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General Anaesthesia Practices for Caesarean Deliveries in Johannesburg Academic Hospitals

Alice Fan

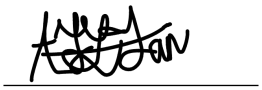
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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Medicine in the branch of Anaesthesiology

Johannesburg 2024

Declaration

I, Alice Fan, 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 25th day of October 2024

Abstract

Background

General anaesthesia (GA) for caesarean deliveries (C/d) presents unique challenges and complexities, influenced by factors such as clinical indications, resource availability, and evolving practice standards. While neuraxial anaesthesia remains the gold standard, circumstances such as failed neuraxial anaesthesia or emergent scenarios necessitate GA utilisation. However, GA, particularly in low and middle-income countries, raises concerns regarding maternal and perinatal outcomes. Moreover, the scarcity of standardised guidelines exacerbates variability in practice. Against this backdrop, our study aims to evaluate and describe current GA practices for C/d within Johannesburg academic hospitals, examining potential disparities between specialists and non-specialists. By elucidating prevailing practices, our findings will inform the development of localised guidelines, thereby enhancing patient care and fostering consistency in anaesthetic management.

Methods

A prospective, descriptive, contextual, and cross-sectional study was conducted using a self-administered questionnaire distributed electronically via REDCap®. The questionnaire, based on national and international guidelines, consisted of 35 questions. Participants included medical officers, registrars, and specialist anaesthetists affiliated with the University of Witwatersrand.

Results

Of 228 eligible participants, 146 responded. Demographic analysis showed most respondents were aware of obstetric guidelines, with ESMOE and OAA/DAS being the most common. Challenges in GA for C/d included airway management, risk of aspiration, and foetal concerns. Induction techniques varied, with propofol and rocuronium increasingly preferred. Analgesic practices differed between specialists and non-specialists, with alfentanil and remifentanil being prominent. The study also explored practices for managing a "cannot intubate, cannot ventilate" scenario during emergency C/d.

Conclusion

Specialists and non-specialists exhibit awareness of obstetric anaesthesia guidelines, but challenges persist in GA for C/d. Variations in airway management, analgesic preferences, and emergency scenario management underscore the need for standardised practices and ongoing evaluation. This study provides valuable insights into current practices and highlights opportunities for improvement in obstetric anaesthesia care.

Acknowledgements

I would like to express my sincere gratitude to my supervisors, Dr Thomas Kleyenstuber and Dr Janine Wagner, for their unwavering guidance and invaluable support throughout this process.

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List of Abbreviations

AAGA:	Accidental awareness during general anaesthesia
AAGBI:	Association of Anaesthetists of Great Britain and Ireland
ASA:	American Society of Anesthesiologists
C/d:	Caesarean delivery
CICO:	Cannot intubate, cannot ventilate
CME:	Continuous medical education
DAS:	Difficult Airway Society
DREAMY:	Direct Reporting of Awareness in Maternity Patients
ESMOE:	Essential Steps in Managing Obstetric Emergencies
ESP:	Erector spinae plane
FONA:	Front-of-neck access
GA:	General anaesthesia
HELP:	Head-elevated laryngoscopy position
HFNO:	Humidified high-flow nasal oxygen
LMIC:	Low and middle-income countries
NA:	Neuraxial anaesthesia
NAP5:	5th National Audit Project
NICE:	National Institute for Health and Care Excellence
NMBA:	Neuromuscular blocking agent
NSAIDs:	Nonsteroidal anti-inflammatory drugs
OAA:	Obstetric Anaesthetists' Association
PCA:	Patient-controlled analgesia
PONV:	Post-operative nausea and vomiting
PTSD:	Posttraumatic stress disorder
QL:	Quadratus lumborum
RCA:	Royal College of Anaesthetists
RSI:	Rapid sequence induction
SAD:	Supraglottic airway device
SOAP:	The Society for Obstetric Anesthesia and Perinatology
TAP:	Transverses abdominis plane
UK:	United Kingdom
UKOSS:	United Kingdom Obstetric Surveillance System
USA:	United States of America

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Statement

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

The formatting of this research report, but not the draft article, complies with the University of the Witwatersrand's Style Guide for Theses, Dissertations and Research Reports.

The formatting of the draft article is in keeping with the author guidelines (Section 2 page 8-15) stipulated by the South African Journal of Anaesthesia and Analgesia, the journal to which it is intended to be submitted.

Section 1: Literature review

Introduction

Neuraxial anaesthesia, namely spinal and epidural anaesthesia, is widely recognised as the preferred method for caesarean deliveries (C/d).[1] However, there are specific scenarios in which general anaesthesia (GA) is favoured.[1] These scenarios include contraindications to neuraxial anaesthesia, patient refusal, insufficient time to perform neuraxial anaesthesia and anticipated major haemorrhage.[2] Notably, approximately one-third of all GA administered for C/d is due to failed neuraxial anaesthesia.[3] Various factors, such as socioeconomic disparities, resource constraints, limited availability of guidelines, and inadequate continuous medical education (CME), contribute significantly to the preference for GA in C/d.[4]

The Royal College of Anaesthetists (RCA) recommends a GA rate of less than 1% for elective C/d and less than 5% for emergent C/d.[4] The national C/d rate in South Africa in the 2015/16 District Health Barometer statistics was 26%, with Gauteng showing the fourth-highest rate.[5] C/d rates were 76% in private hospitals and 36% in public hospitals. [6] Internationally, GA rates are 6% in the United States of America (USA), 8.3 % in England and 3.7 % in Japan.[4,7,8]

In low and middle-income countries (LMIC), the use of GA for C/d is associated with a threefold increase in the risk of maternal mortality and a twofold increase in the risk of perinatal deaths, as reported in a 2016 systematic review and meta-analysis by Sohby et al.[9] Additionally, the utilisation of GA for C/d in LMIC may elevate morbidity due to the heightened risk of complications such as maternal bleeding, intraoperative awareness, and suboptimal postoperative analgesia.[4]

Various challenges exist when employing GA for C/d, such as establishing a definitive airway, preventing aspiration pneumonia, and minimising the risk of accidental awareness during general anaesthesia (AAGA).[10] Research has shown that around one in every 433 C/d performed under GA will result in a failed intubation, necessitating a front-of-neck access (FONA) procedure in one out of every sixty failed intubations.[3] Additionally, there is a

mortality rate of one death for every ninety failed intubations.[3] The United Kingdom Obstetric Surveillance System (UKOSS) study found an 8% incidence of aspiration during failed intubations in obstetric patients.[3] Furthermore, the 5th National Audit Project (NAP5) and the Direct Reporting of Awareness in Maternity patients (DREAMY) study revealed a higher incidence of AAGA during GA for C/d, with one case in 670 C/d and one case in 212 C/d, respectively.[11,12]

In the domain of GA for C/d, induction techniques have undergone notable changes over time, particularly in selecting induction agents, pre-delivery opioid utilisation, and airway management.[13] Historically, the traditional rapid sequence induction (RSI) technique for C/d involved using thiopental and suxamethonium alongside maintenance with 50% nitrous oxide, oxygen, and halothane.[13] However, modern practice has seen the substitution of halothane with isoflurane and sevoflurane, with propofol gaining precedence over thiopental.[13,14] Regionally, thiopental remains the favoured induction agent in Wales, Australia, and New Zealand, while propofol holds sway in North America and Japan. According to the 2021 multicentre observational DREAMY study conducted in the United Kingdom, 56% of British anaesthesiologists favoured thiopental, while 42.8% opted for propofol.[15,16]
Regarding neuromuscular blocking agents (NMBA), the traditional utilisation of suxamethonium at 1mg/kg has shifted in favour of rocuronium due to its superior side effect profile.[2]

The use of opioids during the induction of GA for C/d continues to be a subject of ongoing clinical discussion.[17] Traditionally, opioids have been administered following umbilical cord clamping to minimise foetal exposure and the associated risk of neonatal respiratory depression.[14] However, the use of opioids during induction has been associated with a reduced requirement for GA.[14] It has been shown to contribute to stabilising haemodynamics in cases of maternal cardiac pathology and pre-eclampsia.[14] A recent systematic review and meta-analysis of randomised controlled trials examining the use of induction opioids in C/d found that, overall, the administration of remifentanil and alfentanil did not significantly impact neonatal outcomes. However, the use of fentanyl was found to be associated with a notable decrease in five-minute Apgar scores.[17] In the United Kingdom (UK), 43.2% of C/d patients receive short-acting opioids during induction.[16] Moreover, for post-delivery analgesia, 70% of British anaesthesiologists utilise morphine, 23% utilise fentanyl, and 5%

utilise alfentanil. Additionally, 37% of practitioners perform transverse abdominis plane blocks (TAP) for postoperative pain management.[15]

The administration of supplemental nasal prong oxygen was previously not recommended; however, the Obstetric Anaesthetists' Association (OAA) and Difficult Airway Society (DAS) 2015 guideline now supports using oxygen at a rate of 5L/min during airway manipulation.[18] There is some controversy surrounding the use of cricoid pressure. The UK Confidential Enquiries into Maternal Death reports (1994 to 2005) documented only two deaths from aspiration when cricoid pressure was routinely applied. Nevertheless, it is important to note that misapplication of cricoid pressure may lead to cricoid pressure-induced airway obstruction and a decrease in lower oesophageal sphincter tone.[19]

GA for C/d is frequently an individualised practice and often department-specific, most likely due to the limited availability of guidelines and protocols.[20] International and regional obstetric anaesthesia guidelines vary, and practices are not standardised.[20] Inconsistencies among guidelines occur due to differences in organisational management practices, service delivery, education, infrastructure, expertise, and resource availability. Guidelines are also influenced by the developers' expert opinion, clinical experience, and writing approach.[20–22]

Available international guidelines include the OAA/DAS 2015 Obstetric Airway Guidelines,[18] the RCA 2022 guidelines for the provision of anaesthesia services for an obstetric population,[23] the 2016 American Society of Anesthesiologists (ASA) Task Force on Obstetric Anesthesia and The Society for Obstetric Anesthesia and Perinatology practice guidelines for obstetric anesthesia,[24] the OAA/ Association of Anaesthetists of Great Britain and Ireland (AAGBI) 2013 guidelines for obstetric anaesthetic services,[25] and the National Institute for Health and Care Excellence (NICE) Caesarean Birth 2021 guideline.[26] In South Africa, the only guideline available nationally is the Essential steps in managing obstetric emergencies (ESMOE) 2010 protocol.[27]

There are currently no recommended guidelines available at the University of Witwatersrand Anaesthesiology Department. The OAA/DAS offers three algorithms for a safe obstetric GA focusing on airway management. The algorithms cover circumstances ranging from successful intubation to circumstances whereby the patient cannot be intubated or oxygenated. It also provides available options once a failed intubation has

occurred. The 2022 RCA guideline recommendations are generalised and highlight staffing and organisation requirements that are necessary to provide adequate anaesthetic care for the obstetric population. The ASA guideline covers the pre-anaesthetic evaluation, preparation, Standardised guidelines aid in ensuring high-quality care by limiting inconsistency in patient care and have the potential to improve patient outcomes.[21] Despite the availability of a national guideline (ESMOE) there are no published studies assessing the current practice of Anaesthetists in Johannesburg Academic Hospitals, nor are there studies establishing and evaluating access to and uptake or acceptance of these guidelines.

