%) participants used a table tilt, 4 (2.5%) participants used an intravenous fluid vacolitre as a wedge or manually displaced the uterus to the left and 16 (10.0%) participants did not displace the uterus. Phenylephrine was the agent of choice to treat hypotension following spinal anaesthetic by 158 (99.4%) participants, 1 (0.6%) participant selected ephedrine and 1 (0.6%) participant selected other.
Figure 1 shows the considered safe minimum platelet count for spinal anaesthesia when all other organ function is normal. Senior anaesthetists accepted a lower platelet count compared to junior anaesthetists ($p= 0.018$).

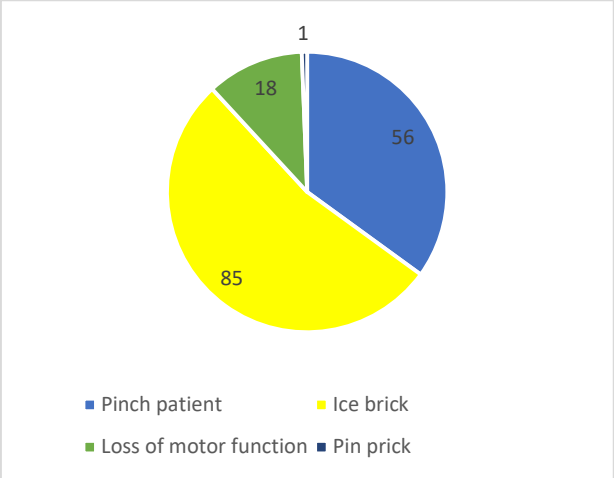
Figure 1: Considered safe minimum platelet count for spinal anaesthesia



Hyperbaric bupivacaine 0.5% was used by all participants. A volume of 1.8 ml was used by 105 (65.6%) participants, a volume greater than 1.8ml by 49 (30.6%) participants and a volume less than 1.8ml by 6 (3.8%) participants. A significant difference was evident, (p= 0.012), with senior anaesthetists using greater than 1.8 ml hyperbaric bupivacaine in their spinal anaesthetics. Most participants, 153 (98.1%), use fentanyl as an additive for spinal anaesthesia with 3 (1.9%) selecting sufentanil and 4 (2.5%) not selecting any additive. While no respondents selected morphine as a first line additive, 3 (1.9%) participants did submit a response with a morphine dose of 100 µg. The dose of 0.2 ml fentanyl was selected by 128 (80.0%) participants. Senior anaesthetists selected a fentanyl dose that was not 0.2 ml (p= 0.007) with 14 (8.8%) participants selecting a value 0.3 – 0.5 ml.

The desired sensory level for obstetric spinal anaesthesia was T4 – 7 for 113 (70.6%) participants, a level of T8 – 10 was selected by 39 (24.4%) participants and 7 (4.4%) participants selected a level above T4. A significant difference (p= 0.041) was found in the desired sensory level for surgery between senior and junior anaesthetists; with senior anaesthetists preferring a T4 – 7 level compared with junior anaesthetists who preferred a T8 – 10 level. Figure 2 shows the preferred method to check the sensory level following administration of spinal anaesthesia.

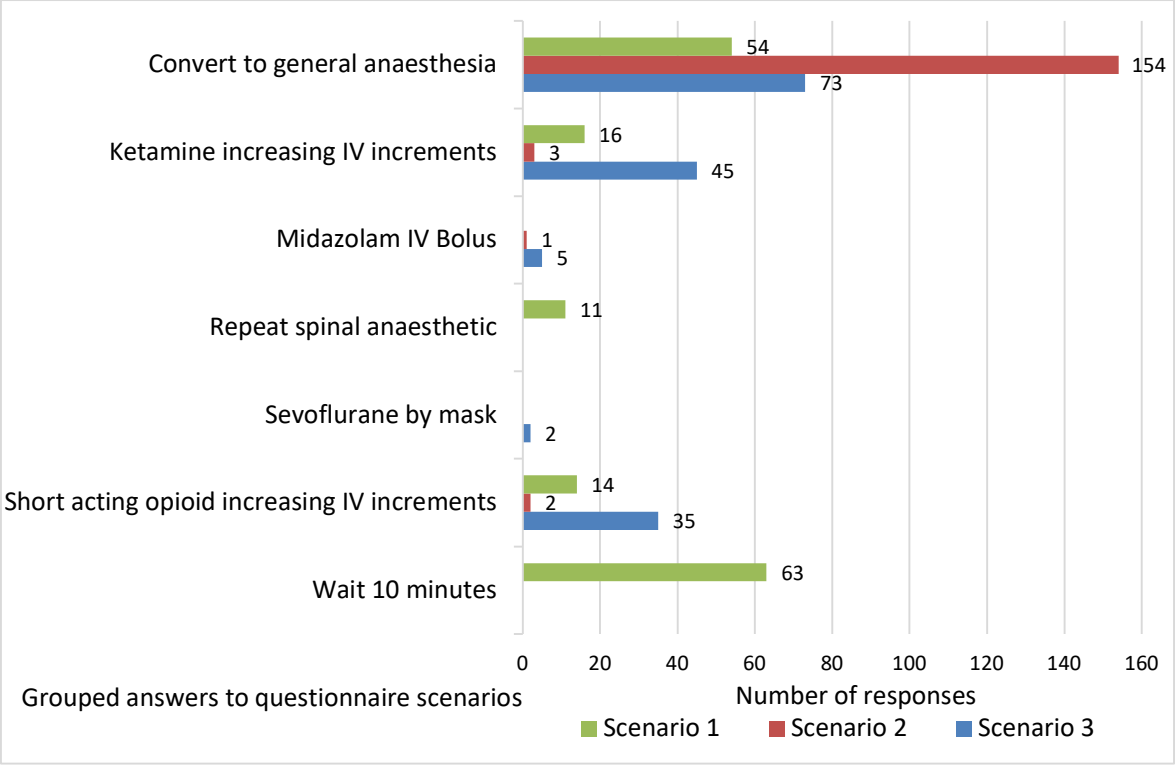
Figure 2: Preferred method to check sensory level following spinal anaesthesia



A spinal anaesthetic was deemed to have failed after 1 – 10 minutes by 38 (23.8%) participants, 92 (57.5%) participants after 11 – 20 minutes, 27 (16.9%) participants after 21 – 30 minutes and 3 (1.9%) participants after more than 30 minutes.

Three clinical scenarios were provided with a variety of management options. Participants could select only one answer they deemed most appropriate. Figure 3 shows a summary of participants' selected choices for each scenario with different choices available for each scenario. The first clinical scenario required participants to select an intervention for a patient currently in theatre for an elective CD who, 20 minutes after spinal anaesthesia administration, had loss of cold sensation to T6 level but was able to lift one leg prior to skin incision. In the second scenario, an elective CD patient had received spinal anaesthesia 15 minutes prior and now experienced significant pain on skin incision. In the third scenario an emergency CD patient had received spinal anaesthesia 10 minutes prior and experienced pain on incision of uterus.

Figure 3: Summary of participant selected answers in each clinical scenario



Discussion

In the Wits Department of Anaesthesiology, anaesthetists follow the ESMOE guidelines[10] for CD under spinal anaesthesia. However, there were some deviations from the ESMOE guidelines when comparing senior to junior anaesthetists' practices but these were all within acceptable practices found in the literature.

Junior anaesthetists performed significantly more obstetric anaesthetics compared to senior anaesthetists which is in keeping with the findings of Farina et al.[4] With the introduction of ESMOE training in the anaesthetic department at Chris Hani Baragwanath Academic Hospital in 2017, it was not unexpected to see a significant difference between junior and senior anaesthetists who had received ESMOE training.

The ESMOE guidelines[10] specify the use of any clear fluid for pre-load and a crystalloid as a co-load. Our study showed that participants did not have a clear preference regarding fluid choice during spinal anaesthesia and more training around fluid choices may be beneficial. Mercier et al.[23] found, in 2014, that a combination of crystalloid and colloid (specifically 6% hydroxyethyl starch) showed a significant reduction in hypotension and the use of vasopressors. However, no combination of fluid therapy can prevent the need for vasopressors when hypotension does occur.[24] While evidence suggests giving both crystalloid and colloids as both pre-load and co-load fluids, the ESMOE guidelines[10] advocate for crystalloids.

A critical component of safe spinal anaesthesia is the monitoring of patients. The ESMOE guidelines[10] highlight the use of patient monitoring and specify the use of ECG, NIBP and pulse oximetry and the timing of NIBP monitoring. Adherence to these guidelines was very good in the department with 93.8% using all three monitoring forms and 63.1% changing the monitoring interval 5 – 10 minutes after delivery of the foetus. Most anaesthetists cycle NIBP every minute with 30.6% of the department not changing the NIBP interval following delivery, which may result in unnecessary discomfort for the patient.

The left lateral displacement of the uterus is required to reduce the risk of intra-operative hypotension and ensure a high standard of anaesthetic care.[4, 10] Only 11.9% of participants indicated they would use an obstetric wedge compared to 75.6% who would use a table tilt. This difference may be due to teaching the use of the wedge in obstetrics in the 1970's.[25] A comparison by Hartley et al.[26] in 2001 showed almost no difference in hypotension when comparing a wedge and lateral tilt. In 2017 Farber et al.[27] showed that a higher dose of a phenylephrine infusion was needed in supine patients compared to those with a wedge or tilt. While the ESMOE guidelines specify the use of a wedge, any left lateral displacement of the uterus is beneficial in reducing hypotension.[27]

Spinal anaesthesia carries a risk of epidural haematoma formation which may result in permanent neurological damage.[15] The debate of a safe minimum platelet count to perform a spinal anaesthetic is ongoing. Goodier et al.[15] in 2015, advocate a platelet count of 100 x $10^{\wedge 9}$/l, while in 2021 the Society of Obstetric Anaesthesia and Perinatology (SOAP)[16] suggests a count of 70 x $10^{\wedge 9}$/l. It is important to note that in the consensus statement by SOAP, there are documented cases of epidural haematoma formation with a platelet count of 1 – 91 x $10^{\wedge 9}$/l and cases were more likely to occur with a lower platelet count.[16] In the Wits Department of Anaesthesiology, senior anaesthetists were significantly more likely to accept a lower platelet count.

The choice of agent and volume used in spinal anaesthesia may vary depending on institutional guidelines. The ESMOE guidelines[10] state that hyperbaric bupivacaine 9 mg (1.8 ml) should be used with fentanyl 10 µg (0.2 ml) for a total volume of 2.0 ml. Alternatively, Mercier et al.[23] in the CAESAR trial described a spinal anaesthetic mixture containing hyperbaric bupivacaine 11 mg, sufentanil 3 µg, and morphine 100 µg. While 65.6% of the Wits Department of Anaesthesiology used the ESMOE[10] recommended dosage, a significant difference was found between senior and junior anaesthetists where seniors favoured higher volumes for both bupivacaine and fentanyl. The doses and volumes used by senior anaesthetists in the Wits Department of Anaesthesiology are within described international practices,[18, 23] however, the reasoning behind this clinical decision would require further investigation.