Conclusion

This literature review provides a comprehensive overview of current practices and challenges in anaesthesia for C/d. It underscores the importance of addressing disparities in guideline adherence, optimising anaesthetic techniques, and promoting standardised practices to improve patient outcomes. Further research is warranted to evaluate the efficacy of interventions aimed at enhancing guideline adherence and minimising risks associated with GA for C/d.

Problem Statement

GA for C/d is associated with increased maternal and perinatal mortality and morbidity. The paucity of standardised evidence-based and patient-centred care guidelines may be responsible for poorer outcomes. There is limited data on the GA practices for C/d in Johannesburg academic hospitals. It is, therefore, vital to obtain this data to assess the need for the implementation of standardised guidelines and CME.

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Section 2: Author's guideline

South African Journal of Anaesthesia and Analgesia

Guidelines available from: http://www.sajaa.co.za/index.php/sajaa/about/submissions.

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.

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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

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Journal references:

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Section 3: Draft article

Cover Page

General anaesthesia practices for caesarean deliveries in Johannesburg academic hospitals

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Abstract

Background

General anaesthesia (GA) for caesarean deliveries (C/d) presents unique challenges and complexities, influenced by factors such as clinical indications, resource availability, and evolving practice standards. While neuraxial anaesthesia remains the gold standard, circumstances such as failed neuraxial anaesthesia or emergent scenarios necessitate GA utilisation. However, GA, particularly in low and middle-income countries, raises concerns regarding maternal and perinatal outcomes. Moreover, the scarcity of standardised guidelines exacerbates variability in practice. Against this backdrop, our study aims to evaluate and describe current GA practices for C/d within Johannesburg academic hospitals, examining potential disparities between specialists and non-specialists. By elucidating prevailing practices, our findings will inform the development of localised guidelines, thereby enhancing patient care and fostering consistency in obstetric anaesthetic management.

Methods

A prospective, descriptive, contextual, and cross-sectional study was conducted using a self-administered questionnaire distributed electronically via REDCap®. The questionnaire, based on national and international guidelines, consisted of 35 questions. Participants included medical officers, registrars, and specialist anaesthetists affiliated with the University of Witwatersrand.

Results

Of 228 eligible participants, 146 responded. Demographic analysis showed most respondents were aware of obstetric guidelines, with ESMOE and OAA/DAS being the most common. Challenges in GA for C/d included airway management, risk of aspiration, and foetal concerns. Induction techniques varied, with propofol and rocuronium increasingly preferred. Analgesic practices differed between specialists and non-specialists, with the use of alfentanil and remifentanil being prominent. The study also explored practices for managing a "cannot intubate, cannot ventilate" scenario during emergency C/d.

Conclusion

Specialists and non-specialists exhibit awareness of obstetric anaesthesia guidelines, but challenges persist in GA for C/d. Variations in airway management, analgesic preferences, and emergency scenario management underscore the need for standardised practices and ongoing evaluation. This study provides valuable insights into current practices and highlights opportunities for improvement in obstetric anaesthesia care.

Keywords: General anaesthesia practices, caesarean deliveries.

Draft Article

General anaesthesia practices for caesarean deliveries in Johannesburg academic hospitals

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Introduction

Neuraxial anaesthesia (NA), such as spinal and epidural anaesthesia, is the gold standard for caesarean deliveries (C/d), but there are circumstances where general anaesthesia (GA) is used preferentially.[1] Additionally, failed neuraxial anaesthesia accounts for one-third of all GA conducted for C/d.[2] Furthermore, socioeconomic disparities, scarcity of resources, lack of guidelines, and inadequate continuous medical education are also major contributing factors to the use of GA for C/d.[3]

In Gauteng in 2015, the C/d rate was 26% in district hospitals, 36% at regional hospitals and 42% at central hospitals, of these approximately 5% were performed under GA.[4] The Royal College of Anaesthetists (RCA) recommends a GA rate of <1% for elective C/d and <5% for emergent C/d.[3] In low and middle-income countries (LMIC), providing GA for C/d triples the risk of maternal mortality and doubles the risk of perinatal deaths.[5] Additionally, it may increase morbidity due to the increased risk of major haemorrhage, intraoperative awareness, and suboptimal postoperative analgesia.[3]

The anaesthetic challenges associated with GA for C/d include establishing a definitive airway, avoiding aspiration, and minimising accidental awareness during general anaesthesia (AAGA).[6]

Induction techniques for C/d have varied over time, specifically the choice of induction agent, opioid use, and airway management.[7,8] Rapid sequence induction (RSI) is the traditional method which involves the use of thiopentone and suxamethonium.[7–9]

However, propofol and rocuronium have become more popular due to their superior side effect profiles.[7–9] The use of opioids during C/d is controversial.[10] While opioids are typically administered after cord-clamping to minimise uteroplacental transfer to the neonate, they can provide maternal haemodynamic stability and minimise AAGA.[7]
A recent systematic review and meta-analysis found that remifentanil and alfentanil had no negative effects on neonatal outcomes, but fentanyl decreased Apgar scores at five minutes.[10] Supplementary oxygen through nasal prongs is now recommended during airway manipulation.[6,11] Cricoid pressure use is controversial and, if applied incorrectly, may cause airway obstruction and decrease lower oesophageal sphincter tone.[7,8,12]

The individualised practice of GA for C/d may be due to the limited availability of standardised guidelines.[13] International and regional obstetric anaesthesia guidelines are inconsistent due to differences in organisational management practices, service delivery, education, infrastructure, expertise, and resource availability.[13,14]
Available international guidelines include the Obstetric Anaesthetists' Association and Difficult Airway Society (OAA/ DAS) 2015 obstetric airway guidelines,[11] the RCA 2022 guidelines for the provision of anaesthesia services for an obstetric population,[15] the 2016 American Society of Anesthesiologists Task Force on Obstetric Anesthesia and The Society for Obstetric Anesthesia and Perinatology practice guidelines for obstetric anaesthesia,[16] the OAA/ Association of Anaesthetists of Great Britain and Ireland 2013 guidelines for obstetric anaesthetic services,[17] and the National Institute for Health and Care Excellence caesarean birth 2021 guideline.[18] The only available local guideline is the Essential Steps in Managing Obstetric Emergencies (ESMOE) 2010 protocol.[19] Currently, no recommended guidelines are available in the University of Witwatersrand Anaesthesiology Department.

Standardised guidelines are crucial to ensuring high-quality patient care and improving patient outcomes.[14] Despite the existence of a national guideline (ESMOE), there are no published studies on the current GA practice for C/d of anaesthetists in Johannesburg Academic Hospitals or on access, uptake, and acceptance of these guidelines.

This study aims to evaluate and describe the current GA practices for C/d in Johannesburg academic hospitals and assess the consistency among specialists and non-specialists. The results will aid in establishing a baseline for evaluating future interventions and determining the need for local guidelines.

Methods

A prospective, descriptive, contextual, and cross-sectional study was conducted using a self-administered questionnaire distributed electronically through the REDCap® web application. The questionnaire was created based on current national and international guidelines and reviewed by ten specialist anaesthetists affiliated with the University of Witwatersrand Department of Anaesthesiology, with a special interest in obstetric anaesthesia. The questionnaire comprised 35 questions divided into eight categories: demographics, GA for C/d experience, positioning, AAGA, airway management, difficult obstetric airway scenario, pharmacology, and analgesia.

Permission was obtained from the relevant authority bodies, and ethics permission was granted by the University of the Witwatersrand Human Research Ethics Committee (Medical), clearance certificate number M230337 Med23-03-031.

All medical officers, registrars, and specialist anaesthetists affiliated with the University of the Witwatersrand were invited to participate voluntarily and anonymously. There were 228 eligible participants, consisting of 49 medical officers, 100 registrars and 79 specialist anaesthetists. A minimum of 144 participants was required, assuming a 5% margin of error, 95% confidence level, and 50% response distribution.

Data collected from the questionnaire were transferred from the REDCap® web platform to a Microsoft Office Excel® spreadsheet. The data was analysed in consultation with a biostatistician on RStudio®. The demographic data was analysed using numerical summaries, means, medians, standard deviations, and interquartile ranges where appropriate. Frequencies and percentages were used to summarise the findings relating to anaesthetic practice. Categorical data was analysed using the Chi-square and Fisher's Exact tests. In the instances where categorical data was ordinal, a Chi-square test for trend was used. For non-parametric continuous data, the Kruskal-Wallis and Wilcoxon summed-ranked tests were employed. A p-value of less than 0.05 was considered significant.

Results

Out of 228 individuals, 153 responded to the survey. After removing seven incomplete questionnaires, the final sample size (N) was 146, resulting in a response rate of 64%. Table I provides a summary of the demographic responses. Almost all the respondents were aware of obstetric guidelines (136, 93.2%), with the ESMOE (100, 68.5%) and OAA/DAS (85, 58.2%) being the most common guidelines known. No statistically significant difference existed between specialists' and non-specialists' awareness of guidelines (p= 0.42).

The experiences of GA for C/d with regard to indications, challenges, positioning and AAGA are presented in Table II. The most common challenges faced by respondents were airway management (87, 59.6%), risk of aspiration (58, 39.7%) and foetal concerns (39, 26.7%). Airway management was identified as the most challenging aspect of GA by almost half of the respondents (70, 47.9%). No statistically significant difference existed between the proportions of specialists' and non-specialists' common and most common challenges (all p>0.2). The most common indications for performing GA differed between specialists and non-specialists but did not reach statistical significance (p=0.094). Specialists (14, 45.2%) identified a high risk of major haemorrhage as a key reason for performing GA, compared to non-specialists (37, 32.2%). Non-specialists indicated contraindication to NA as the most common reason for GA (46, 40%). There was a statistical difference in preference in patient positioning between non-specialists and specialists (p=0.001). The majority of non-specialists preferred the lateral tilt position (82, 72%) whereas specialists preferred both the lateral tilt position (15, 48%) and the placement of a wedge (12, 39%).

Half of the respondents identified the period between securing the airway and before cord-clamping as the highest risk period for AAGA (73, 50%). Fewer respondents identified induction (19, 13%) and emergence and extubation (3, 2.1%) as the highest risk periods. Ensuring adequate end-tidal levels of volatile agents for maintenance was the most utilised strategy to prevent AAGA (69, 47.3%).