Assessment of efficacy and level of spinal anaesthetic prior to commencement of surgery is a standard of patient care in all cases. Spinal failure rates for CD range between 0.5% and 6%[8] but in a study by Alabi et al.[9], in the Eastern Cape, a higher rate of 11.7% was found. Using an ice brick provides a safe and reliable method to assess level of spinal anaesthesia where a level of T4 – T6[9] is desirable. While the ESMOE guidelines[10] require monitoring of the level of spinal anaesthetic, there is no specified method of assessment. Our study showed 53.1% of participants would use an ice brick to check the level of the spinal while 35.0% would ask the surgeon to pinch the patient prior to surgery. Jones et al[19] provided no standard approach to testing the level of the spinal.

Managing an ineffective spinal anaesthetic during CD may be challenging. In the first clinical scenario where an elective CD patient has loss of cold sensation to T6 level after 20 minutes but lifting one leg, participants indicated that most would wait an additional 10 minutes, convert to GA immediately and some participants would repeat the spinal anaesthetic. The ESMOE guidelines[10] recommend that if a partial spinal is evident then clinicians should consider conversion to GA, local anaesthesia/ketamine supplementation or delay surgery for later. If there is no effect after 20 minutes the spinal should be repeated. There is limited benefit to waiting an additional 10 minutes as most spinal anaesthetics will be effective after 15 – 20 minutes.[19] Conversion to GA is a valid option as elective theatres for obstetrics are in high demand and a patient may be delayed for several days or even become an emergency CD if the surgery is postponed. Repeating the spinal anaesthetic may be considered dangerous as there is some effect present, and the risk of a high spinal would be increased.[7] In the 2017 study by Jones et al.[19] a similar scenario favoured changing position, repeating the spinal anaesthetic with a partial dose spinal mixture or converting to GA.

In the second scenario where an elective CD patient received a spinal anaesthetic 15 minutes prior and feels pain on skin incision, 96.3% of participants indicated they would convert to GA. Jones et al.[19] in a 2017 study of government hospitals in KwaZulu-Natal, also found that conversion to GA was the most common choice for this scenario but had a much lower percentage opting for this choice. It is possible that conversion to GA was more readily chosen as the Wits Department of Anaesthesiology is an academic training institution with exposure to more complex cases where conversion to GA may occur more often.

The third scenario, where an emergency CD patient experienced pain on incision of the uterus, 45.6% of participants would convert to GA followed by 28.1% of participants administering intravenous ketamine in bolus increments. Jones et al.[19] found a preference for giving ketamine over conversion to GA. While both choices are valid options and suggested by the ESMOE guidelines,[10] it would be difficult to make a statement favouring one choice over the other.

Conclusion

There are clear trends in the current practices of anaesthesia for CD in the Wits Department of Anaesthesiology which predominantly follow the guidelines set out by ESMOE. Significant differences in anaesthetic practices were found between senior and junior anaesthetists in dosage of spinal anaesthetic and considered safe platelet level but were within international practice standards. The ESMOE guidelines are conservative in their approach which may be safer for junior practitioners who are developing skills. The development of a standard practice guideline within the department, incorporating ESMOE guidelines and current literature practices, would be beneficial. These results are limited to the specific site and not generalisable. Further similar studies at other sites would be beneficial to gauge national practice.

Declaration

This research report was done in partial fulfilment of the requirements for the first author's Master of Medicine degree at the University of the Witwatersrand.

Acknowledgements

We thank Dr Gavin Jones and Dr Annette Theron for allowing us to use and modify their questionnaires. We thank Mr Asanda Sibanda for his assistance with statistical analysis.

Author contributions

Protocol development: BW, MF and MS; data collection: BW, Data analysis: BW; interpretation of results: BW, MF and MS; manuscript preparation: BW; manuscript review: BW, MF and MS.

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Conflicts of interest

No conflicts of interest.

References

1. National Committee on Confidential Enquiries into Maternal Deaths. Saving Mothers 2017-2019: Seventh triennial report on confidential enquiries into maternal deaths in South Africa. 2021.

2. Gebhardt G, Fawcus S, Moodley J, Farina Z. Maternal death and caesarean section in South Africa: results from the 2011-2013 Saving Mothers report of the National Committee for Confidential Enquiries into Maternal Deaths. S Afr Med J. 2015;105(4):287-91. DOI: 10.7196/SAMJ.9351.

3. National Committee on Confidential Enquiries into Maternal Deaths. Saving Mothers 2014-2016: Seventh triennial report on confidential enquiries into maternal deaths in South Africa: Executive summary. Pretoria, National Department of Health.: 2018. Available from: https://www.sasog.co.za/Content/Docs/Saving_Mothers.pdf. [Accessed:25 Oct 2019].

4. Farina Z, Rout C. 'But it's just a spinal': Combating increasing rates of maternal death related to spinal anaesthesia. S Afr Med J. 2013;103(2):81-2. DOI: 10.7196/SAMJ.6308.

5. Jadon A. Complications of regional and general anaesthesia in obstetric practice. Indian J Anaesth. 2010;54(5):415. DOI: 10.4103/0019-5049.71039.

6. Littleford J. Effects on the fetus and newborn of maternal analgesia and anesthesia: a review. Can J Anaesth. 2004;51(6):586-609. DOI: 10.1007/BF03018403.

7. Newman B. Complete spinal block following spinal anaesthesia: World Federation of Societies of Anesthesiologists; 2010. Available from: https://resources.wfsahq.org/atotw/complete-spinal-block-following-spinal-anaesthesia/. [Accessed:1 Nov 2019].

8. Rukewe A, Adebayo O, Fatiregun A. Failed obstetric spinal anesthesia in a Nigerian teaching hospital: Incidence and risk factors. Anesth Analg. 2015;121(5):1301-5. DOI: 10.1213/ane.0000000000000868.

9. Alabi A, Adeniyi OV, Adeleke OA, Pillay P, Haffajee MR. Factors associated with failed spinal anaesthesia for Caesarean sections in Mthatha general hospital, Eastern Cape, South Africa. S Afr Fam Pract. 2017;59(4):128-32. DOI: 10.1080/20786190.2017.1292696.

10. Essential Steps in the Management of Obstetric Emergencies Anaesthesia Working Group. National ESMOE guidelines for district and regional hospitals protocol for caesarean section under spinal anaesthesia.: 2011. Available from: http://www.kznhealth.gov.za/family/protocol_caesarean_section_under_spinal_anaesthesia.pdf. [Accessed:15 Oct 2019].

11. Essential Steps in the Management of Obstetric Emergencies Anaesthesia Working Group. National ESMOE guidelines for district and regional hospitals protocol for caesarean section under general anaesthesia.: 2011. Available from: http://www.kznhealth.gov.za/family/Protocol_caesarean_section_under_general_anaesthesia.pdf. [Accessed:15 Oct 2019].

12. Bishop D, Rodseth RN, Dyer RA. Recipes for obstetric spinal hypotension: The clinical context counts. S Afr Med J. 2016;106(9):861-4. DOI: 10.7196/SAMJ.2016.v106i9.10877AJOL.

13. Mercier FJ. Preloading prior to spinal anaesthesia for Caesarean delivery. Br J Anaesth. 2015;115(2):327. DOI: 10.1093/bja/aev249.

14. Ngan Kee WD, Lee A, Khaw KS, Ng FF, Karmakar MK, Gin T. A randomized double-blinded comparison of phenylephrine and ephedrine infusion combinations to maintain blood pressure during spinal anesthesia for cesarean delivery: the effects on fetal acid-base status and hemodynamic control. Anesth Analg. 2008;107(4):1295-302. DOI: 10.1213/ane.0b013e31818065bc.

15. Goodier C, Lu JT, Hebbar L, Segal BS, Goetzl L. Neuraxial anesthesia in parturients with thrombocytopenia: a multisite retrospective cohort study. Anesth Analg. 2015;121(4):988-91. DOI: 10.1213/ane.0000000000000882.

16. Bauer ME, Arendt K, Beilin Y, Gernsheimer T, Perez Botero J, James AH, et al. The Society for Obstetric Anesthesia and Perinatology interdisciplinary consensus statement on neuraxial procedures in obstetric patients with thrombocytopenia. Anesth Analg. 2021;132(6):1531-44. DOI: 10.1213/ANE.0000000000005355.

17. D'Angelo R, Smiley RM, Riley ET, Segal S. Serious complications related to obstetric anesthesia: The Serious Complication Repository Project of the Society for Obstetric Anesthesia and Perinatology. Anesthesiology. 2014;120(6):1505-12. DOI: aln.0000000000000253.

18. Dyer RA, Rout CC, Kruger AM, van der Vyver M, Lamacraft G, James MF. Prevention and treatment of cardiovascular instability during spinal anaesthesia for caesarean section. S Afr Med J. 2004;94(5):367-72. DOI: 10.10520/EJC65767.

19. Jones G, Samuel R, Biccard B. Management of failed spinal anaesthesia for caesarean section. S Afr Med J. 2017;107(7):611-4. DOI: 10.7196/SAMJ.2017.v107i7.12056.

20. Chetty S. The anaesthetic management of patients undergoing caesarean section surgery and its impact on post-operative analgesia [dissertation on the Internet]: University of the Witwatersrand; 2017. Available from: https://pdfs.semanticscholar.org/e231/8bbf4ae0935564270f072a9c533d6d2ae303.pdf. [Accessed:5 Feb 2020].

21. Draugalis J, Coons SJ, Plaza CM. Best practices for survey research reports: a synopsis for authors and reviewers. Am J Pharm Educ. 2008;72(1):11. DOI: 10.5688/aj720111.

22. Theron A, Rout C. "Safe anaesthesia" for the South African rural obstetric patient in KwaZulu-Natal. South Afr J Anaesth Analg. 2014;20(6):233-7. DOI: 10.1080/22201181.2014.983717.

23. Mercier FJ, Diemunsch P, Ducloy-Bouthors AS, Mignon A, Fischler M, Malinovsky JM, et al. 6% Hydroxyethyl starch (130/0.4) vs Ringer's lactate preloading before spinal anaesthesia for Caesarean delivery: the randomized, double-blind, multicentre CAESAR trial.

Br J Anaesth. 2014;113(3):459-67. DOI: 10.1093/bja/aeu103.

24. Loubert C. Fluid and vasopressor management for Cesarean delivery under spinal anesthesia: continuing professional development. Can J Anaesth. 2012;59(6):604-19. DOI: 10.1007/s12630-012-9705-9.

25. Crawford JS, Marilyn B, Davies P. Time and lateral tilt at Caesarean section. Br J Anaesth. 1972;44(5):477-84. DOI: 10.1093/bja/44.5.477.

26. Hartley H, Seed PT, Ashworth H, Kubli M, O'Sullivan G, Reynolds F. Effect of lateral versus supine wedged position on development of spinal blockade and hypotension. Int J Obstet Anesth. 2001;10(3):182-8. DOI: 10.1054/ijoa.2001.0853.

27. Farber MK, Bateman BT. Phenylephrine infusion: Driving a wedge in our practice of left uterine displacement? Anesthesiology. 2017;127(2):212-4. DOI: 10.1097/ALN.0000000000001738.

Appendices

Appendix 1: Author guidelines for Southern African Journal of Anaesthesia and Analgesia

Author Guidelines

Submitted manuscripts that are not in the correct format and without the required supporting documentation specified in these guidelines will be returned to the author(s) for correction and will delay publication.