Table I: Demographics and guideline awareness

Characteristic	Overall, n = 146	Non-specialist, n = 115	Specialist, n = 31	p-value*
	n (%)	n (%)	n (%)	
Age group				<0.001
25-29	22 (15.1)	22 (19.1)	0 (0.0)	
30-39	97 (66.4)	87 (75.7)	10 (32.3)	
40-49	20 (13.7)	6 (5.2)	14 (45.2)	
50-59	4 (2.7)	0 (0.0)	4 (12.9)	
≥60	3 (2.1)	0 (0.0)	3 (9.7)	
Gender identity				0.54
Female	84 (57.5)	64 (55.7)	20 (64.5)	
Male	61 (42.5)	51 (44.3)	11 (35.5)	
Experience post community service				<0.001
< 1	11 (7.5)	11 (9.6)	0 (0.0)	
1-2	20 (13.7)	20 (17.4)	0 (0.0)	
3-5	61 (41.8)	61 (53.0)	0 (0.0)	
6-9	31 (21.2)	21 (18.3)	10 (32.3)	
10-20	17 (11.6)	2 (1.7)	15 (48.4)	
≥20	6 (4.1)	0 (0.0)	6 (19.4)	
Current rank				<0.001
Junior registrar (registrar in the first 2 years of training)	54 (37.0)	54 (47.0)	0 (0.0)	
Senior registrar (registrar in the final 2 years of training)	33 (22.6)	33 (28.7)	0 (0.0)	
Specialist anaesthetist/Consultant	29 (19.9)	0 (0.0)	29 (93.5)	
Medical officer (of which n (%) 22 (79%) have diploma	28 (19.2)	28 (24.3)	0 (0.0)	
Career medical officer†	2 (1.4)	0 (0.0)	2 (6.5)	
Aware of obstetric anaesthesia guidelines	136 (93.2)	110 (94.0)	26 (89.7)	0.42
Known guidelines (Multiple answer)				
ESMOE‡	**100 (68.5)**	**79 (68.7)**	**21 (67.7)**	**0.92**
OAA/ DAS§	**85 (58.2)**	**67 (58.3)**	**18 (58.1)**	**0.98**
NICE¶	24 (16.4)	18 (15.7)	6 (19.4)	0.62
RCA‖	19 (13.0)	14 (12.2)	5 (16.1)	0.55
ASA SOAP**	10 (6.8)	8 (7.0)	2 (6.5)	>0.99
AAGBI††	8 (5.5)	5 (4.3)	3 (9.7)	0.37

*Fisher's exact test; †Career medical officers are considered as consultants; ‡ESMOE: Essential steps in managing obstetric emergencies; §OAA/DAS: Obstetric Anaesthetists' Association/ Difficult Airway Society; ¶NICE: National Institute for Health and Care Excellence; ‖RCA: Royal College of Anaesthetists; **ASA SOAP: American Society of Anesthesiologist Task Force on Obstetric Anesthesia and The Society for Obstetric Anesthesia and Perinatology; ††AAGBI: Association of Anaesthetists of Great Britain and Ireland

Table III presents the respondents' airway management practices. Most participants (115, 78.8%) preferred the ramped/head-elevated laryngoscopy position (HELP) for airway management and intubation, and the semi-recumbent/head-up position was preferred (88, 60.3%) over the neutral supine (54, 37.0%) and left lateral positions (4, 2.7%) for extubation.

For the preoxygenation endpoint, 49.3% of the respondents aimed to achieve an end-tidal oxygen concentration of at least 90%, 40.4% aimed for at least 80%, 4.8% chose three to five minutes of tidal volume breathing, 3.4% chose oxygen saturation of ≥ 99%, and 0.7% chose eight vital capacity breaths.

Supplementary nasal prong oxygen was rarely administered during routine intubations (10, 6.8%) but was more commonly utilised during anticipated difficult intubations (66, 45.2%). 86.3% of the respondents indicated that they would use humidified high-flow nasal oxygen (HFNO) as part of airway management if it was readily available. Cricoid pressure (104, 71.2%) was commonly performed, and most respondents preferred direct (123, 84.2%) over video-laryngoscopy (23, 15.8 %). Airway management techniques were not significantly different between specialists and non-specialists. Most respondents (126, 86.3%) preferred short-acting opioids to blunt the intubation response. The use of beta-blockers to blunt intubation response was reported by 9.7% of specialists, which was significantly higher than non-specialists (1, 0.9%) (p= 0.025).

Table IV summarises the pharmacological practices for GA for C/d. Propofol is the preferred intravenous induction agent (142, 97.3%) at a dose of 2mg/kg (91, 62.3%). Suxamethonium is the most commonly used neuromuscular blocking agent (NMBA) (143, 97.9%%).
With regard to postoperative nausea and vomiting (PONV), 96.6 % of the respondents routinely administer agents to prevent PONV, with ondansetron (133, 91.1%) and dexamethasone (132, 90.4%) being the most used agents.

Table V presents the analgesic practices for GA for C/d. A statistical difference was found in the pre-cord clamping opioid administration practices between specialists and non-specialists (p=0.008). Alfentanil was the preferred opioid in both groups (109, 74.7 %), but a higher proportion of non-specialists (91,79.1%) administered alfentanil compared to specialists (18, 58.1%).

The most commonly used analgesics pre-cord clamping were paracetamol (117, 80.1%), intravenous lignocaine (92, 63%), short-acting opioids (89, 61%) and ketamine (60, 41.1%). The administration of ketamine, both for pre-cord (p=0.001) and post-cord (p=0.001) clamping, was significantly more common amongst non-specialists than specialists. For intraoperative analgesia, the most commonly used drugs were long-acting opioids (137, 93.8%), nonsteroidal anti-inflammatory drugs (NSAIDs) (89, 61%), paracetamol (71, 48.6%), and ketamine (70, 47.9%).

Table II: Anaesthetists' experience of general anaesthesia for caesarean deliveries

Characteristic	**Overall**, n = 146	**Non-specialist**, n = 115	**Specialist**, n = 31	**p-value**[*]
	n (%)	n (%)	n (%)	
Common challenges (Multiple answer)				
Airway management	**87 (59.6)**	**71 (61.7)**	**16 (51.6)**	**0.31**
Aspiration risk	58 (39.7)	43 (37.4)	15 (48.4)	0.27
Foetal concerns	39 (26.7)	33 (28.7)	6 (19.4)	0.30
Positioning	35 (24.0)	29 (25.2)	6 (19.4)	0.50
AAGA[ǂ]	26 (17.8)	21 (18.3)	5 (16.1)	0.78
Uterotonic management	23 (15.8)	19 (16.5)	4 (12.9)	0.78
Pharmacological dosing adjustments	18 (12.3)	14 (12.2)	4 (12.9)	>0.99
Post-operative analgesia	15 (10.3)	12 (10.4)	3 (9.7)	>0.99
Indications for general anaesthesia	14 (9.6)	10 (8.7)	4 (12.9)	0.50
None	11 (7.5)	8 (7.0)	3 (9.7)	0.70
Intra-operative analgesia	10 (6.8)	8 (7.0)	2 (6.5)	>0.99
Induction	1 (0.7)	1 (0.9)	0 (0.0)	>0.99
Maintenance	8 (5.5)	8 (7.0)	0 (0.0)	0.20
Emergence and extubation	3 (2.1)	3 (2.6)	0 (0.0)	>0.99
Most Challenging (Single answer)				0.45
Airway management	**70 (47.9)**	**57 (49.6)**	**13 (41.9)**	
None	13 (8.9)	10 (8.7)	3 (9.7)	
Positioning	11 (7.5)	10 (8.7)	1 (3.2)	
AAGA[†]	9 (6.2)	8 (7.0)	1 (3.2)	
Aspiration risk	9 (6.2)	5 (4.3)	4 (12.9)	
Foetal concerns	8 (5.5)	6 (5.2)	2 (6.5)	
Pharmacological dosing adjustments in the obstetric patient	6 (4.1)	5 (4.3)	1 (3.2)	
Post-operative analgesia	5 (3.4)	4 (3.5)	1 (3.2)	
Uterotonic management	5 (3.4)	3 (2.6)	2 (6.5)	
Indications for general anaesthesia	4 (2.7)	3 (2.6)	1 (3.2)	
Maintenance	3 (2.1)	3 (2.6)	0 (0.0)	
Intra-operative analgesia	2 (1.4)	1 (0.9)	1 (3.2)	
Induction	1 (0.7)	0 (0.0)	1 (3.2)	
Most common indication for general anaesthesia				0.094
Contraindications to do a neuraxial technique	59 (40.4)	46 (40.0)	13 (41.9)	
High risk for major haemorrhage	51 (34.9)	37 (32.2)	14 (45.2)	
Failed spinal	18 (12.3)	17 (14.8)	1 (3.2)	
Inadequate pre-operative investigations	17 (11.6)	15 (13.0)	2 (6.5)	
Other	1 (0.7)	0 (0.0)	1 (3.2)	
Positioning on theatre bed				0.001
Lateral tilt	**97 (66.4)**	**82 (71.3)**	**15 (48.4)**	
Neutral supine position	23 (15.8)	20 (17.4)	3 (9.7)	
Placement of a wedge	23 (15.8)	11 (9.6)	**12 (38.7)**	
Manual uterine displacement	2 (1.4)	1 (0.9)	1 (3.2)	
Other	1 (0.7)	1 (0.9)	0 (0.0)	
Highest period of risk for AAGA				0.82
Period after airway management and before cord clamping	**73 (50.0)**	**56 (48.7)**	**17 (54.8)**	
Maintenance	30 (20.5)	25 (21.7)	5 (16.1)	
Airway management	21 (14.4)	16 (13.9)	5 (16.1)	
Induction	19 (13.0)	16 (13.9)	3 (9.7)	
Emergence and extubation	**3 (2.1)**	**2 (1.7)**	**1 (3.2)**	
Prevention strategies for AAGA (multiple answer)				
Adequate end-tidal levels of volatile agents	69 (47.3)	52 (45.2)	17 (54.8)	0.34
Ensuring correct drug labelling	55 (37.7)	44 (38.3)	11 (35.5)	0.78
Additional doses of induction agent	55 (37.7)	43 (37.4)	12 (38.7)	0.89
Use of opioids	48 (32.9)	39 (33.9)	9 (29.0)	0.61
Higher doses of induction agents	30 (20.5)	24 (20.9)	6 (19.4)	0.85
Use of benzodiazepines	26 (17.8)	21 (18.3)	5 (16.1)	0.78
None	4 (2.7)	3 (2.6)	1 (3.2)	>0.99

[*]Fisher's exact test; [†]AAGA: Accidental awareness during general anaesthesia

Table III: Airway management practices

Characteristic	Overall, n = 146	Non-specialist, n = 115	Specialist, n = 31	p-value*
	n (%)	n (%)	n (%)	
Position for airway management and intubation				0.009
Ramped /head-elevated laryngoscopy position (HELP)	115 (78.8)	91 (79.1)	24 (77.4)	
Neutral supine position	28 (19.2)	24 (20.9)	4 (12.9)	
Other	3 (2.1%)	0 (0.0)	3 (9.7)	
Common position for extubation				0.056
Semi-recumbent/ head-up position	88 (60.3)	71 (61.7)	17 (54.8)	
Neutral supine position	54 (37.0)	43 (37.4)	11 (35.5)	
Left lateral position	4 (2.7)	1 (0.9)	3 (9.7)	
Preferred endpoint of preoxygenation				0.079
End-tidal oxygen concentration ≥ 90%	**72 (49.3)**	**60 (52.2)**	**12 (38.7)**	
End-tidal oxygen concentration ≥ 80%	59 (40.4)	47 (40.9)	12 (38.7)	
3- 5 minutes of tidal breaths breathing	7 (4.8)	4 (3.5)	3 (9.7)	
SpO2 ≥ 99%	5 (3.4)	2 (1.7)	3 (9.7)	
End-tidal oxygen concentration ≥ 70%	2 (1.4)	1 (0.9)	1 (3.2)	
8 vital capacity breaths	1 (0.7)	1 (0.9)	0 (0.0)	
Routine use of supplementary nasal prong oxygen during preoxygenation & intubation				
Nasal prong oxygen ≤ 5L/min	10 (6.8)	9 (7.7)	1 (3.4)	0.69
High flow nasal prong oxygen ≥10- 15L/min	7 (4.8)	6 (5.1)	1 (3.4)	>0.99
Use of nasal prong oxygen for anticipated difficult airway	66 (45.2)	55 (47.0)	11 (37.9)	0.38
Routine inclusion of HFNO† (≥30L/min) in airway management if freely available	126 (86.3)	101 (87.8)	25 (80.6)	0.38
Routine use of cricoid pressure	**104 (71.2)**	**83 (72.2)**	**21 (67.7)**	**0.63**
Routine laryngoscopy technique				0.58
Direct laryngoscopy	123 (84.2)	98 (85.2)	25 (80.6)	
Video-laryngoscopy	23 (15.8)	17 (14.8)	6 (19.4)	
Drugs used to blunt intubation response (multiple answer)				
Short- acting opioid	126 (86.3)	102 (88.7)	24 (77.4)	0.14
Lignocaine	110 (75.3)	89 (77.4)	21 (67.7)	0.27
Magnesium sulphate	27 (18.5)	18 (15.7)	9 (29.0)	0.089
None	5 (3.4)	3 (2.6)	2 (6.5)	0.3
Beta-blocker	4 (2.7)	1 (0.9)	3 (9.7)	0.025

*Fisher's exact test, Pearson's Chi-squared test; †HFNO: Humidified high-flow nasal oxygen

Post-operative analgesia practices differed between specialists and non-specialists, with a higher proportion of non-specialists favouring local anaesthetic infiltration (p= 0.014) and specialists preferring patient-controlled analgesia (PCA) (p<0.001). More specialists included NSAIDs as part of their post-operative pain management plan (21, 72.4%) compared to non-specialists (63, 53.8 %), but the difference was not statistically significant (p = 0.07).