Authorship

Named authors must consent to publication by signing a covering letter which should be submitted as a supplementary file. Authorship should be based on substantial contribution to:
(i) conception, design, analysis and interpretation of data;
(ii) drafting or critical revision for important intellectual content; and
(iii) approval of the version to be published. These conditions must all be met (uniform requirements for manuscripts submitted to biomedical journals; refer to www.icmje.org); and
(iv) exact contribution of each author must be stated.

Declaration of conflict of interest

Authors must declare all sources of support for the research and any association with a product or subject that may constitute a conflict of interest. If there is no conflict of interest to declare please include the following statement: The authors declare no conflict of interest.

Funding source

All sources of funding should be declared. Also define the involvement of study sponsors in the study design, collection, analysis and interpretation of data; the writing of the manuscript; the decision to submit the manuscript for publication. If the study sponsors had no such involvement, this should be stated as follows: No funding source to be declared.

Research ethics committee approval

The submitting author must provide written confirmation of Research Ethics Committee approval for all studies including case reports. The ethics committee as well as the approval number should be included.

Statistical analysis

Authors are advised to involve medical statisticians at the protocol stage of their research project: to plan sample size, and the selection of appropriate statistical tests for analysis and presentation.

Protection of patient's rights to privacy

Identifying information should not be published in written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes and the patient (or parent or guardian) gives informed written consent for publication. The patient should be shown the manuscript to be published. Refer to www.icmje.org.

Ethnic classification

The rationale for analysis based on racio-ethnic-cultural categorisation should be indicated.

Categories of submissions

Shorter items are more likely to be accepted for publication, owing to space constraints and reader preferences.

Original articles

Original articles on research relevant to anaesthesia and analgesia should not exceed 3 200 words, no more than 30 references, with up to 6 tables or figures. A structured abstract under the following headings, Background, Methods, Results, and Conclusions is a requirement and should not exceed 300 words.

Clinical review articles

Review articles relevant to anaesthesia and analgesia should not exceed 2 400 words, with a maximum of 20 references and no more than 6 tables or figures. A summary of 300 words or less is required.

Case reports

Case reports should not exceed 1 800 words with no more than 10 references. Figures are limited to 2 figures and may include images or photographs. The case report should have three headings: Summary (not exceeding 100 words), Case report (with no introduction) and Discussion. Case reports will be published online only. The summary and the URL will appear in the printed version.

Scientific letters

Scientific Letters should not exceed 2 400 words with a maximum of 10 references. Only one table or illustration is permissible. A structured abstract under the following headings, Background, Methods, Results, and Conclusions, is a requirement and should not exceed 250 words.

Letters to the editor

Letters to the editor should be 800 words or less with only one image or table.

Manuscript preparation

Refer to articles in recent issues for the presentation of headings and subheadings. If in doubt, refer to 'uniform requirements' - www.icmje.org. Manuscripts must be provided in UK English.

Qualification, affiliation and contact details

This information must be provided for ALL authors and must be submitted as a supplementary file.

Email addresses of all author must be provided.
ORCID number of ALL authors must be provided - if authors do not have ORCID, please register at https://orcid.org/

Abbreviations

All abbreviations should be spelt out when first used and thereafter used consistently, e.g. 'intravenous (IV)' or 'Department of Health (DoH)'.

Scientific measurements

Scientific measurements must be expressed in SI units except blood pressure (mmHg) and haemoglobin (g/dl). Litres is denoted with a lowercase 'l' e.g. 'ml' for millilitres). Units should be preceded by a space (except for %), e.g. '40 kg' and '20 cm' but '50%'. Greater/smaller than signs (> and 40 years of age) should also be preceded by a space e.g. > 20 years. No spaces should precede ± and °, i.e. '35±6' and '19°C'.

Numbers should be written as grouped per thousand-units, i.e. 4 000, 22 160...

Quotes should be placed in single quotation marks: i.e. The respondent stated: '...'

Round brackets (parentheses) should be used, as opposed to square brackets, which are reserved for denoting concentrations or insertions in direct quotes.

General formatting

The manuscript must be in Microsoft Word or RTF document format. Text must be 1,5-spaced, in 12-point Times New Roman font, and contain no unnecessary formatting (such as text in boxes, except for Tables). The manuscript must be free of track changes.

Disclaimers should follow the Conclusion and it should be in the following order: Acknowledgements, Declaration conflict of interest, Funding source, Ethics declaration and ORCID.

Illustrations and tables

If tables or illustrations submitted have been published elsewhere, the author(s) should provide consent to republication obtained from the copyright holder.

Tables may be embedded in the manuscript file and provided as 'supplementary files'. They must be numbered in Arabic numerals (1,2,3...) and referred to consecutively in the text (e.g. 'Table 1'). Tables should be constructed carefully and simply for intelligible data representation. Unnecessarily complicated tables are strongly discouraged.

Tables must be cell-based (i.e. not constructed with text boxes, tabs or enters) and accompanied by a concise title and column headings. Footnotes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || then ** †† ‡‡ etc.

Figures must be numbered in Arabic numerals and referred to in the text e.g. '(Figure 1)'. Figure legends: Figure 1: 'Title...'. All illustrations/figures/graphs must be of high resolution/quality: 300 dpi or more is preferable, but images must not be resized to increase resolution. Unformatted and uncompressed images must be attached as 'supplementary files' upon submission (not embedded in the accompanying manuscript). TIFF and PNG formats are preferable; JPEG and PDF formats are accepted, but authors must be wary of image compression. Illustrations and graphs prepared in Microsoft PowerPoint or Excel must be accompanied by the original workbook.

References

Authors must verify references from the original sources. Only complete, correctly formatted reference lists will be accepted. Reference lists may be generated with the use of reference manager software, but the final document must be delinked from the reference database or otherwise generated manually. Citations should be inserted in the text as superscript, e.g. These regulations are endorsed by the World Health Organization,[2] and others.[3,4-6] The superscript reference number should come after the punctuation mark and should not be in brackets.

All references should be listed at the end of the article in numerical order of appearance in the Vancouver style (not alphabetical order). Approved abbreviations of journal titles must be used; see the List of Journals in Index Medicus. Names and initials of all authors should be given; if there are more than six authors, the first four names should be given followed by et al. First and last page, volume and issue numbers should be given. Wherever possible, references must be accompanied by a digital object identifier (DOI) link and PubMed ID (PMID)/PubMed Central ID (PMCID). Authors are encouraged to use the DOI lookup service offered by Crossref. Crossref DOIs should always be displayed as a full URL link in the form https://doi.org/10.xxxx/xxxxx

Journal references:

Jun BC, Song SW, Park CS, Lee DH. The analysis of maxillary sinus aeration according to aging process: volume assessment by 3-dimensional reconstruction by high-resolutional CT scanning. Otolaryngol Head Neck Surg. 2005 Mar;132(3):429-34.

Polgreen PM, Diekema DJ, Vandeberg J, Wiblin RT, et al. Risk factors for groin wound infection after femoral artery catheterization: a case-control study. Infect Control Hosp Epidemiol [Internet]. 2006 Jan [cited 2007 Jan 5];27(1):34-7. Available from: http://www.journals.uchicago.edu/ICHE/journal/issues/v27n1/2004069/2004069.web.pdf.

Book references: Jeffcoate N. Principles of Gynaecology. 4th ed. London: Butterworth, 1975:96-101. *Chapter/section in a book:* Weinstein L, Swartz MN. Pathogenic Properties of Invading Microorganisms. In: Sodeman WA jun, Sodeman WA, eds. Pathologic Physiology: Mechanisms of Disease. Philadelphia: WB Saunders, 1974:457-472.
Internet references: World Health Organization. The World Health Report 2002 - Reducing Risks, Promoting Healthy Life. Geneva: World Health Organization, 2002. http://www.who.int/whr/2002 (accessed 16 January 2010).

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Appendix 2: Literature review

This literature review will cover spinal anaesthesia, South African Essential Steps in the Management of Obstetric Emergencies, general anaesthesia in caesarean delivery, fluid management, safe platelets counts for administration, spinal anaesthesia medications and dosages, assessment of spinal anaesthesia level and local and international practices.

Introduction

In 1985 the World Health Organization (WHO) first described a caesarean delivery rate of 10 − 15% as being ideal for any region (1). South Africa has an average caesarean delivery rate double this at 23.1% according to the Saving Mothers report from 2011 − 2013 (2) and 5.7% from the Saving Mothers report 2014 − 2016 (3). According to unpublished statistics resented at Departmental meetings, Chris Hani Baragwanath Academic Hospital (CHBAH) performs more than 700 caesarean deliveries per month and has a caesarean delivery rate of 40 − 50%, Rahima Moosa Mother and Child Hospital (RMMCH) performs an average of 340 caesarean deliveries per month with a caesarean delivery rate of approximately 35 − 38%, and Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) performs an average of 350 caesarean deliveries per month with a caesarean delivery rate of approximately 45 – 55%. With the increasing number of caesarean deliveries being performed, predominantly under spinal anaesthesia, there is an increasing risk of complications related to spinal anaesthesia (4).

Spinal anaesthesia

Spinal anaesthesia for obstetrics is perceived as a safe anaesthetic choice and is administered by junior staff at health facilities throughout South Africa (4). The perceived benefit is that a general anaesthetic is avoided in an obstetric patient with a higher risk of aspiration and difficult intubation (5). There is also a benefit to the foetus as it is not exposed to the harmful effects of general anaesthesia medications which may cross the placental barrier (6). However, general anaesthesia proficiency is required to convert a spinal anaesthetic to a general anaesthetic. Theron et al. (7) expressed a concern that increases in obstetric spinal anaesthesia numbers have resulted in poor obstetric general anaesthesia practice and this poses a risk to patients.

The complications of obstetric spinal anaesthesia are categorised into cardiovascular, neurological, drug-related and miscellaneous (8). Cardiovascular complications are mainly related to the chemical sympathectomy caused by the local anaesthetic agent and these may be exaggerated by pregnancy-related changes with the commonest complication being hypotension; but may also include cardiac arrest and bradycardia (5, 8).

Neurological complications include a postdural puncture headache, nerve injury, meningitis, backache, transient neurologic syndrome, and epidural abscess formation (9, 10). A rare complication is when a high (total) spinal occurs as a result of the local anaesthetic agent affecting the cervical spinal cord and brainstem (11). Urgent cardiorespiratory support is required. Miscellaneous complications may include local anaesthetic toxicity, nausea and vomiting, pruritus, anaphylaxis and shivering (8, 10).

South African Essential Steps in the Management of Obstetric Emergencies

The guidelines drafted by the South African Essential Steps in the Management of Obstetric Emergencies (ESMOE) (12) provide a framework for practitioners to follow with a focus on clinicians working in district and lower level facilities but are suited to higher level facilities. The ESMOE guidelines cover several aspects of obstetric spinal anaesthesia such as preparation of the patient, specific spinal technique, monitoring, post-delivery management, and the recovery period. However, there may be deviations in practice from the recommended methods to allow for patient variability and specific scenarios. According to the Department of Anaesthesiology the ESMOE guidelines have been implemented as mandatory training for interns since 2017 at CHBAH.