Table VI presents the practices for handling a "cannot intubate, cannot ventilate" (CICO) situation during an emergency C/d. Ninety-four respondents (64.4%) indicated that the third attempt by the most senior person was a failed intubation. After the first failed intubation attempt, 110 of the respondents (75.3%) chose to facemask ventilate the patient prior to the second attempt at intubation. Most respondents (113, 77.4%) would prefer video-laryngoscopy as the technique for the second intubation attempt.

Table IV: Pharmacological practices

Characteristic	Overall, n = 146	Non-specialist, n = 115	Specialist, n = 31	p-value*
	n (%)	n (%)	n (%)	
Intravenous induction agent				>0.99
Propofol	142 (97.3)	112 (97.4)	30 (96.8)	
Etomidate	4 (2.7)	3 (2.6)	1 (3.2)	
Preferred intravenous induction agent in ideal resource setting				0.59
Propofol	**132 (90.4)**	**105 (91.3)**	**27 (87.1)**	
Thiopentone	8 (5.5)	5 (4.3)	3 (9.7)	
Etomidate	5 (3.4)	4 (3.5)	1 (3.2)	
Ketamine	1 (0.7)	1 (0.9)	0 (0.0)	
Commonest induction dose of propofol				0.54
1 mg/kg	7 (4.8)	5 (4.3)	2 (6.5)	
1.5 mg/kg	29 (19.9)	25 (21.7)	4 (12.9)	
2 mg/kg	91 (62.3)	72 (62.6)	19 (61.3)	
2.5 mg/kg	18 (12.3)	12 (10.4)	6 (19.4)	
3 mg/kg	1 (0.7)	1 (0.9)	0 (0.0)	
Neuromuscular blocking agent for caesarean delivery				0.009
Suxamethonium	**143 (97.9)**	**115 (100.0)**	**28 (90.3)**	
Rocuronium	3 (2.1)	0 (0.0)	3 (9.7)	
Preferred neuromuscular blocking agent in ideal resource setting				0.72
Suxamethonium	73 (50.0)	59 (51.3)	14 (45.2)	
Rocuronium	**71 (48.6)**	**54 (47.0)**	**17 (54.8)**	
Cisatracurium	1 (0.7)	1 (0.9)	0 (0.0)	
Other	1 (0.7)	1 (0.9)	0 (0.0)	
Routinely administers agents for PONV†	141 (96.6)	113 (98.3)	28 (90.3)	0.064
Agents used for PONV† (multiple answer)				
Ondansetron	133 (91.1)	105 (91.3)	28 (90.3)	>0.99
Dexamethasone	132 (90.4)	106 (92.2)	26 (83.9)	0.18
Metoclopramide	43 (29.5)	33 (28.7)	10 (32.3)	0.70
Droperidol	2 (1.4)	1 (0.9)	1 (3.2)	0.38
Promethazine	2 (1.4)	1 (0.9)	1 (3.2)	0.38

*Fisher's exact test, Pearson's Chi-squared test; †PONV: postoperative nausea and vomiting

Following a third failed intubation attempt, 129 of the respondents (88.4%) would insert a supraglottic airway device (SAD), 87 (59.6%) would facemask ventilate, and 12 (8.2%) would proceed to front-of-neck-access (FONA). Ninety-two of the respondents (63%) indicated that two attempts were the maximum number of attempts at inserting an SAD.

The majority of respondents indicated that the two-person technique (127, 87%) and simple airway adjuncts (118, 80.85%) would be utilised to maximise face mask ventilation after failed SAD insertion. Forty-two (28.8%) respondents reported feeling comfortable performing FONA. Among those, a significant portion were specialists (14, 45.2%) (p=0.023).

Table V: Analgesia practices

Characteristic	Overall, n = 146	Non-specialist, n = 115	Specialist, n = 31	p-value*
	n (%)	n (%)	n (%)	
Pre-cord clamping opioid administration in ideal resource setting				0.16
Alfentanil	**71 (48.6)**	**59 (51.3)**	**12 (38.7)**	
Remifentanil	45 (30.8)	35 (30.4)	10 (32.3)	
None	25 (17.1)	19 (16.5)	6 (19.4)	
Sufentanil	4 (2.7)	2 (1.7)	2 (6.5)	
Fentanyl	1 (0.7)	0 (0.0)	1 (3.2)	
Actual opioid administration pre-cord clamping				0.008
Alfentanil	**109 (74.7)**	**91 (79.1)**	**18 (58.1)**	
None	25 (17.1)	19 (16.5)	6 (19.4)	
Fentanyl	6 (4.1)	2 (1.7)	4 (12.9)	
Remifentanil	**5 (3.4)**	**2 (1.7)**	**3 (9.7)**	
Other	1 (0.7)	1 (0.9)	0 (0.0)	
Analgesia practices pre-cord clamping (multiple answers)				
Paracetamol	117 (80.1)	**100 (87.0)**	17 (54.8)	**<0.001**
Intravenous lignocaine	92 (63.0)	76 (66.1)	16 (51.6)	0.14
Short- acting opioids	89 (61.0)	68 (59.1)	21 (67.7)	0.38
Ketamine	60 (41.1)	**55 (47.8)**	5 (16.1)	**0.001**
Magnesium sulphate	38 (26.0)	29 (25.2)	9 (29.0)	0.67
Regional technique	8 (5.5)	4 (3.5)	4 (12.9)	0.063
Alpha-2- agonist	7 (4.8)	6 (5.2)	1 (3.2)	>0.99
Indicated pre-operative regional technique and used (multiple answer)				
Bilateral TAP† blocks	5 (3.4)	3 (2.6)	2 (6.5)	0.29
Bilateral ESP‡ blocks	4 (2.7)	2 (1.7)	2 (6.5)	0.20
Bilateral QL§ blocks	1 (0.7)	1 (0.9)	0 (0.0)	>0.99
Did not opt for pre-operative regional technique	138 (95)	111 (97)	27 (87)	0.063
Intra -operative analgesia post- cord clamping (multiple answer)				
Long-acting opioid	137 (93.8)	108 (93.9)	29 (93.5)	>0.99
NSAIDs¶	89 (61.0)	72 (62.6)	17 (54.8)	0.43
Paracetamol	71 (48.6)	49 (42.6)	**22 (71.0)**	**0.005**
Ketamine	70 (47.9)	**63 (54.8)**	7 (22.6)	**0.001**
Short- acting opioid	64 (43.8)	**56 (48.7)**	8 (25.8)	0.023
Magnesium sulphate	23 (15.8)	20 (17.4)	3 (9.7)	0.41
Intravenous lignocaine	17 (11.6)	15 (13.0)	2 (6.5)	0.53
Post-operative Analgesia (multiple answer)				
Local anaesthetic infiltration	134 (91.8)	111 (94.9)	23 (79.3)	0.014
Long- acting opioid	124 (84.9)	101 (86.3)	23 (79.3)	0.39
Paracetamol	111 (76.0)	85 (72.6)	26 (89.7)	0.055
NSAIDs¶	84 (57.5)	63 (53.8)	21 (72.4)	0.070
PCA‖	28 (19.2)	13 (11.1)	**15 (51.7)**	**<0.001**
Regional technique	19 (13.0)	15 (12.8)	4 (13.8)	>0.99
Perform Regional Technique				0.85
Bilateral TAP† blocks	17 (11.6)	13 (11.3)	4 (12.9)	
Bilateral ESP‡ blocks	1 (0.7)	1 (0.9)	0 (0.0)	
Bilateral QL§ blocks	1 (0.7)	1 (0.9)	0 (0.0)	
Did not opt for post-operative regional technique	127 (87.0)	100 (87.0)	27 (87.1)	

*Fisher's exact test, Pearson's Chi-squared test; †TAP: Transverse abdominis plane; ‡ESP: Erector spinae plane; §QL: Quadratus lumborum; ¶NSAID: Nonsteroidal anti-inflammatory drugs; ‖PCA: patient- controlled analgesia

Table VI: Difficult airway scenario

Characteristic	Overall, n = 146	Non-specialist, n = 115	Specialist, n = 31	p-value*
	n (%)	n (%)	n (%)	
Number of attempts before failed intubation declaration				0.10
1	3 (2.1)	2 (1.7)	1 (3.2)	
2	33 (22.6)	28 (24.3)	5 (16.1)	
3 (your own 3rd attempt)	16 (11.0)	9 (7.8)	7 (22.6)	
3 (3rd attempt by a senior colleague or experienced colleague)	94 (64.4)	76 (66.1)	18 (58.1)	
Actions to optimize laryngoscopy visualization (multiple answer)				
External laryngeal manipulation	124 (84.9)	101 (87.8)	23 (74.2)	0.086
Request for video laryngoscope	105 (71.9)	84 (73.0)	21 (67.7)	0.56
Reposition head/ neck	98 (67.1)	81 (70.4)	17 (54.8)	0.10
Reduce/ remove cricoid pressure	88 (60.3)	67 (58.3)	21 (67.7)	0.34
Use a stylet/ bougie	66 (45.2)	50 (43.5)	16 (51.6)	0.42
Respondents utilising facemask ventilation until second intubation attempt	110 (75.3)	87 (75.7)	23 (74.2)	0.87
Respondents not utilising facemask ventilation until second attempt	36(24.7)	28(24.3)	8(25.8)	
Desaturation point to initiate facemask ventilation†				0.44
< 92%	65 (44.5)	52 (45.2)	13 (41.9)	
< 88%	37 (25.3)	27 (23.5)	10 (32.3)	
< 80%	8 (5.5)	8 (7.0)	0 (0.0)	
Actions to maximise second intubation success (multiple answer)				
Request for video-laryngoscope	113 (77.4)	92 (80.0)	21 (67.7)	0.15
Request for next laryngoscopy to be done by senior	83 (56.8)	67 (58.3)	16 (51.6)	0.51
Remove cricoid pressure	46 (31.5)	35 (30.4)	11 (35.5)	0.59
Actions after third unsuccessful intubation attempt (multiple answer)				
Oxygenate with SAD‡	129 (88.4)	99 (86.1)	30 (96.8)	0.12
Declare an emergency	99 (67.8)	81 (70.4)	18 (58.1)	0.19
Oxygenate with facemask	87 (59.6)	73 (63.5)	14 (45.2)	0.065
Call for assistance (intensivist, ENT§ surgeon)	45 (30.8)	35 (30.4)	10 (32.3)	0.85
FONA¶	12 (8.2)	8 (7.0)	4 (12.9)	0.28
Maximum number of attempts at inserting SAD‡				0.56
1	31 (21.2)	25 (21.7)	6 (19.4)	
2	92 (63.0)	73 (63.5)	19 (61.3)	
3	21 (14.4)	16 (13.9)	5 (16.1)	
4	2 (1.4)	1 (0.9)	1 (3.2)	
Actions to optimise facemask ventilation after failed SAD‡ insertion (multiple answer)				
Two-person technique	127 (87.0)	102 (87.2)	25 (86.2)	>0.99
Simple airway adjuncts	118 (80.8)	100 (85.5)	18 (62.1)	0.004
Adequate muscle relaxation	82 (56.2)	67 (57.3)	15 (51.7)	0.59
None	0 (0.0)	0 (0.0)	0 (0.0)	
Comfortable performing FONA‖	**42 (28.8)**	**28 (24.3)**	**14 (45.2)**	**0.023**