General anaesthesia

General anaesthesia in obstetric practice is a challenging skill because the physiological changes of pregnancy places patients at increased risk of aspiration and difficult intubation (13). The ESMOE guidelines (14) provide an outline for providers to administer a general anaesthetic by guiding anaesthetists' assessment of airway difficulties prior to intubation, directing anaesthetists on how to check for signs of hypovolemia, premedicate the patient, and intubate the patient. Algert et al. (15) showed there was an increased risk to the neonate following general anaesthesia with the highest risk of complications occurring in those presenting for emergency caesarean delivery for foetal distress. Additionally, Chang et al. (16) found that the use of general anaesthesia for caesarean delivery has an eight-fold increase in the risk of postpartum haemorrhage.

Fluid management

Fluid administration for an obstetric spinal anaesthetic has been an ongoing debate. The proposed aim is to limit the degree of hypotension that occurs following administration of a spinal anaesthetic by administration of crystalloids or colloids or both. A patient may receive fluids prior to the administration of spinal anaesthesia (pre-loading) or immediately after administration of a spinal anaesthetic (co-loading), or a combination may be given (17, 18). Mercier et al. (19) conducted the CAESAR trial in 2014 and found that giving 500 ml of colloid fluid and 500 ml of crystalloid fluid was superior to giving only 1000 ml of crystalloid. An older study in 2004 by Dyer et al. (20) compared crystalloid preload versus crystalloid co-loading and found that there was a reduction in ephedrine requirements when co-loading was the fluid management of choice.

No combination of fluid therapy can prevent the need for vasopressors when hypotension occurs (17). Phenylephrine is the first line vasopressor in obstetric spinal anaesthesia and aggressive management of hypotension is recommended by ESMOE (12). The use of ephedrine is limited to hypotension associated with a bradycardia as evidence has shown that ephedrine causes acidosis in the foetus (21).

Safe platelet count

The platelet count at which administration of a spinal anaesthetic may be given is debateable. The risk is that a patient may develop a spinal haematoma resulting in permanent neurological damage (22). D'Angelo et al. (23) reported an incidence of a spinal haematoma of 1 in 251 463. The recommendation is that a spinal anaesthetic is safe to administer if the patient's platelet count is greater than 100 x 109/l (22). Some studies support administering a spinal anaesthetic to patients with a platelet level of 75 x 109/l (24, 25).

Spinal anaesthesia medications and dosages

The agents and dosage used in spinal anaesthesia may vary. The ESMOE guidelines (12) state that hyperbaric bupivacaine should be used with fentanyl in a mixture of 10 μg (0.2 ml) and 9 mg bupivacaine (1.8 ml) for a total volume of 2.0 ml. Alternatively, Mercier et al. (19) in the CAESAR trial described a spinal anaesthetic mixture containing hyperbaric bupivacaine 11 mg, sufentanil 3 μg, and morphine 100 μg.

Sng et al. (26) compared isobaric bupivacaine to hyperbaric bupivacaine and found no difference in risk of converting to general anaesthesia. The adjuvant choices include the short acting opioids sufentanil or fentanyl or the long acting morphine which provides analgesia for 18 − 24 hours (27).

Assessment of spinal anaesthesia sensory level

The level of sensory block is variable among patients due to the physiological changes of pregnancy. A smaller volume of local anaesthetic should be used to mitigate the risk of a spinal level above the desired maximum level of T4 (26). There is the possibility of a spinal anaesthetic being ineffective either partially or completely (28). Spinal anaesthesia for caesarean delivery has a failure rate between 0.5% and 6% (29). Alabi et al. (30) found a failed spinal anaesthesia rate of 11.7% in the Eastern Cape. The management of a failed spinal anaesthetic requires prompt action. The ESMOE guidelines (12) recommend repeating the spinal anaesthetic injection if no effects are seen after 20 minutes. If a partial block is present the recommendation is to convert to general anaesthesia or administer ketamine and local anaesthetic agents as required (28).

Local and international practices

In 2014 a doctoral thesis study by S Chetty (31) looked at the anaesthetic management of patients undergoing caesarean delivery and its impact on post-operative pain management. The study included a national survey of anaesthetic practices for caesarean delivery in both the public and private sectors and included a morphine spinal intervention study. There was a focus on the post-operative pain management of patients following caesarean delivery. The study concluded that spinal anaesthesia was the preferred method of analgesia for caesarean delivery and standards of care were similar to international standards at the time. The addition of intrathecal morphine improved patient pain scores. There were some differences in dosages of drugs used in spinal anaesthesia when comparing senior and junior practitioners. This study will focus on the use of ESMOE practice guidelines during the intra-operative management of patients for caesarean delivery and compare them across levels of anaesthesia training. ESMOE training for internship medical doctors in the Department of Anaesthesiology was implemented in 2017 and despite this, guidelines for ESMOE are still not readily available in theatres.

A survey by Shatalin et al. (32) looked at anaesthesia practices in Israel and found that general anaesthesia was performed in 10% of caesarean deliveries with an increase in the use of neuraxial techniques as well as an increase in the use of intrathecal morphine during the previous 10 years. Oji-Zurmeyer et al. (33) conducted a survey in Austria and noted that all centres offered a neuraxial anaesthesia service, some centres made use of ultrasound guidance for neuraxial analgesia and 94% of centres had lipid rescue solutions available. Both studies showed spinal anaesthesia related hypotension is treated with boluses of phenylephrine. Neither study mentions specific methods relating to administration of spinal or general anaesthesia practices for caesarean delivery.

Practice guidelines provide a safe framework for clinicians to follow as well as allowing for variability between patients. Obstetric anaesthesia is a challenging and evolving field which requires practice and skill to master the various techniques. With an increasing number of caesarean deliveries performed annually by junior practitioners, greater focus is required on the guidelines for obstetric anaesthesia. The doctoral thesis by S Chetty is the only study which briefly looks at practices for caesarean delivery. No other study specifically assessing anaesthetic practices at the University of the Witwatersrand (Wits) could be found.

References

1. Betrán AP, Torloni MR, Zhang JJ, Gülmezoglu AM, Aleem HA, Althabe F, et al. WHO statement on caesarean section rates. BJOG. 2016;123(5):667-70. DOI: 10.1111/1471-0528.13526.

2. Gebhardt G, Fawcus S, Moodley J, Farina Z. Maternal death and caesarean section in South Africa: results from the 2011-2013 Saving Mothers report of the National Committee for Confidential Enquiries into Maternal Deaths. S Afr Med J. 2015;105(4):287-91. DOI: 10.7196/SAMJ.9351.

3. National Committee on Confidential Enquiries into Maternal Deaths. Saving Mothers 2014- 2016: Seventh triennial report on confidential enquiries into maternal deaths in South Africa: Executive summary. Pretoria, National Department of Health.: 2018. Available from: https://www.sasog.co.za/Content/Docs/Saving_Mothers.pdf. [Accessed:25 Oct 2019].

4. Farina Z, Rout C. 'But it's just a spinal': Combating increasing rates of maternal death related to spinal anaesthesia. S Afr Med J. 2013;103(2):81-2. DOI: 10.7196/SAMJ.6308.

5. Jadon A. Complications of regional and general anaesthesia in obstetric practice. Indian J Anaesth. 2010;54(5):415. DOI: 10.4103/0019-5049.71039.

6. Littleford J. Effects on the fetus and newborn of maternal analgesia and anesthesia: a review. Can J Anaesth. 2004;51(6):586-609. DOI: 10.1007/BF03018403.

7. Theron A, Rout C. "Safe anaesthesia" for the South African rural obstetric patient in KwaZulu-Natal. South Afr J Anaesth Analg. 2014;20(6):233-7. DOI:10.1080/22201181.2014.983717.

8. Huda A, Abir, G, Brown, J. Complications Post–Neuraxial Anaesthesia in Obstetric Patients: World Federation of Societies of Anesthesiologists; 2019. Available from: https://www.researchgate.net/publication/330292942_Complications_PostNeuraxial_Anaesthesia_in_Obstetric_Patients. [Accessed:1 Nov 2019].

9. Gaiser R. Postdural puncture headache: a headache for the patient and a headache for the anesthesiologist. Curr Opin Anaesthesiol. 2013;26(3):296-303. DOI: 10.1097/ACO.0b013e328360b015.

10. Duncan A, Patel S. Neurological complications in obstetric regional anesthetic practice. J Obstet Anaesth Crit Care. 2016;6(1):3-10. DOI: 10.4103/2249-4472.181055.

11. Newman B. Complete spinal block following spinal anaesthesia: World Federation of Societies of Anesthesiologists; 2010. Available from: https://resources.wfsahq.org/atotw/complete-spinal-block-following-spinal-anaesthesia/. [Accessed:1 Nov 2019].

12. Essential Steps in the Management of Obstetric Emergencies Anaesthesia Working Group. National ESMOE guidelines for district and regional hospitals protocol for caesarean section under spinal anaesthesia.: 2011. Available from: http://www.kznhealth.gov.za/family/protocol_caesarean_section_under_spinal_anaesthesia.pdf. [Accessed:15 Oct 2019].

13. Munnur U, de Boisblanc B, Suresh M. Airway problems in pregnancy. Critical Care Med 2005;33(10):S259-S68. DOI: 10.1097/01.ccm.0000183502.45419.c9.

14. Essential Steps in the Management of Obstetric Emergencies Anaesthesia Working Group. National ESMOE guidelines for district and regional hospitals protocol for caesarean section under general anaesthesia.: 2011. Available from: http://www.kznhealth.gov.za/family/Protocol_caesarean_section_under_general_anaesthesia.pdf. [Accessed:15 Oct 2019].

15. Algert C, Bowen JR, Giles WB, Knoblanche GE, Lain SJ, Roberts CL. Regional block versus general anaesthesia for caesarean section and neonatal outcomes: a population-based study. BMC Med 2009;7(1):20. DOI: 10.1186/1741-7015-7-20.

16. Chang C, Wang IT, Chen YH, Lin HC. Anesthetic management as a risk factor for postpartum hemorrhage after cesarean deliveries. AJOG. 2011;205(5):462. e1-. e7. DOI: 10.1016/j.ajog.2011.06.068.

17. Loubert C. Fluid and vasopressor management for Cesarean delivery under spinal anesthesia: continuing professional development. Can J Anaesth. 2012;59(6):604-19. DOI: 10.1007/s12630-012-9705-9.

18. Bishop D, Rodseth RN, Dyer RA. Recipes for obstetric spinal hypotension: The clinical context counts. S Afr Med J. 2016;106(9):861-4. DOI:10.7196/SAMJ.2016.v106i9.10877AJOL.

19. Mercier FJ, Diemunsch P, Ducloy-Bouthors AS, Mignon A, Fischler M, Malinovsky JM, et al. 6% Hydroxyethyl starch (130/0.4) vs Ringer's lactate preloading before spinal anaesthesia for Caesarean delivery: the randomized, double-blind, multicentre CAESAR trial. Br J Anaesth. 2014;113(3):459-67. DOI: 10.1093/bja/aeu103.

20. Dyer RA, Farina Z, Joubert IA, Du Toit P, Meyer M, Torr G, et al. Crystalloid preload versus rapid crystalloid administration after induction of spinal anaesthesia (coload) for elective caesarean section. Anaesth Intens Care. 2004;32(3):351-7. DOI: 10.1177/0310057x0403200308.

21. Kee W, Khaw KS, Tan PE, Ng FF, Karmakar MK. Placental transfer and fetal metabolic effects of phenylephrine and ephedrine during spinal anesthesia for cesarean delivery. Anesthesiology. 2009;111(3):506-12. DOI: 10.1097/ALN.0b013e3181b160a3.

22. Goodier C, Lu JT, Hebbar L, Segal BS, Goetzl L. Neuraxial anesthesia in parturients with thrombocytopenia: a multisite retrospective cohort study. Anesth Analg. 2015;121(4):988-91. DOI: 10.1213/ane.0000000000000882.

23. D'Angelo R, Smiley RM, Riley ET, Segal S. Serious complications related to obstetric anesthesia: The Serious Complication Repository Project of the Society for Obstetric Anesthesia and Perinatology. Anesthesiology. 2014;120(6):1505-12. DOI: aln.0000000000000253.

24. Leffert L. What's new in obstetric anesthesia? Focus on preeclampsia. Int J Obstet Anesth.2015;24(3):264-71. DOI: 10.1016/j.ijoa.2015.03.008.

25. Dyer RA, Piercy JL, Reed AR, Lombard CJ, Schoeman LK, James MF. Hemodynamic changes associated with spinal anesthesia for cesarean delivery in severe preeclampsia. Anesthesiology. 2008;108(5):802-11. DOI: 10.1097/01.anes.0000311153.84687.c7.

26. Sng BL, Han NL, Leong WL, Sultana R, Siddiqui FJ, Assam PN, et al. Hyperbaric vs. isobaric bupivacaine for spinal anaesthesia for elective caesarean section: a Cochrane systematic review. Anaesthesia. 2018;73(4):499-511. DOI: 10.1111/anae.14084.

27. Gogarten W. Spinal anaesthesia for obstetrics. Best Pract Res Clin Anaesthesiol. 2003;17(3):377-92. DOI: 10.1016/s1521-6896(02)00116-7.

28. Jones G, Samuel R, Biccard B. Management of failed spinal anaesthesia for caesarean section. S Afr Med J. 2017;107(7):611-4. DOI: 10.7196/SAMJ.2017.v107i7.12056.

29. Rukewe A, Adebayo O, Fatiregun A. Failed obstetric spinal anesthesia in a Nigerian teaching hospital: Incidence and risk factors. Anesth Analg. 2015;121(5):1301-5. DOI: 10.1213/ane.0000000000000868.

30. Alabi A, Adeniyi OV, Adeleke OA, Pillay P, Haffajee MR. Factors associated with failed spinal anaesthesia for Caesarean sections in Mthatha general hospital, Eastern Cape, South Africa. S Afr Fam Pract. 2017;59(4):128-32. DOI: 10.1080/20786190.2017.1292696.

31. Chetty S. The anaesthetic management of patients undergoing caesarean section surgery and its impact on post-operative analgesia [dissertation on the Internet]: University of the Witwatersrand; 2017. Available from: https://pdfs.semanticscholar.org/e231/8bbf4ae0935564270f072a9c533d6d2ae303.pdf. [Accessed:5 Feb 2020].

32. Shatalin D, Weiniger CF, Buchman I, Ginosar Y, Orbach-Zinger S, Ioscovich A. A 10-year update: national survey questionnaire of obstetric anesthesia units in Israel. Int J Obstet Anesth. 2019;38:83-92. DOI: 10.1016/j.ijoa.2018.10.014.

33. Oji-Zurmeyer J, Ortner CM, Klein KU, Gries M, Kuhn C, Schroffenegger T, et al. National survey of obstetric anaesthesia clinical practices in the republic of Austria. Int J Obstet Anesth. 2019;39:95-8. DOI: 10.1016/j.ijoa.2019.02.002.

Appendix 3: Study proposal and annexures

A survey of current practice in anaesthesia for caesarean delivery in a Department of Anaesthesiology

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Introduction

In 1985 the World Health Organization (WHO) first described a caesarean delivery rate of 10 − 15% as being ideal for any region (1). South Africa has an average caesarean delivery rate double this at 23.1% according to the Saving Mothers report from 2011 − 2013 (2) and 25.7% from the Saving Mothers report 2014 − 2016 (3). According to unpublished statistics presented at Departmental meetings, Chris Hani Baragwanath Academic Hospital (CHBAH) performs more than 700 caesarean deliveries per month and has a caesarean delivery rate of 40 − 50%, Rahima Moosa Mother and Child Hospital (RMMCH) performs an average of 340 caesarean deliveries per month with a caesarean delivery rate of approximately 35 − 38%, and Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) performs an average of 350 caesarean deliveries per month with a caesarean delivery rate of approximately 45 – 55%. With the increasing number of caesarean deliveries being performed, predominantly under spinal anaesthesia, there is an increasing risk of complications related to spinal anaesthesia (4).

Spinal anaesthesia for obstetrics is perceived as a safe anaesthetic choice and is administered by junior staff at health facilities throughout South Africa (4). The perceived benefit is that a general anaesthetic is avoided in an obstetric patient with a higher risk of aspiration and difficult intubation (5). There is also a benefit to the foetus as it is not exposed to the harmful effects of general anaesthesia medications which may cross the placental barrier (6). However, general anaesthesia proficiency is required to convert a spinal anaesthetic to a general anaesthetic. Theron et al. (7) expressed a concern that increases in obstetric spinal anaesthesia numbers have resulted in poor obstetric general anaesthesia practice and this poses a risk to patients.

The complications of obstetric spinal anaesthesia are categorised into cardiovascular, neurological, drug-related and miscellaneous (8). Cardiovascular complications are mainly related to the chemical sympathectomy caused by the local anaesthetic agent and these may be exaggerated by pregnancy-related changes with the commonest complication being hypotension; but may also include cardiac arrest and bradycardia (5, 8).

Neurological complications include a post dural puncture headache, nerve injury, meningitis, backache, transient neurologic syndrome, and epidural abscess formation (9, 10). A rare complication is when a high (total) spinal occurs as a result of the local anaesthetic agent affecting the cervical spinal cord and brainstem (11). Urgent cardiorespiratory support is required. Miscellaneous complications may include local anaesthetic toxicity, nausea and vomiting, pruritus, anaphylaxis and shivering (8, 10).

The guidelines drafted by the South African Essential Steps in the Management of Obstetric Emergencies (ESMOE) (12) provide a framework for practitioners to follow with a focus on clinicians working in district and lower level facilities but are suited to higher level facilities. The ESMOE guidelines cover several aspects of obstetric spinal anaesthesia such as preparation of the patient, specific spinal technique, monitoring, post-delivery management, and the recovery period. However, there may be deviations in practice from the recommended methods to allow for patient variability and specific scenarios. According to the Department of Anaesthesiology the ESMOE guidelines have been implemented as mandatory training for interns since 2017 at CHBAH.

General anaesthesia in obstetric practice is a challenging skill because the physiological changes of pregnancy places patients at increased risk of aspiration and difficult intubation (13). The ESMOE guidelines (14) provide an outline for providers to administer a general anaesthetic by guiding anaesthetists' assessment of airway difficulties prior to intubation, directing anaesthetists on how to check for signs of hypovolemia, premedicate the patient, and intubate the patient. Algert et al. (15) showed there was an increased risk to the neonate following general anaesthesia with the highest risk of complications occurring in those presenting for emergency caesarean delivery for foetal distress. Additionally, Chang et al. (16) found that the use of general anaesthesia for caesarean delivery has an eight-fold increase in the risk of postpartum haemorrhage.

Fluid administration for an obstetric spinal anaesthetic has been an ongoing debate. The proposed aim is to limit the degree of hypotension that occurs following administration of a spinal anaesthetic by administration of crystalloids or colloids or both. A patient may receive fluids prior to the administration of spinal anaesthesia (pre-loading) or immediately after administration of a spinal anaesthetic (co-loading), or a combination may be given (17, 18). Mercier et al. (19) conducted the CAESAR trial in 2014 and found that giving 500 ml of colloid fluid and 500 ml of crystalloid fluid was superior to giving only 1000 ml of crystalloid. An older study in 2004 by Dyer et al. (20) compared crystalloid preload versus crystalloid co-loading and found that there was a reduction in ephedrine requirements when co-loading was the fluid management of choice.

No combination of fluid therapy can prevent the need for vasopressors when hypotension occurs (17). Phenylephrine is the first line vasopressor in obstetric spinal anaesthesia and aggressive management of hypotension is recommended by ESMOE (12). The use of ephedrine is limited to hypotension associated with a bradycardia as evidence has shown that ephedrine causes acidosis in the foetus (21).

The platelet count at which administration of a spinal anaesthetic may be given is debateable. The risk is that a patient may develop a spinal haematoma resulting in permanent neurological damage (22). D'Angelo et al. (23) reported an incidence of a spinal haematoma of 1 in 251 463. The recommendation is that a spinal anaesthetic is safe to administer if the patient's platelet count is greater than 100 x 10^9/l (22). Some studies support administering a spinal anaesthetic to patients with a platelet level of 75 x 10^9/l (24, 25).

The agents and dosage used in spinal anaesthesia may vary. The ESMOE guidelines (12) state that hyperbaric bupivacaine should be used with fentanyl in a mixture of 10 µg (0.2 ml) and 9 mg bupivacaine (1.8 ml) for a total volume of 2.0 ml. Alternatively, Mercier et al. (19) in the CAESAR trial described a spinal anaesthetic mixture containing hyperbaric bupivacaine 11 mg, sufentanil 3 µg, and morphine 100 µg.

Sng et al. (26) compared isobaric bupivacaine to hyperbaric bupivacaine and found no difference in risk of converting to general anaesthesia. The adjuvant choices include the short acting opioids sufentanil or fentanyl or the long acting morphine which provides analgesia for 18 − 24 hours (27).

The level of sensory block is variable among patients due to the physiological changes of pregnancy. A smaller volume of local anaesthetic should be used to mitigate the risk of a spinal level above the desired maximum level of T4 (26). There is the possibility of a spinal anaesthetic being ineffective either partially or completely (28). Spinal anaesthesia for caesarean delivery has a failure rate between 0.5% and 6% (29). Alabi et al. (30) found a failed spinal anaesthesia rate of 11.7% in the Eastern Cape. The management of a failed spinal anaesthetic requires prompt action. The ESMOE guidelines (12) recommend repeating the spinal anaesthetic injection if no effects are seen after 20 minutes. If a partial block is present the recommendation is to convert to general anaesthesia or administer ketamine and local anaesthetic agents as required (28).

In 2014 a doctoral thesis study by S Chetty (31) looked at the anaesthetic management of patients undergoing caesarean delivery and its impact on post-operative pain management. The study included a national survey of anaesthetic practices for caesarean delivery in both the public and private sectors and included a morphine spinal intervention study. There was a focus on the post-operative pain management of patients following caesarean delivery. The study concluded that spinal anaesthesia was the preferred method of analgesia for caesarean delivery and standards of care were similar to international standards at the time. The addition of intrathecal morphine improved patient pain scores. There were some differences in dosages of drugs used in spinal anaesthesia when comparing senior and junior practitioners. This study will focus on the use of ESMOE practice guidelines during the intra-operative management of patients for caesarean delivery and compare them across levels of anaesthesia training. ESMOE training for internship medical doctors in the Department of Anaesthesiology was implemented in 2017 and despite this, guidelines for ESMOE are still not readily available in theatres.