*Fisher's exact test, Pearson's Chi-squared test;
†The respondents that indicated to facemask ventilate prior to the second intubation attempt were given the option to indicate the desaturation point for facemask ventilation. n= 110.
‡SAD: Supraglottic airway device; §ENT: Ear, nose and throat; ¶FONA: Front of neck access

Discussion

Most of the anaesthetists working in the academic hospitals in Johannesburg were cognisant of the national ESMOE guideline and the OAA/DAS guideline, with no significant differences observed between specialists and non-specialists. The most challenging aspects of GA for C/d were airway management, the risk of aspiration, and foetal concerns.

These findings were similar to those from multiple international studies conducted in Japan, the United Kingdom (UK), and the United States of America (USA).[20–22] Specialists were more likely to perform GA in the case of major haemorrhage anticipation, while non-specialists identified contraindication to NA as the primary reason for GA use. A scarcity of resources, including medicines, equipment and staff, may dictate individual practice.[20,23]

In the direct reporting of awareness in maternity patients (DREAMY) study the highest period for AAGA occurred during induction as well as emergence.[24] However, in this study, only 3% identified emergence as a high-risk period for AAGA. A study by Novakovic et al.[25] demonstrated that 50% of AAGA cases in the study sample occurred during emergence from anaesthesia. The study attributed a lack of guidelines and personnel experience as the cause of AAGA during emergence. It noted that 40% of the anaesthetists switched off the vaporiser prior to the placement of skin sutures. Additionally, 50% of the anaesthetists in the study had less than 10 years of experience, as opposed to 84% in this study. Conversely, a study by Inoue et al.[26] that AAGA during emergence could not be solely attributed to a lack of experience. Further research is warranted to investigate this disparity. Reported pharmacological practices in this study aligned with the 5th National Audit Project (NAP5).[27]

Although practices pertaining to the application of a left lateral tilt were in keeping with UK practices, the reduced use of wedge placement may be due to a scarcity of this resource.[8,19] Further study to investigate the availability at institutions is recommended to ascertain limitations to utilisation and causes of underutilisation of wedges.

The lower rates of application of cricoid pressure, as compared to the UK, may reflect the ongoing debate surrounding the use of cricoid pressure and the lack of adopted standardised practice.[8,12]

The preoxygenation endpoint in this study deviated from the recommendation in the ESMOE guideline but aligned more closely with the international OAA/DAS guideline. This may be due to the fact the OAA/DAS guideline was published more recently. However, this deviation underscores the potential necessity of updating the ESMOE guideline or establishing a new local guideline.[11,19]

Although video-laryngoscopy use was similar to that in the UK, practices pertaining to the use of nasal prong oxygen and HFNO were not in keeping with the prevailing practice in the UK.[8] This may be a result of a lack of access or stock shortages, but further study is recommended to explore limitations to the use of such.

The use of propofol over thiopentone has been increasingly favoured, as demonstrated in this study, the DREAMY study, and research conducted in Japan.[21,22,24,28] This shift may be attributed to recommendations from the NAP5 study, which has shown fewer adverse effects with propofol.[27] Additionally, the decreasing use of thiopentone may be due to its diminishing availability and decreasing familiarity with its use.[1,22] Suxamethonium was the preferred NMBA, most likely due to its predictable and rapidly achieved intubating conditions. Interestingly, in Japan, rocuronium is the NMBA of choice.[21]

Analgesic preferences varied amongst specialists and non-specialists, pre-, intra-, and post-operatively. Alfentanil was the most commonly used opioid, with a higher proportion of non-specialists administering it. Respondents preferred remifentanil if freely available. These findings were dissimilar to the UK, where fentanyl is most widely used.[22] Pre-cord clamping, non-specialists used more paracetamol and ketamine than specialists. Post-cord clamping, specialists were more likely to administer paracetamol, while ketamine and short-acting opioids were more often used by non-specialists. Sub-anaesthetic doses of ketamine have been shown to provide preemptive analgesia, resulting in improved postoperative pain management and reduced opioid requirements after spinal anaesthesia.[29] However, further studies are needed for general anaesthesia. Additional investigation is required to clarify the differences in ketamine usage between non-specialists and specialists.

Postoperatively, specialists administered PCA more frequently than non-specialists. Regional technique data aligned with that of the UK.[28] The variation in analgesic practices and opioid use may be due to limited guidelines for GA for C/d. Available guidelines focus on analgesia for C/d done under NA.[11,15–19] Moreover, patient population heterogeneity, ranging from elective to emergency cases, may necessitate tailored pain relief practices.

The findings obtained from the CICO scenario aligned with the OAA/DAS guidelines.[11] Specialists (45%) exhibited a higher degree of comfort in performing FONA procedures than non-specialists (24%). This observed discrepancy ($p= 0.023$) in comfort levels between the

two groups may be attributed to a reduction in CICO instances necessitating FONA, likely stemming from advancements in technology and the adoption of safer practices.[3] Notably, studies conducted in England and Japan reported no occurrences of CICO scenarios.[21,22] Moreover, the integration of video-laryngoscopy, now widely accessible, into difficult airway algorithms demonstrates a 92% success rate as a rescue procedure. [8,20,30] Collectively, these factors may contribute to reduced exposure of junior anaesthetists to scenarios requiring FONA.

Limitations

The results of this study are based solely on the study population and cannot be extrapolated to the wider population of the province, private sector, or country. Furthermore, the response rate for specialists was only 39%, and the findings may not be representative of all specialist practices.

The survey used in this study did not differentiate between elective and emergency procedures, which may have impacted the results due to the heterogeneity of the patient population.

Conclusion

This study has revealed that both specialists and non-specialists are well-informed about obstetric anaesthesia guidelines and practices. However, there are challenges in performing GA for C/d, such as airway management, reducing the risk of aspiration, and ensuring foetal wellbeing.

Our analysis has highlighted the most preferred techniques for airway management. However, there are ongoing debates about the use of cricoid pressure. Moreover, the differences in preoxygenation endpoints and practices have emphasised the need for further research to determine best practices.

The variations in analgesic preferences, especially between specialists and non-specialists, have shown that perioperative pain management strategies are individualised. Our study has revealed that alfentanil is prominent among the opioids used, and remifentanil preference is

increased if it is freely available. This demonstrates the evolving use of opioids in obstetric anaesthesia.

This study has shown that the discourse surrounding GA for C/d is multifaceted and influenced by many factors, including clinical guidelines, practitioner preferences, and technological advancements. This study provides valuable insights into current practices and highlights the need for ongoing evaluation and refinement to improve patient outcomes in obstetric anaesthesia.

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Conflicts of interest
The authors of this study declare no conflict of interest.

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Section 4: Protocol

General Anaesthesia Practices for Caesarean Deliveries in Johannesburg Academic Hospitals

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Department of Anaesthesiology

4.1 Introduction

Neuraxial anaesthesia such as spinal and epidural anaesthesia is the gold standard for caesarean deliveries (C/d) but there are circumstances where general anaesthesia (GA) is used preferentially.[1] These include patient refusal, failed neuraxial anaesthesia, contraindications to neuraxial anaesthesia, foetal bradycardia, cord prolapse, placental abruption, and major placental praevia.[2] Failed neuraxial anaesthesia for C/d contributes up to one-third of GA conducted for C/d.[3] Socioeconomic disparities, scarcity of resources, lack of guidelines, and inadequate continuous medical education (CME) are also major contributing factors to the use of GA for C/d.[4]

The current GA rate recommended by the Royal College of Anaesthetists (RCA) for elective C/d is <1%, and <5% for emergent C/d.[4] According to the 2015/16 District Health Barometer statistics, the overall national caesarean rate in South Africa was 26 %, with Gauteng having had the fourth highest rate. In Gauteng, the C/d rate has been found to be 26% in district hospitals, 36% at regional hospitals, and 42% at central hospitals.[5]

A study conducted in 2016 showed that in low and middle-income countries (LMIC), GA for C/d was associated with a three-fold increase in mortality, and double the risk of perinatal deaths.[6] The use of GA may not only result in increased maternal and perinatal mortality, but also increased morbidity due to increased risk of complications such as maternal bleeding, intraoperative awareness, and suboptimal postoperative analgesia. These effects may not only personally affect the mother and child but may affect families and society itself due to the increased risks of developing postpartum depression, posttraumatic stress disorder (PTSD), poor maternal-infant bonding, and impaired ability to successfully breastfeed.[7]

GA for C/d is associated with an increased risk of complications such as surgical site sepsis, venous thromboembolic events, and increased blood loss.[8] The anaesthetic challenges associated with GA for C/d include establishing a definitive airway, aspiration pneumonia, and minimizing accidental awareness during general anaesthesia (AAGA).[9]
It has been found that for every 433 C/d done under GA, one will result in a failed intubation, with one front of neck access (FONA) procedure for every sixty failed intubations, and a mortality of one death for every ninety failed intubations.[3] The United Kingdom Obstetric

Surveillance System (UKOSS) study found an 8% incidence for aspiration during failed intubations in obstetric patients.[3] In the 5th National Audit Project (NAP5) one in every 670 C/d resulted in AAGA.[7]

GA for C/d has evolved over the years and there seems to be some divergence in induction techniques, specifically choice of induction agents, predelivery opioid use, and airway management. Fifty years ago, the advocated GA technique for C/d was the traditional rapid sequence induction (RSI) with thiopentone and suxamethonium, followed by maintenance with 50% nitrous oxide, oxygen, and halothane.[10] Half a century later, internationally halothane has been replaced with isoflurane and sevoflurane, and propofol has gained favour over thiopentone.[10,11] However, a survey done in the United Kingdom (UK) on current practice showed that over 90% of British Anaesthetists still prefer thiopentone, mainly for historical reasons.[11,12] Other reasons for the preference include a reduction in AAGA, familiar dose predictability, cardiovascular stability, and minimal effects on the baby.[12] In Wales, and Australia and New Zealand thiopentone is also the induction agent of choice in 86% and 85% of cases respectively. In North America however, the induction agent of choice is propofol.[12] In terms of neuromuscular blocking agents, suxamethonium at 1mg/kg was traditionally used but rocuronium has gained popularity with its better side effect profile.[13]

The use of opioids during induction for C/d remains controversial.[14] Conventionally, opioids were given after umbilical cord clamping to minimize uteroplacental transfer and subsequent neonatal respiratory depression. However, opioid use at induction has been advocated to minimize AAGA and to provide hemodynamic stability in the presence of pre-eclampsia and maternal cardiac pathology.[11] A recent systematic review and meta-analysis of randomized controlled trials on induction opioids in C/d showed that overall, remifentanil and alfentanil did not appear to affect neonatal outcomes but fentanyl was associated with a significant decrease in five-minute Apgar scores.[14] A survey done in the UK showed that only 15% of non-preeclamptic patients are given opioids routinely during a RSI for C/ds.[12] The survey also described the post-delivery analgesic practices with 70% of British Anaesthetists administering morphine post-delivery, 23% administering fentanyl, 5% alfentanil, and 37% performing transverse abdominis plane blocks (TAP) blocks.[12]

Previously routine supplementary nasal prong oxygen was not recommended. However, supplementary nasal prong oxygen at 5L/min is currently being supported to maintain bulk flow of oxygen during airway manipulation.[15] Controversy has also arisen around the use of cricoid pressure.[16] In the UK Confidential Enquires into Maternal Death reports (1994 to 2005) there was only two deaths from aspiration when cricoid pressure was routinely applied.[16] However, misapplication of cricoid pressure can result in cricoid pressure induced airway obstruction, as well as a decrease in lower oesophageal sphincter tone.[16]

GA for C/d is frequently an individualized practice and often department specific, most likely due to limited availability of guidelines and protocols.[17] International and regional obstetric anaesthesia guidelines vary, and practices are not standardized.[17] Inconsistencies among guidelines occur due to differences in organizational management practices, service delivery, education, infrastructure, expertise, and resource availability. Guidelines are also influenced by the developers' expert opinion, clinical experience, and writing approach.[17–19]

Available international guidelines include the Obstetric Anaesthetists' Association (OAA)/ Difficult Airway Society (DAS) 2015 Obstetric Airway Guidelines[15],
the Royal College of Anaesthetists (RCA) 2022 guidelines for the provision of anaesthesia services for an obstetric population [20], the 2016 American Society of Anaesthesiologists (ASA) Task Force on Obstetric Anaesthesia and The Society for Obstetric Anaesthesia and Perinatology practice guidelines for obstetric anaesthesia [21], the OAA/ Association of Anaesthetists of Great Britain and Ireland (AAGBI) 2013 guidelines for obstetric anaesthetic services [22], and the National Institute for Health and Care Excellence (NICE) Caesarean Birth 2021 guideline [23]. In South Africa, the only guideline available nationally is the Essential steps in managing obstetric emergencies (ESMOE) 2010 protocol [24]. There are currently no recommended guidelines available in the University of Witwatersrand Anaesthesiology Department. The OAA/DAS offers three algorithms for a safe obstetric GA with a focus on airway management. The algorithms cover circumstances that range from achieving successful intubation to circumstances whereby the patient cannot be intubated or oxygenated. It also provides the options that are available once a failed intubation has occurred. The 2022 RCA guideline recommendations are generalized and highlight staffing and organization requirements that are necessary to provide adequate anaesthetic care for the obstetric population. The ASA guideline covers the pre-anaesthetic evaluation, preparation, and anaesthetic care for C/d. The recommendations include equipment facilities, personnel,

general and neuraxial anaesthesia technique, intravenous fluids, vasopressors use, as well as neuraxial opioids for postoperative analgesia after neuraxial anaesthesia. It also covers the management of obstetric haemorrhages and airway emergencies. The ASA guidelines do not cover postoperative analgesia after GA for C/d.
The OAA/AAGBI guideline was developed to ensure that obstetric patients are cared for by the same standards as non-obstetric patients. It focuses on the roles and duties of obstetric anaesthetists within the multidisciplinary team. The NICE guidelines have recommendations covering aspects of when to offer C/d, C/d education, the procedural aspects of C/d, and the care thereafter. The ESMOE guideline is a protocol that is specific for C/d under GA. The protocol gives specific steps on the preparation for a GA for C/d as well as the technique and recovery.

Standardized guidelines aid to ensure high quality of care by limiting inconsistency in patient care, and have the potential to improve patient outcomes.[18] Despite the availability of a national guideline, there are no published studies assessing current practice of Anaesthetists in Johannesburg Academic Hospitals, nor are there studies establishing and evaluating access to, uptake, or acceptance of these guidelines.

The purpose of this study is to, therefore, establish and describe current practice, and to gauge if practices are standardized and in accordance with current, available guidelines. This will assist with determining the need for producing and establishing locally relevant guidelines. Furthermore, it will assist in generating a baseline from which further instituted interventions can be evaluated.

4.2 Problem Statement

GA for C/d is associated with increased maternal and perinatal mortality and morbidity. The paucity of standardized evidence-based and patient-centred care guidelines may be responsible for poorer outcomes. Currently, there is limited data on the GA practices for C/d in Johannesburg academic hospitals. It is therefore vital to obtain this data to assess the need for the implementation of standardized guidelines, and continuing medical education (CME).

4.3 Aim

The aim of this study is to describe the current GA practices and experiences of Anaesthetists working in the Department of Anaesthesiology at the University of Witwatersrand.

4.4 Objectives

Primary Objectives

- Describe the anaesthetists' awareness of clinical guidelines, and challenges experienced during the provision of GA for C/d.
- Describe the anaesthetists' practices with respect to positioning, airway management, and pharmacology relating to the performance of GA for C/d.
- Compare the anaesthetists' airway management practices for a "cannot intubate and cannot ventilate" airway scenario with the OAA/ DAS 2015 Obstetric Airway Guidelines.
- Describe anaesthetists' practices with respect to preventing AAGA.
- Describe analgesia practices relating to C/d under GA.

Secondary Objective

Describe the differences in GA practices for C/d between Specialist Anaesthetists and non-Specialist Anaesthetists.

4.5 Research Assumptions

The following definitions will be used in the study:

Accidental awareness during general anaesthesia (AAGA): a complication arising from general anaesthesia where the patient experiences intraoperative awareness and explicit recollections of intraoperative events.
Airway Management: the assessment and interventions used to establish and maintain an effective pathway in which oxygenation and ventilation can occur.
Anaesthetist: a qualified medical doctor who practices anaesthesia, focusing on perioperative care and the administration of anaesthetic agents.

Analgesia: relief of pain.

Aspiration: the inhalation of foreign substances into the lungs.

Caesarean delivery (C/d): a surgical procedure whereby a foetus/foetuses are delivered through a surgical incision in the abdominal and uterine wall. Also known as a caesarean section.

Career Medical Officer: a medical officer working in the capacity of an anaesthetist with more than ten years and considered as a consultant.

Cricoid pressure: a technique used during a rapid sequence induction (RSI) to limit the risk of aspiration. Pressure is applied at the cricoid cartilage in the neck, with the aim of occluding the oesophagus. Also known as Sellick's manoeuvre.

Emergence: the process and period where the patient transitions from the anaesthetized state to the conscious state, after the termination of the anaesthetic agents, at the end of the surgical procedure.

Foetus: an unborn baby from eight weeks after fertilization until birth.

General Anaesthesia (GA): an induced temporary state of unconsciousness with immobility and the absence of pain sensation accomplished with inhalational or intravenous agents.

Induction agent: a drug that produces the rapid loss of consciousness. Induction agents can be given intravenously or inhaled.

Induction: the process and period where the patient transitions from the awake to the anaesthetized state accomplished by inhalational or intravenous agents.

Junior Registrar: An Anaesthetic Registrar in the first two years of training.

Maintenance: the process by which the patient is kept anaesthetized by inhalational or intravenous agents.

Maternal: a term that relates to a mother, especially during pregnancy, childbirth, and the postpartum period.

Medical Officer: a doctor who has completed three years of practice since graduating from medical school, working in the capacity of an Anaesthetist, but not a Registrar.

Multimodal analgesia: a pharmacological approach whereby more than two classes of drugs are used to manage pain.

Neonate: a baby that is less than twenty-eight days old.

Neuromuscular blocking agent: Drugs that temporarily induce skeletal muscle paralysis. Also known as muscle relaxants.

Obstetric: a term that relates to pregnancy, childbirth, and the postpartum period.

Opioid: a class of synthetic drugs that interacts with opioid receptors in the body.

Postpartum: the six-week period after the baby has been delivered.
Rapid sequence induction (RSI): a method of inducing anaesthesia in patients that are at risk of aspiration with the aim of rapidly and safely intubating the trachea, with or without the application of cricoid pressure.
Registrar: a qualified doctor who is receiving advanced training in the field of Anaesthesiology to become a Specialist Anaesthesiologist.
Senior Registrar: An Anaesthetic Registrar in the last two years of training.
Specialist Anaesthetist: a fully qualified medical doctor that has completed the required years of training and exams in anaesthesia. Also known as Consultant Anaesthetist/Anaesthesiologist.

4.6 Demarcation of study field

The study will be conducted as an online electronic survey on the Research Electronic Data Capture (REDCap ®) web application. The population will include all Medical Officers, Registrars, and Specialist Anaesthesiologists working at the University of Witwatersrand Academic Hospitals, namely:

- Charlotte Maxeke Johannesburg Academic Hospital.
- Chris Hani Baragwanath Academic Hospital.
- Helen Joseph Hospital.
- Rahima Moosa Mother and Child Hospital.

4.7 Ethical considerations

The participants' details and the raw data collected will only be accessible to the Principal Researcher, and the Supervisors. The participants' details will be obtained from the respective departmental phone lists. The questionnaires will be completed anonymously. Each participant will be furnished with an information letter that explains the purpose of the study, and completion of the survey will be considered as implied consent.

The study will be conducted through the REDCap® platform which is compliant with Heath Insurance Portability and Accountability Act (HIPA) also known as South Africa's Protection of Personal Information Act No. 4 (POPI).

The study data will be collected and managed using REDCap® electronic data capture tools hosted at the University of Witwatersrand. REDCap® will be used as it is a secure, web-based software platform that is appropriate to support data capture for this study. The data will be stored on a single personal computer, external physical drive, and online storage via the REDCap® platform which will be password protected. All devices that can access the data will have current antivirus software and appropriate firewalls. All the research data will be collected and stored digitally on the REDCap® web application, which negates the need for any hard copies. The data will be stored for a minimum of six years after which the raw data will be erased permanently.

Prior to conducting the study, permission from the following bodies will be sought and only once granted will the study be performed:

- Postgraduate Research Committee.
- Human Research Ethics Committee (Medical) of University of Witwatersrand.
- The Anaesthesiology Head of Department (Prof. Palesa Motshabi) (Appendix 1).

4.8 Research Methodology

4.8.1 Research design

This study has been designed as a prospective, descriptive, contextual, and cross-sectional study. It will be performed using a self-administered questionnaire that will be distributed electronically through the REDCap® web application (Appendix 3).

4.8.2 Study Population

The study population consists of all anaesthetists working in the Johannesburg Academic Hospitals affiliated with the University of Witwatersrand, including Medical Officers, Registrars, and Specialist Anaesthetists.