A survey by Shatalin et al. (32) looked at anaesthesia practices in Israel and found that general anaesthesia was performed in 10% of caesarean deliveries with an increase in the use of neuraxial techniques as well as an increase in the use of intrathecal morphine during the previous 10 years. Oji-Zurmeyer et al. (33) conducted a survey in Austria and noted that all centres offered a neuraxial anaesthesia service, some centres made use of ultrasound guidance for neuraxial analgesia and 94% of centres had lipid rescue solutions available. Both studies showed spinal anaesthesia related hypotension is treated with boluses of phenylephrine. Neither study mentions specific methods relating to administration of spinal or general anaesthesia practices for caesarean delivery.

Practice guidelines provide a safe framework for clinicians to follow as well as allowing for variability between patients. Obstetric anaesthesia is a challenging and evolving field which requires practice and skill to master the various techniques. With an increasing number of caesarean deliveries performed annually by junior practitioners, greater focus is required on the guidelines for obstetric anaesthesia. The doctoral thesis by S Chetty is the only study which briefly looks at practices for caesarean delivery. No other study specifically assessing anaesthetic practices at the University of the Witwatersrand (Wits) could be found.

Problem Statement

Over the years there have been variations in some of the practices of administering anaesthesia for obstetric patients. Through means of a structured survey this research project will attempt to determine the current practices within the Wits Department of Anaesthesiology and compare those to currently accepted guidelines and literature.

Aim

The aim of this survey is to describe the current practices of anaesthesia for obstetric patients requiring caesarean delivery, including the management practice of common complications, among anaesthesia providers at Wits.

Objectives

The objectives of this study are to:

- describe the current practice of anaesthesia in obstetric cases
- describe compliance to recommendations and guidelines
- compare practice between junior and senior anaesthesia staff.

Research assumptions

The following definitions will be used in this study.

Anaesthetist: is a qualified doctor working in the Department of Anaesthesiology including interns, medical officers, registrars and consultants.

Junior anaesthetist: is a medical officer or registrar with three years or less of training in anaesthesia.

Senior anaesthetist: is a medical officer or registrar with more than three years of training in anaesthesia.

Anaesthesiologist: an anaesthetist who has completed all training requirements to register with the Health Professional Council of South Africa (HPCSA).

Consultant: an anaesthesiologist or career medical officer with more than 10 years of experience in practicing anaesthesia.

Registrar: is a qualified doctor who is registered with the HPCSA as a trainee anaesthesiologist.

Medical officer: is a qualified doctor who is practising in the Department of Anaesthesiology under specialist supervision. Medical officers with more than 10 years of experience are career medical officers and regarded as consultants.

Intern: is a doctor who has completed a university degree and is currently undergoing practical training prior to registration with the HPCSA as an independent practitioner.

Spinal anaesthetic: is anaesthesia which is injected directly into the subarachnoid space of the spinal column with the intention of causing anaesthesia for surgical delivery of a foetus. (27)

Demarcation of study field

The survey will be conducted in the Department of Anaesthesiology which is affiliated to the Faculty of Health Sciences of Wits. The department has a staff complement of 80 consultants, 119 registrars, 40 medical officers, and 32 interns. The hospitals listed below make up the core academic and training platforms of the department.

- Charlotte Maxeke Johannesburg Academic Hospital: a 1200-bed central hospital.
- Chris Hani Baragwanath Academic Hospital: a 2888-bed central hospital.
- Helen Joseph Hospital: a 500-bed regional hospital.
- Rahima Moosa Mother and Child Hospital: a 338-bed regional hospital.
- The satellite training sites will not be included in this study.

Ethical considerations

Approval to conduct this study will be obtained from the Human Research Ethics Committee (Medical) and the Graduate Studies Committee of Wits. Approval will also be obtained from the Academic Head of the Department of Anaesthesiology at Wits (Appendix 1).

This survey will assess current practices within the Department of Anaesthesiology at Wits by using a self-administered questionnaire.

At the departmental academic meetings, anaesthetists will be informed about the study and invited to participate. The anaesthetists that agree will receive an information letter (Appendix 2) and the questionnaire (Appendix 3) which has been adapted for this study.

Permission was obtained from the authors of previous similar questionnaires (Appendix 4). Completion of the questionnaire will be considered as implied consent.

Each questionnaire will be allocated a study number to be able to calculate the response rate. A completed questionnaire will be folded and returned in a sealed box. Anonymity will be maintained as no identifying information will be collected. The questionnaire will take 10 − 15 minutes to complete. Only the researcher and supervisors will have access to the raw data material to ensure confidentiality. The study will be conducted in accordance with the principles of the declaration of Helsinki (34) and the South African guidelines for Good Clinical Practice (35). All data will be stored in a locked cupboard for six years following the completion of the study.

Research methodology

1.1 Research design

A prospective, contextual, descriptive research design will be followed.

A prospective study requires that data are collected from when the study begins and outcomes are observed over a period of time or at the end of the study (36). For this study data will be collected at the time the research occurs and clinical practices will be determined after the questionnaires have been analysed.

A contextual study observes a specific location in time in an organisational level or geographical location and attempts to aid understanding of the specific study group in their environment (37). The context of this study is the Department of Anaesthesiology at Wits.

In a descriptive study the researcher examines the variables as they occur naturally without any intervention. It requires identification of particular phenomena based on an observational basis or the correlation between phenomena (38).

In this study the clinical practices in the Department of Anaesthesiology will be observed through a questionnaire.

8.2 Study population

The study population will be the anaesthetists in the Department of Anaesthesiology at Wits.

Study sample

8.3.1 Sample method

In this study a convenience sampling method will be used. Questionnaires will be handed out to all anaesthetists attending departmental academic meetings. Convenience sampling makes use of a non-probability sampling technique where participants are selected because of their easy accessibility and proximity to the researcher (39).

8.3.2 Sample size

The sample size was determined following consultation with a biostatistician and confirmed by using the Raosoft® sample size calculator. The Department of Anaesthesiology consists of 40 medical officers, 119 registrars, 80 consultants, and 32 interns which gives a total of 271 staff. Questionnaires will be given to the entire accessible population with the intention of obtaining a 100% response rate but a minimum of 60% response rate has been determined to be acceptable (40).

The minimum recommended sample size for this survey is 160 to achieve a 95% confidence level, 5% margin of error, and 50% response distribution.

8.3.3 Inclusion criteria

Anaesthetists working in the Department of Anaesthesiology at Wits who are willing to participate in the survey.

8.3.4 Exclusion criteria

Blank questionnaires will be excluded.

8.4 Collection of data

8.4.1 Development of the questionnaire

Collection of data will be obtained through means of a self-administered questionnaire (Appendix 3) which will be distributed at departmental meetings over two months. The questionnaire is an amended version of two different questionnaires developed by Theron et al. (7) and Jones et al. (28) who have published articles relating to the questionnaires. The adapted questionnaire has been reviewed by three senior anaesthesiologists within the Department of Anaesthesiology and following their recommendations the questionnaire has been amended to ensure face and content validity. The questionnaire consists of a section related to demographics of the respondents and 23 questions on anaesthesia practices for caesarean delivery.

8.4.2 Determination of current practices in obstetric anaesthesia for caesarean delivery

The aim of the questionnaire is to determine current practices for caesarean delivery anaesthesia among anaesthetists in the Department of Anaesthesiology at Wits. Therefore, there is no minimum required mark.

8.4.3 Data collection process

The Department of Anaesthesiology has weekly meetings for all department members. At the beginning of these meetings the researcher will give a short introduction to the research study and invite anaesthetists present to participate. An information letter together with the questionnaire will be given to those who express an interest in participating.

Each questionnaire will be given a study number which will allow the researcher to calculate the response rate. Blank questionnaires will be included to calculate a response rate but not included in the data interpretation. Partially completed questionnaires will be included in the data interpretation.

During the completion of the questionnaires the researcher will be present to assist with any concerns regarding the questionnaire and research process, as well as to protect against any data contamination. To further mitigate against data contamination, questionnaires will be handed out during non-consecutive department meetings over a period of two months and at different sites. Each questionnaire should take approximately 10 – 15 minutes to complete, after which they will be placed in a sealed box at the door entrance to protect anonymity and confidentiality.

Covid-19 contingency plan for data collection will be through means of an online self-administered questionnaire through the website SurveyMonkey®. The questionnaire (Appendix 3) will be uploaded to SurveyMonkey® and a link as well as the covering letter (Appendix 2) will be emailed to all members of the Department of Anaesthesia. The survey will protect respondent's anonymity by not requiring any identifying information or email address to submit answers.

Access to SurveyMonkey® will be restricted through login details known only to the primary investigator and supervisors. On conclusion of the survey all data will be exported to an Excel® database which will be securely kept on a password protected computer which will only be accessible by the primary investigator.

Data analysis

All data from questionnaires will be captured on Microsoft® Office 365 Excel® spreadsheets. The statistical program STATA® version 16 will be used to process and analyse the data. For descriptive analysis of statistics all categorical data will be expressed as frequency tables and proportions. Means and standard deviations or median and interquartile ranges will be used for continuous variables, depending on the distribution of the data.

The survey consists of only categorical data which will be summarised as frequencies and percentages. The 95% confidence interval will also be calculated.

To analyse differences between senior and junior anaesthesia providers a Fishers exact or Chi squared test will be used. To compare the data of choice of ASA Monitors a Chi squared test will be used and a student's t-test will be used to compare quantities of drug used in spinal anaesthesia. The data points from the survey will be compared to the ESMOE guidelines through a Fishers exact test or Chi squared test to analyse differences with a p-value of less than 0.05.

Significance of the study

Globally there is an increasing trend in the number of caesarean deliveries and South Africa is certainly following this trend as evident in the Saving Mothers reports (1, 3). This study would be significant as it would highlight the various approaches to caesarean delivery anaesthesia within the Department of anaesthesiology and compare those approaches, at different skill levels, to the recently introduced ESMOE training guidelines and current literature. Currently there is no study comparing current practices for caesarean delivery anaesthesia to the ESMOE guidelines in the Department of Anaesthesiology at Wits. As such the results of this study would establish a practice baseline of anaesthetists in the Department of Anaesthesiology and we may compare this to the ESMOE guidelines. Based on the results of the study motivation for further in-service training (specifically medical officers and registrars who do not receive training currently) in ESMOE guidelines could be sought after and copies of the ESMOE guidelines placed in theatres.

Validity and reliability of the study

The validity and reliability of this study will be maintained by the following:

- appropriate study design;
- use of a questionnaire which is adapted with face and content validity;
- presence of researcher during completion of questionnaires to address any questions that may arise and to prevent data contamination;
- maintaining anonymity by numbering the questionnaires with no identifying data and placing completed and folded questionnaires in a sealed box;
- analysing data with the assistance of a statistician.

Potential limitations

The study will be limited because only anaesthetists working in the Department of Anaesthesiology at Wits will be surveyed so any conclusions will apply only to the relevant hospitals and may not be a true reflection of anaesthetic practices at other facilities. The use of convenience sampling may result in data being skewed or creation of bias. The honesty of answers may also result in the data obtained not being accurate. A poor response rate may be a limitation to the study. There is also the possibility the survey may be completed more than once by the same person.

Project outline

Activity	Nov – Dec 2019	Jan 2020	Feb 2020	Mar – May 2020	May – Jul 2020	Aug – Sep 2020	Oct – Nov 2020	Dec 2020
Proposal preparation								
Literature review								
Proposal submission								
Postgraduate approval								
Ethics approval								
Data collection								
Draft analysis								
Draft article								
Submission								

Financial obligations

The cost of printing and paper will be incurred by the Department of Anaesthesiology.

Item	Price per page	Number of pages	Copies	Total (Rands)
Proposal	1	15	10	R 150
Ethics	1	10	25	R 250
Post graduate form	1	2	6	R 12
Final MMed Submission	1	100	4	R 400
Questionnaires	1	5	208	R1040
Grand total				**R 1852**

The cost of SurveyMonkey® for standard access is R540 for one month.

References

1. Betrán AP, Torloni MR, Zhang JJ, Gülmezoglu AM, Aleem HA, Althabe F, et al. WHO statement on caesarean section rates. BJOG. 2016;123(5):667-70. DOI: 10.1111/1471-0528.13526.

2. Gebhardt G, Fawcus S, Moodley J, Farina Z. Maternal death and caesarean section in South Africa: results from the 2011-2013 Saving Mothers report of the National Committee for Confidential Enquiries into Maternal Deaths. S Afr Med J. 2015;105(4):287-91. DOI: 10.7196/SAMJ.9351.

3. National Committee on Confidential Enquiries into Maternal Deaths. Saving Mothers 2014-2016: Seventh triennial report on confidential enquiries into maternal deaths in South Africa: Executive summary. Pretoria, National Department of Health.: 2018. Available from: https://www.sasog.co.za/Content/Docs/Saving_Mothers.pdf. [Accessed:25 Oct 2019].

4. Farina Z, Rout C. 'But it's just a spinal': Combating increasing rates of maternal death related to spinal anaesthesia. S Afr Med J. 2013;103(2):81-2. DOI: 10.7196/SAMJ.6308.

5. Jadon A. Complications of regional and general anaesthesia in obstetric practice. Indian J Anaesth. 2010;54(5):415. DOI: 10.4103/0019-5049.71039.

6. Littleford J. Effects on the fetus and newborn of maternal analgesia and anesthesia: a review. Can J Anaesth. 2004;51(6):586-609. DOI: 10.1007/BF03018403.

7. Theron A, Rout C. "Safe anaesthesia" for the South African rural obstetric patient in KwaZulu-Natal. South Afr J Anaesth Analg. 2014;20(6):233-7. DOI: 10.1080/22201181.2014.983717.

8. Huda A, Abir, G, Brown, J. Complications Post–Neuraxial Anaesthesia in Obstetric Patients: World Federation of Societies of Anesthesiologists; 2019. Available from: https://www.researchgate.net/publication/330292942_Complications_Post-Neuraxial_Anaesthesia_in_Obstetric_Patients. [Accessed:1 Nov 2019].

9. Gaiser R. Postdural puncture headache: a headache for the patient and a headache for the anesthesiologist. Curr Opin Anaesthesiol. 2013;26(3):296-303. DOI: 10.1097/ACO.0b013e328360b015.

10. Duncan A, Patel S. Neurological complications in obstetric regional anesthetic practice. J Obstet Anaesth Crit Care. 2016;6(1):3-10. DOI: 10.4103/2249-4472.181055.

11. Newman B. Complete spinal block following spinal anaesthesia: World Federation of Societies of Anesthesiologists; 2010. Available from: https://resources.wfsahq.org/atotw/complete-spinal-block-following-spinal-anaesthesia/. [Accessed:1 Nov 2019].

12. Essential Steps in the Management of Obstetric Emergencies Anaesthesia Working Group. National ESMOE guidelines for district and regional hospitals protocol for caesarean section under spinal anaesthesia.: 2011. Available from: http://www.kznhealth.gov.za/family/protocol_caesarean_section_under_spinal_anaesthesia.pdf. [Accessed:15 Oct 2019].

13. Munnur U, de Boisblanc B, Suresh M. Airway problems in pregnancy. Critical Care Med 2005;33(10):S259-S68. DOI: 10.1097/01.ccm.0000183502.45419.c9.

14. Essential Steps in the Management of Obstetric Emergencies Anaesthesia Working Group. National ESMOE guidelines for district and regional hospitals protocol for caesarean section under general anaesthesia.: 2011. Available from: http://www.kznhealth.gov.za/family/Protocol_caesarean_section_under_general_anaesthesia.pdf. [Accessed:15 Oct 2019].

15. Algert C, Bowen JR, Giles WB, Knoblanche GE, Lain SJ, Roberts CL. Regional block versus general anaesthesia for caesarean section and neonatal outcomes: a population-based study. BMC Med 2009;7(1):20. DOI: 10.1186/1741-7015-7-20.

16. Chang C, Wang IT, Chen YH, Lin HC. Anesthetic management as a risk factor for postpartum hemorrhage after cesarean deliveries. AJOG. 2011;205(5):462. e1-. e7. DOI: 10.1016/j.ajog.2011.06.068.

17. Loubert C. Fluid and vasopressor management for Cesarean delivery under spinal anesthesia: continuing professional development. Can J Anaesth. 2012;59(6):604-19. DOI: 10.1007/s12630-012-9705-9.

18. Bishop D, Rodseth RN, Dyer RA. Recipes for obstetric spinal hypotension: The clinical context counts. S Afr Med J. 2016;106(9):861-4. DOI: 10.7196/SAMJ.2016.v106i9.10877AJOL.

19. Mercier FJ, Diemunsch P, Ducloy-Bouthors AS, Mignon A, Fischler M, Malinovsky JM, et al. 6% Hydroxyethyl starch (130/0.4) vs Ringer's lactate preloading before spinal anaesthesia for Caesarean delivery: the randomized, double-blind, multicentre CAESAR trial. Br J Anaesth. 2014;113(3):459-67. DOI: 10.1093/bja/aeu103.

20. Dyer RA, Farina Z, Joubert IA, Du Toit P, Meyer M, Torr G, et al. Crystalloid preload versus rapid crystalloid administration after induction of spinal anaesthesia (coload) for elective caesarean section. Anaesth Intens Care. 2004;32(3):351-7. DOI: 10.1177/0310057x0403200308.

21. Kee W, Khaw KS, Tan PE, Ng FF, Karmakar MK. Placental transfer and fetal metabolic effects of phenylephrine and ephedrine during spinal anesthesia for cesarean delivery. Anesthesiology. 2009;111(3):506-12. DOI: 10.1097/ALN.0b013e3181b160a3.

22. Goodier C, Lu JT, Hebbar L, Segal BS, Goetzl L. Neuraxial anesthesia in parturients with thrombocytopenia: a multisite retrospective cohort study. Anesth Analg. 2015;121(4):988-91. DOI: 10.1213/ane.0000000000000882.

23. D'Angelo R, Smiley RM, Riley ET, Segal S. Serious complications related to obstetric anesthesia: The Serious Complication Repository Project of the Society for Obstetric Anesthesia and Perinatology. Anesthesiology. 2014;120(6):1505-12. DOI: aln.0000000000000253.

24. Leffert L. What's new in obstetric anesthesia? Focus on preeclampsia. Int J Obstet Anesth. 2015;24(3):264-71. DOI: 10.1016/j.ijoa.2015.03.008.

25. Dyer RA, Piercy JL, Reed AR, Lombard CJ, Schoeman LK, James MF. Hemodynamic changes associated with spinal anesthesia for cesarean delivery in severe preeclampsia. Anesthesiology. 2008;108(5):802-11. DOI: 10.1097/01.anes.0000311153.84687.c7.

26. Sng BL, Han NL, Leong WL, Sultana R, Siddiqui FJ, Assam PN, et al. Hyperbaric vs. isobaric bupivacaine for spinal anaesthesia for elective caesarean section: a Cochrane systematic review. Anaesthesia. 2018;73(4):499-511. DOI: 10.1111/anae.14084.

27. Gogarten W. Spinal anaesthesia for obstetrics. Best Pract Res Clin Anaesthesiol. 2003;17(3):377-92. DOI: 10.1016/s1521-6896(02)00116-7.

28. Jones G, Samuel R, Biccard B. Management of failed spinal anaesthesia for caesarean section. S Afr Med J. 2017;107(7):611-4. DOI: 10.7196/SAMJ.2017.v107i7.12056.

29. Rukewe A, Adebayo O, Fatiregun A. Failed obstetric spinal anesthesia in a Nigerian teaching hospital: Incidence and risk factors. Anesth Analg. 2015;121(5):1301-5. DOI: 10.1213/ane.0000000000000868.

30. Alabi A, Adeniyi OV, Adeleke OA, Pillay P, Haffajee MR. Factors associated with failed spinal anaesthesia for Caesarean sections in Mthatha general hospital, Eastern Cape, South Africa. S Afr Fam Pract. 2017;59(4):128-32. DOI: 10.1080/20786190.2017.1292696.

31. Chetty S. The anaesthetic management of patients undergoing caesarean section surgery and its impact on post-operative analgesia [dissertation on the Internet]: University of the Witwatersrand; 2017. Available from: https://pdfs.semanticscholar.org/e231/8bbf4ae0935564270f072a9c533d6d2ae303.pdf. [Accessed:5 Feb 2020].

32. Shatalin D, Weiniger CF, Buchman I, Ginosar Y, Orbach-Zinger S, Ioscovich A. A 10-year update: national survey questionnaire of obstetric anesthesia units in Israel. Int J Obstet Anesth. 2019;38:83-92. DOI: 10.1016/j.ijoa.2018.10.014.

33. Oji-Zurmeyer J, Ortner CM, Klein KU, Gries M, Kuhn C, Schroffenegger T, et al. National survey of obstetric anaesthesia clinical practices in the republic of Austria. Int J Obstet Anesth. 2019;39:95-8. DOI: 10.1016/j.ijoa.2019.02.002.

34. World Medical Association. World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-4. DOI: 10.1001/jama.2013.281053.

35. Department of Health. Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa: 2006. Available from: http://www.kznhealth.gov.za/research/guideline2.pdf. [Accessed:20 Jan 2020].

36. Ranganathan P, Aggarwal R. Study designs: Part 1–An overview and classification. Perspect Clin Res. 2018;9(4):184. DOI: 10.4103/picr.PICR_124_18.

37. Booth A, Moore G, Flemming K, Garside R, Rollins N, Tunçalp Ö, et al. Taking account of context in systematic reviews and guidelines considering a complexity perspective. BMJ Glob Health. 2019;4(Suppl 1):e000840-e. DOI: 10.1136/bmjgh-2018-000840.

38. Williams C. Research methods. JBER. 2007;5(3). DOI: 10.19030/jber.v5i3.2532.

39. Etikan I, Musa SA, Alkassim RS. Comparison of convenience sampling and purposive sampling. AJTAS. 2016;5(1):1-4. DOI: 10.11648/j.ajtas.20160501.11.

40. Draugalis J, Coons SJ, Plaza CM. Best practices for survey research reports: a synopsis for authors and reviewers. Am J Pharm Educ. 2008;72(1):11. DOI: 10.5688/aj720111.