4.8.3 Study Sample

4.8.3.1 Sample size

There are approximately 228 eligible participants in the Department of Anaesthesiology, consisting of:

- 49 Medical Officers.
- 100 Registrars.
- 79 Specialist Anaesthetists /Consultants.

Assuming a 5 % margin of error, 95% confidence level, and 50% response distribution, 144 participants will be required.

4.8.3.2 Sampling Method

The study will make use of non-probability convenience sampling.
An electronic questionnaire will be distributed via the REDCap® platform, and participants will complete the questionnaire at their convenience.

4.8.3.3 Inclusion Criteria

All Medical Officers, Registrars, and Specialist Anaesthetists working in the academic hospitals affiliated with the University of Witwatersrand, at the time of data collection, will be eligible to participate in the study.

4.8.3.4 Exclusion Criteria

The following individuals will be excluded from the study:

- Medical Students.
- Medical Interns.
- Community Service Doctors.
- Anaesthetists employed and working at hospitals in Johannesburg not affiliated with the University of Witwatersrand.

4.8.4 Data collection

Participants will be requested to anonymously complete an electronic self-administered questionnaire which will be distributed on the REDCap® web platform. The data will also be stored on this platform.

4.8.4.1 Data collection tool

The content of the questionnaire is based on current and available international guidelines and has been reviewed and corrected by ten Specialist Anaesthetists, affiliated with the University of Witwatersrand Department of Anaesthesiology, who have a special interest in regional and obstetric anaesthesia.

4.8.5 Data analysis

Data collected from the surveys will be transferred from the REDCap® web platform to a Microsoft Office Excel® spreadsheet. The data will be analysed in consultation with a biostatistician. Descriptive and inferential statistics will be utilised. The demographic data will be analysed using numerical and visual summaries, means, medians, standard deviations, and interquartile ranges where appropriate. Frequencies and percentages will be used to summarise the findings relating to anaesthetic practice. Frequencies and percentages will be used to summarise the response options. Categorical data will be analysed using the Chi-square and Fisher's Exact tests. In the instances where categorical data is ordinal, a Chi-square test for trend will be used. For non-parametric continuous data, the Kruskal-Wallis and Wilcoxon summed-ranked tests will be employed. A p-value of less than 0.05 will be considered significant.

4.8.6. Significance of the study

GA for C/d is associated with increased maternal and perinatal mortality and morbidity, as well as many anaesthetic challenges. The scarcity of guidelines can lead to variable patient care and poor outcomes. Currently, there is limited data on the GA practices for C/d at Johannesburg academic hospitals. This study will assess guideline adherence, the need for development and institution of standardized protocols, and will establish whether CME

activities are required. This study will also serve as a baseline from which future interventions can be governed.

4.9 Validity and reliability of the study

Validity and reliability of the study will be ensured by:

- Having a representative study sample.
- Using an appropriate questionnaire based on a thorough literature review.
- Having ten Specialist Anaesthetists, affiliated with the University of Witwatersrand Department of Anaesthesiology, who have a special interest in regional and obstetric anaesthesia review the questionnaire prior to data collection, to ensure content and face validity. (Appendix 3)
- Analysing data in consultation with a biostatistician.

4.10 Potential limitations of the study

The study is contextual by nature. The results will only represent the practices of anaesthetists working in the University of Witwatersrand Department of Anaesthesiology, and therefore, the findings cannot be generalized to other departments or institutions.
The use of convenience sampling is also considered a limitation as this may result in sampling bias. Furthermore, participants may not respond honestly to the questions in the survey or may fail to complete the questions.

4.11 Project outline

4.11.1 Time frame

Year	2022						2023							
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Proposal	X	X	X	X	X	X	X							
Ethics approval									X					
Postgraduate approval								X						
Data collection										X	X	X		
Data analysis													X	
Submission														X

4.11.2 Financial plan

Description	Cost	Quantity	Total Quantity	Total Cost
Printing (proposal)	R1 per page	15 pages max	4 x copies	R60
Printing (research dissertation)	R1 per page	100 pages max	4 x copies	R400
Binding (research dissertation)	R12		4	R48
Grand Total				**R508**

The Department of Anaesthesiology will bear the cost of the following:

- Printing and paper for the proposal, as well documents relating to ethics and post-graduate approval.
- The use of the REDCap® platform.

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Section 5: Appendices

Appendix 1: ESMOE guideline



National ESMOE guidelines
for district and regional hospitals



PROTOCOL FOR CAESAREAN SECTION
UNDER GENERAL ANAESTHESIA

PREPARATION

Full history and examination
- NB airway and assess difficulty of intubation
- NB signs of hypovolaemia - decide whether the patient requires resuscitation first

Prepare the patient
- Premedication – sodium citrate 30ml orally, 0 - 30 minutes pre-operatively
- Good IV access, with 500ml clear fluid given as preload
- Urinary catheter

Prepare the theatre
- Full machine check, check ventilator settings
- Check essential equipment and monitoring (ECG, NIBP, SpO_2, capnograph)
- Draw up essential drugs

TECHNIQUE

Position the patient
- Wedge under right hip
- Head and shoulders on a pillow, sniffing

Administration of general anaesthesia
- Measure NIBP now, and every 3 minutes
- Establish ECG and pulse oximetry
- Pre-oxygenate 100% FiO_2 for 3 minutes
- Start the suction, place Yankauer nearby
- Perform rapid-sequence induction with cricoid pressure, then perform laryngoscopy and intubation
- Confirm correct placement of ETT by capnography, auscultation and clinical impression of chest moving equally
- Ventilate, using at least 40% oxygen and not more than 1 MAC volatile
- Use small doses of short-acting muscle relaxant if necessary

Failed intubation
- Call for help, and try to wake patient up
- Institute mask ventilation while maintaining cricoid pressure

If successful mask ventilation:

(i) Check head position, change to a different laryngoscope blade, assistant to externally manipulate the cricoid, and re-attempt intubation.

(ii) If still unsuccessful, decide whether to continue with mask ventilation OR with spontaneous ventilation OR attempt insertion of LMA OR awaken the patient

If unsuccessful mask ventilation:

(i) One further intubation attempt OR attempted insertion of LMA

(ii) If still unsuccessful and unable to ventilate, and spontaneous ventilation has not resumed, perform an emergency cricothyroidotomy (or tracheostomy), and ventilate the patient.

iii) Decide whether to continue with the procedure or wake the patient up

After delivery
- Ask obstetrician if they are certain there is no second baby
- Give 2.5 IU oxytocin IVI slowly, over 1 minute
- Can increase volatile, and give multimodal analgesia – morphine 10mg, consider fentanyl 100ug, non-steroidal anti-inflammatory, paracetamol, and infiltrating the wound with local anaesthetic.

Once the surgery is completed
- Switch off the volatile, and give reversal if a non-depolarising muscle relaxant was given use nerve stimulator or see signs of spontaneous recovery first.
- Extubate in theatre, awake and reversed

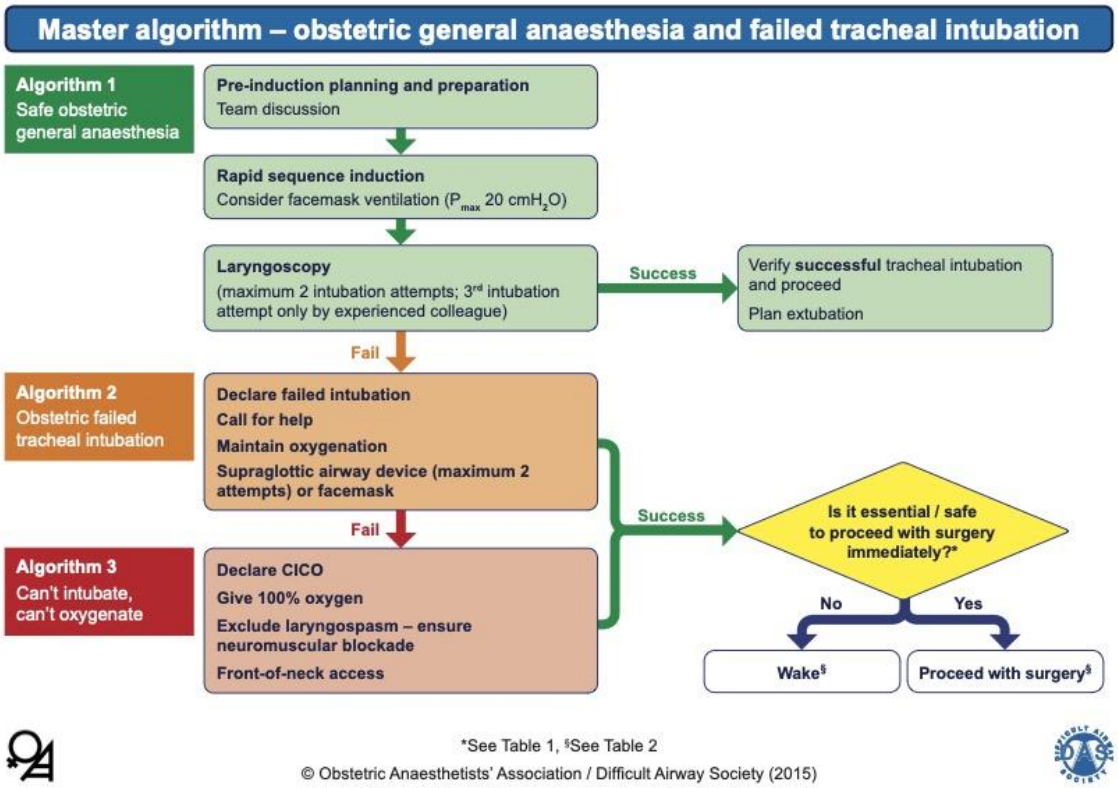
RECOVERY

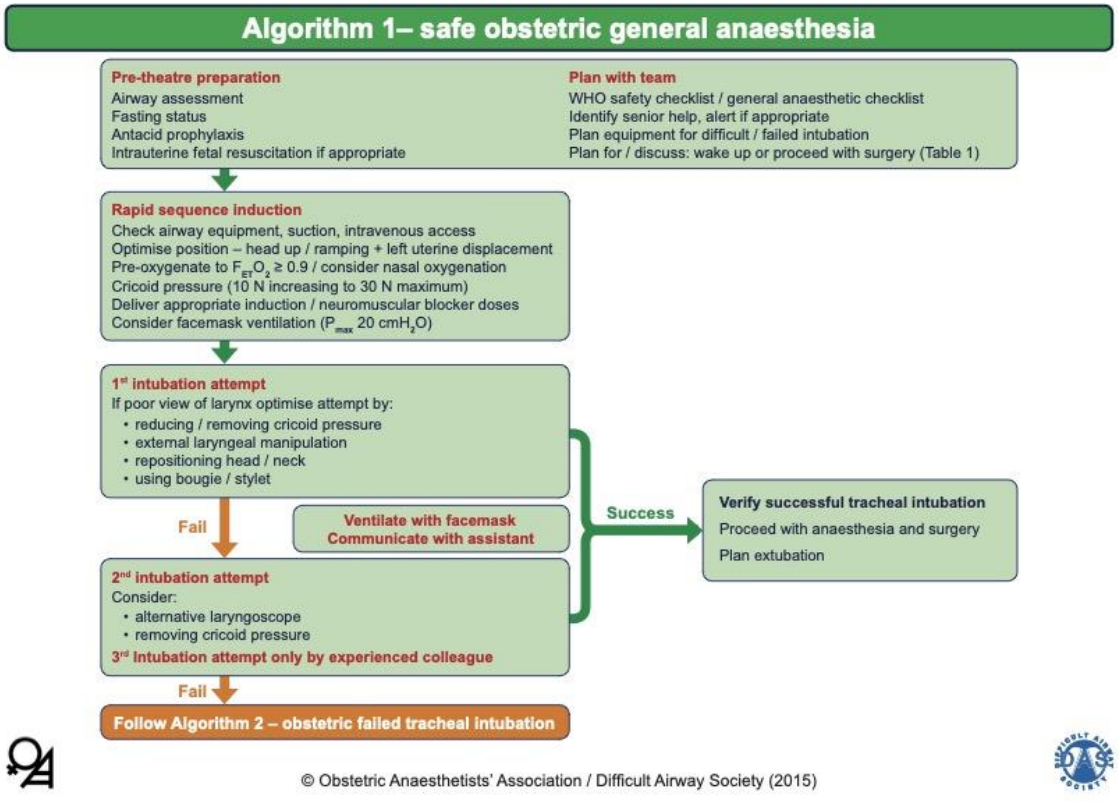
Monitoring
- Administer oxygen via 40% venturi mask
- Monitor NIBP and SpO_2
- Make sure that the patient is not bleeding
- Make sure that the patient is well analgesed
- Infuse 20 IU oxytocin in one litre of clear fluid over 8 hours (125mls/hr)