Annexure 1: Letter from Head of Department of Anaesthesiology

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

WITS UNIVERSITY

Department of Anaesthesia – University of the Witwatersrand

7 York Road, Parktown, 2193 South Africa • Telegrams "Witsmed" • Telephone (011) 488-4344 • Fax (011) 488-4343

Department of Anaesthesia
Area 361
Charlotte Maxeke Johannesburg Academic Hospital

Tel: 011 488-4344

30th October 2019

Subject: **Permission to conduct survey from Department of Anaesthesiology**

To whom it may concern,

This letter stands to affirm that I, Dr PMV Motshabi, grant permission to Dr Benjamin David Watermeyer HPCSA number MP 0805360, to conduct survey in Department of Anaesthesiology at University of Witwatersrand for his study "A cross-sectional survey of current practice in obstetric anaesthesia at the University of the Witwatersrand circuit hospitals".

The approximate period will be, but not limited to, the months of January 2020 to June 2020, until his sample size is obtained. The information obtained from the data will be used for Dr Watermeyer research study for his Masters in Medicine only, and will include information and data relevant to his study.

Yours sincerely,

WITS UNIVERSITY

Dr Palesa Motshabi
Academic Head: Department of Anaesthesia
Head of Clinical Unit: Cardiac Anaesthesia

Tel: +27 (0)11 488 4344
Cell: 083 432 1994
Email: palesa.motshabi@wits.ac.za
Website: www.wits.ac.za

WITS SCHOOL OF CLINICAL MEDICINE

FACULTY OF HEALTH SCIENCES

Charlotte Maxeke Johannesburg Academic Hospital, 6th Floor, Area 361/16, Jubilee Road, Parktown, Johannesburg

Annexure 2: Information letter

Dear Colleague,

My name is Ben Watermeyer and I am currently a registrar in the Department of Anaesthesiology at the University of the Witwatersrand. I would like to extend an invitation to participate in my research project for my MMed degree which is titled: A survey of current practice in anaesthesia for caesarean delivery at a Department of Anaesthesiology. The purpose of the study is to identify the current practices regarding obstetric anaesthesia within the department which will aid in the continued professional development within the department and assist in improving patient outcomes. Even if you do not perform anaesthesia for caesarean deliveries, please complete the questionnaire as you may be involved in training of other clinicians.

Your participation in the study is voluntary and completion and submission of this self-administered questionnaire will constitute your consent. All questionnaires will remain anonymous for your protection and each completed questionnaire will be given a number to calculate the response rate. Only the researcher and supervisors will have access to the raw data which will ensure your confidentiality is protected. You may withdraw from the study at any time prior to the submission of the questionnaire. No incentives will be given for the completion of the questionnaire.

Completion of the questionnaire should not take longer than 10 − 15 minutes and participants are requested not to share the information provided. All questionnaires should be completed online using the provided link to Survey Monkey®, this includes any incomplete questionnaires. Should you have any questions relating to the study or if you would like to access the final report, you may contact the following persons: Ben Watermeyer 072 599 3684 or the study supervisors Maria Fourtounas maria.fourtounas@gmail.com and Melissa Stubbs Melissa.stubbs@gmail.com. A copy of the final report will be accessible at the University of the Witwatersrand Institutional Repository environment on DSpace (WIReDSpace) at www.wiredspace.wits.ac.za.

Permission to conduct the study has been obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand. This committee has a principle function to safeguard the rights and dignity of all human subjects who agree to take part in a research project and maintain the integrity of the research.

Should you have any concern over the way the study is being conducted, please contact the chairperson of the committee who is Professor Clement Penny by email on Clement.Penny@wits.ac.za or by telephone on 011 717 2301. The committee secretaries may be reached at 011 717 2700/1234 and by e-mail at Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za.

Thank you for your participation
Ben Watermeyer

Annexure 3: Questionnaire

Please place a cross (x) over the block that best represents your practices.

Please only select one answer.

If you do not currently practice anaesthesia for caesarean delivery, please select the answers you would teach others.

1: What is your current position in the department?

- ☐ Intern
- ☐ Medical Officer
- ☐ Registrar
- ☐ Consultant or career medical officer in anaesthesia

2: Have you received any training in obstetric anaesthesia guidelines?

- ☐ Yes
- ☐ No

3: If yes, was the training in ESMOE or other South African guidelines?

- ☐ Training in ESMOE
- ☐ Other (please specify): _____

4: How many years of working experience have you had in anaesthesia?

- ☐ < 1 year
- ☐ 1 − 3 years
- ☐ 4 − 9 years
- ☐ ≥ 10 years

5: On average how many anaesthetics for caesarean section do you perform per month?

- ☐ 0 per month
- ☐ ≤ 10 per month
- ☐ 10 − 20 per month
- ☐ 21 − 30 per month
- ☐ ≥ 31 per month

6: What is your preferred fluid type to administer to obstetric patients about to receive a spinal anaesthetic?

- Crystalloid
- Colloid
- Both

7: How do you administer the fluid in question 6?

- Preload only (Prior to administration of spinal anaesthetic)
- Co-load only (Immediately after administration of spinal anaesthetic)
- Combined preload and co-load

8: Which of the following standard ASA monitors do you apply before administering a spinal anaesthetic for caesarean delivery? Please specify if other.

	ECG
	Pulse Oximeter
	NIBP
	Temperature
	Other:

9: How frequently do you monitor the blood pressure after administration of a spinal anaesthetic?

- Every 1 minute
- Every 2 minutes
- Every 3 minutes
- > 3 minutes

10: How long after delivery of foetus do you change the blood pressure monitoring interval?

- Immediately post delivery
- 5 minutes after the last stable blood pressure
- 10 minutes after the last stable blood pressure
- Do not change NIBP cycling interval

11: What method of uterine displacement do you most frequently use?

- Do not displace uterus to left side
- Obstetric wedge (e.g. Sand block, foam wedge pillow)
- Table tilt
- Other: _____

12: What first line agent do you use to treat spinal anaesthetic related hypotension in an obstetric patient?

- Adrenaline
- Dopamine
- Ephedrine
- Phenylephrine
- Other: _____

13: At what minimum platelet count do you administer a spinal anaesthetic? (assume all other organ function is normal)

- $\geq 100 \times 10^9$ per l blood
- $\geq 75 \times 10^9$ per l blood
- $\geq 50 \times 10^9$ per l blood
- $< 50 \times 10^9$ per l blood

14: Which local anaesthetic do you use in your spinal anaesthesia for obstetric patients?

- Isobaric bupivacaine 0.5%
- Hyperbaric bupivacaine 0.5%

15: What dosage of local anaesthetic do you most frequently use?

- Bupivacaine _____ml _____mg

16: What additive do you use for your obstetric spinal anaesthesia?

- Fentanyl
- Sufentanil
- Morphine

17: What dosage of additive do you use?

- Fentanyl _____ml _____ µg
- Sufentanil _____ml _____ µg
- Morphine _____ml _____ µg

18: How do you check for a sensory level after administration of a spinal anaesthetic in obstetrics?

- Ask surgeon to pinch patient with instrument
- Ice brick
- Loss of motor function in legs
- Pin prick

19: At what sensory block level will you proceed with surgery?

- T8 − 10
- T4 − 7
- Above T4

20: How long do you wait before declaring the spinal anaesthesia inadequate?

- 1 – 10 minutes
- 11 – 20 minutes
- 21 – 30 minutes
- > 30 minutes

Please answer the following 3 scenarios. Circle your most appropriate choice of intervention. All patients are 70kg, with no comorbidities

21. Elective Caesarean Delivery (CD), loss of cold sensation to T6 level after 20 minutes but lifting one leg, pre skin incision.

A. Convert to general anaesthesia
B. Ketamine increasing iv increments
C. Repeat spinal anaesthetic
D. Short acting opioid (e.g. Alfentanil) iv increasing increments
E. Wait 10 minutes

22. Elective CD, spinal anaesthetic given 15 minutes ago, significant pain immediately on skin incision.

A. Convert to general anaesthesia
B. Ketamine increasing iv increments
C. Midazolam
D. Sevoflurane by mask
E. Short Acting Opioid (e.g. Alfentanil) iv increments

23. Emergency CD, spinal anaesthetic given 10 minutes ago, pain on incision of uterus.

A. Convert to general anaesthesia
B. Ketamine
C. Midazolam
D. Sevoflurane by mask
E. Short Acting Opioid (e.g. Alfentanil) iv increments

Annexure 4: Letters of permission to use and modify questionnaires

Annette Theron <dr_theron@mweb.co.za> Tue, 10 Sep 2019, 22:53

to me

Dear Benjamin

I am glad you found some inspiration from my article/MMed project.

I attach the questionnaire as I have used it. I have also given it to some other registrars and at some point I have added some thoughts and comments to the questionnaire as I have used it. I think the comments are useful, so I send you the copy with comments. You are most welcome to use some of the ideas.

Best wishes
Annette

Dr Annette Theron
FCA(SA), MMed(Anaes)(UKZN), DA(SA), Dip Obst(SA)
Anaesthesiologist
Tygerberg Hospital

Gavin Jones <gavin@jonesmail.co.za> Mon, 9 Sep 2019, 17:33

to me

Hi Ben,

Apologies for the delayed response.

You are more than welcome to use the questionnaire and manipulate to suit your study.

I will attached the word document which you can save as a pdf once amended.

Let me know if i can assist in any way.

Kind regards,

Gavin

Appendix 4: Research corrections approval letter

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG | FACULTY OF HEALTH SCIENCES | WITS SCHOOL OF CLINICAL MEDICINE | DEPARTMENT OF ANAESTHESIOLOGY
Tel.(011)488 4344

11 February 2020

Ms Palesa Khumalo

Senior Faculty Officer: Clinical Disciplines

Faculty of Health Sciences

Re: Research Corrections – Mmed Dr Ben Watermeyer

This is to confirm that I have read and approved of corrections made by Ben Watermeyer for his Mmed project titled "A survey of current practice in anaesthesia for caesarean delivery at a Department of Anaeshesiology".

Kind regards

Dr Palesa Motshabi
Academic Head: Department of Anaesthesia
Head of Clinical Unit: Cardiac Anaesthesia
Tel: +27 (0)11 488 4344
Cell: 083 432 1994
Email: palesa.motshabi@wits.ac.za
Website: www.wits.ac.za
Charlotte Maxeke Johannesburg Academic Hospital, 6th Floor, Area 301/16, Jubilee Road, Parktown, Johannesburg

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Appendix 5: Postgraduate studies letter of approval

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

03 January 2022
Person No: 347800
PAG

Dr BD Watermeyer
4 Glamour Road
Blairgowrie
2194
South Africa

Dear Dr Benjamin Watermeyer

Master of Medicine in Anaesthesia: Approval of Title

We have pleasure in advising that your proposal entitled *A survey of current practice in anaesthesia for caesarean delivery in a Department of Anaesthesiology.* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Appendix 6: Human research ethics committee clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr B Watermeyer

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M200515

NAME: (Principal Investigator)	Dr B Watermeyer
DEPARTMENT:	School of Clinical Medicine Department of Anaesthesia Medical School University
PROJECT TITLE:	A survey of current practice in anaesthesia for caesarian delivery in a Department of Anaesthesiology
DATE CONSIDERED:	2020/05/29
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr M Fourtounas
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2020/08/18

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the 3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.
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 submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **May** and will therefore reports and re-certification will be due early in the month of **May** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature — Date: 19/08/2020

Appendix 7: Plagiarism and Turnitin report cover page

B Watermeyer MMed research report turnitin-1.docx

ORIGINALITY REPORT

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SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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