Discharge to the ward

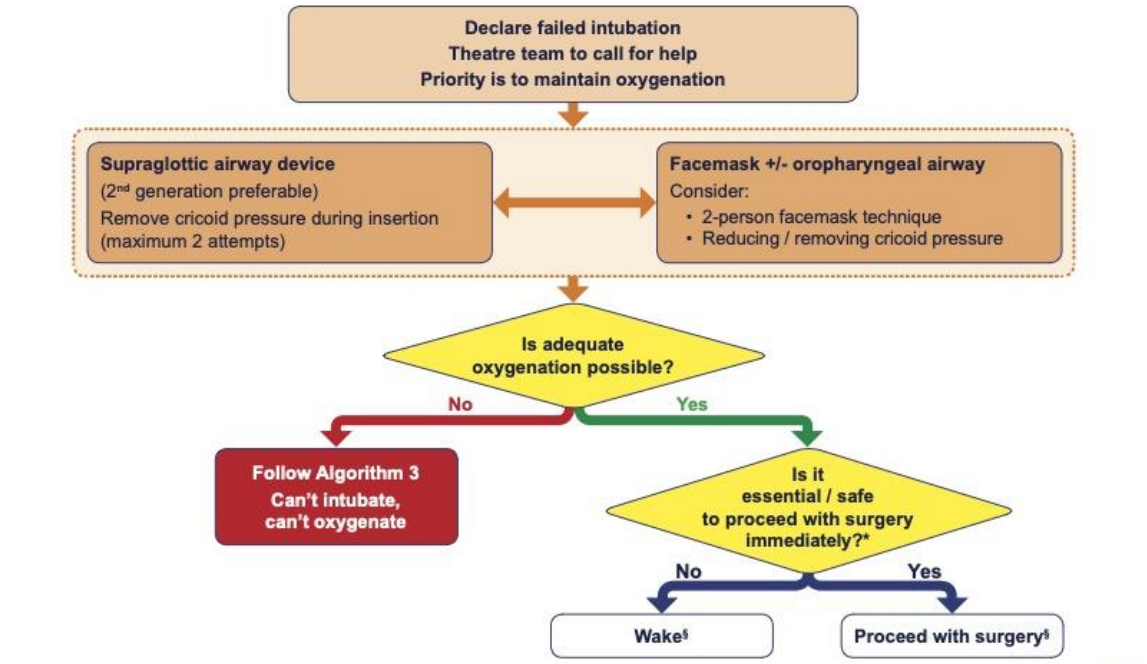
Compiled by the ESMOE Anaesthesia Working Group
July 2009 Updated March 2011

Appendix 2: OAA/DAS 2015 guideline





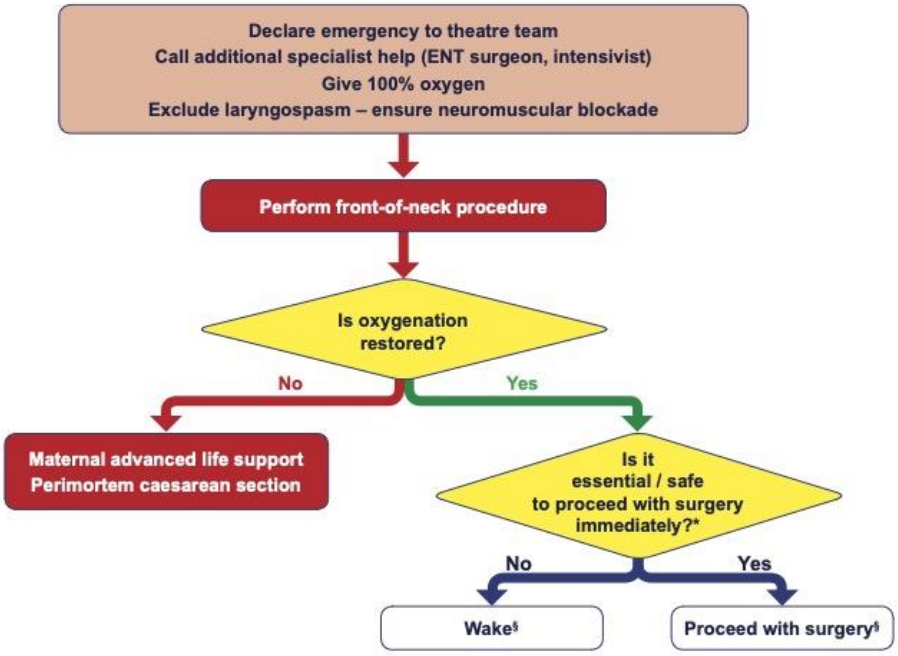
Algorithm 2 – obstetric failed tracheal intubation



*See Table 1, §See Table 2

© Obstetric Anaesthetists' Association / Difficult Airway Society (2015)

Algorithm 3 – can't intubate, can't oxygenate



*See Table 1, §See Table 2

© Obstetric Anaesthetists' Association / Difficult Airway Society (2015)

Appendix 3: Participant questionnaire

Confidential

General anaesthesia practices for caesarean deliveries in Johannesburg academic hospitals

Please complete the questions below regarding your experiences and practices of general anaesthesia for caesarean deliveries.

Thank you!

	Demographics	
1	Which age group do you fall into?	◯ 25-29 ◯ 30-39 ◯ 40-49 ◯ 50-59 ◯ ≥60
2	Which gender do you identify as?	◯ Female ◯ Male ◯ Non-binary ◯ Not prepared to disclose
3	What is your anaesthesiology experience in years post community service?	◯ < 1 ◯ 1-2 ◯ 3-5 ◯ 6-9 ◯ 10-20 ◯ ≥20
4	What is your current rank?	◯ Medical officer ◯ Junior registrar (registrar in the first 2 years of training) ◯ Senior registrar (registrar in the final 2 years of training) ◯ Consultant ◯ Career medical officer
4.1	Do you have a diploma in anaesthesia (DA)?	◯ Yes ◯ No

Experience in general anaesthesia for caesarean deliveries

5 Are you aware of any obstetric anaesthesia guidelines?
- ○ Yes
- ○ No

5.1 Which guidelines do you commonly use for your everyday practice? (More than one choice is acceptable)
- ☐ The Obstetric Anaesthetist's Association (OAA)/ Difficult Airway Society (DAS) 2015 Obstetric Airway Guidelines
- ☐ The Royal College of Anaesthetists (RCA) 2022 guidelines for the provision of anaesthesia services for an obstetric population
- ☐ The 2016 American Society of Anaesthesiologist Task Force on Obstetric Anaesthesia and The Society for Obstetric Anaesthesia and Perinatology Practice guidelines for obstetric anaesthesia
- ☐ The OAA/ Association of Anaesthetists of Great Britain and Ireland (AAGBI) 2013 guidelines for obstetric anaesthetic services
- ☐ The National Institute for Health and Care Excellence (NICE) Caesarean Birth 2021 guideline
- ☐ The Essential Steps in Managing Obstetric Emergencies (ESMOE) 2010 protocol
- ☐ Other

5.1.1 If other please specify in the textbox provided.

_____

6 Which areas in the provision of general anaesthesia for caesarean deliveries do you find challenging? (More than one choice is acceptable)
- ☐ Positioning
- ☐ Aspiration risk
- ☐ Airway management
- ☐ The indications for general anaesthesia for caesarean delivery
- ☐ Induction
- ☐ Maintenance
- ☐ Emergence and extubation
- ☐ Intraoperative Analgesia
- ☐ Postoperative analgesia
- ☐ Accidental Awareness during general anaesthesia (AAGA)
- ☐ Foetal concerns
- ☐ Uterotonic management
- ☐ Pharmacological dosing adjustments in the obstetric patient
- ☐ Other
- ☐ None

6.1 If other, please specify in the textbox provided.

_____

7	Of the challenges you selected above, which do you find the most challenging?	◯ Positioning ◯ Aspiration risk ◯ Airway management ◯ The indications for general anaesthesia for caesarean delivery ◯ Induction ◯ Maintenance ◯ Emergence and extubation ◯ Intraoperative Analgesia ◯ Postoperative analgesia ◯ Accidental Awareness during general anaesthesia (AAGA) ◯ Foetal concerns ◯ Uterotonic management ◯ Pharmacological dosing adjustments in the obstetric patient ◯ Other ◯ None
7.1	If other, please specify in the textbox provided.	_____
8	In your experience what is the most common reason why you have performed general anaesthesia for caesarean deliveries?	◯ Patient refusal ◯ Failed spinal ◯ Spinal wearing off ◯ Severe foetal compromise ◯ High risk of surgical complications ◯ High risk for major haemorrhage ◯ Inadequate preoperative investigations ◯ Contraindications to do a neuraxial technique ◯ Other
8.1	If other, please specify in the textbox provided.	_____

Positioning for general anaesthesia for caesarean section

9 Once the patient is on the theatre bed, how do you position the patient?

- ◯ Lateral tilt
- ◯ Placement of a wedge
- ◯ Manual uterine displacement
- ◯ Neutral supine position
- ◯ Other

9.1 If other, please specify in the textbox provided.

_____

Accidental awareness during general anaesthesia (AAGA) for caesarean deliveries

10 During general anaesthesia for caesarean delivery, at which point do you think the patient is at the highest risk for accidental awareness during general anaesthesia (AAGA)?

- ◯ Induction
- ◯ Airway management
- ◯ Period after airway management and before cord clamping
- ◯ Maintenance
- ◯ Emergence and extubation

11 What management strategies do you use to minimize accidental awareness during general anaesthesia (AAGA) for caesarean deliveries?
(More than one option is acceptable)

- ☐ Use higher doses of induction agents
- ☐ Obtain adequate end-tidal levels of volatile agents prior to incision
- ☐ Use of opioids
- ☐ Ensuring correct drug labelling and correct drugs are given
- ☐ Have additional doses of the induction agent available in the event of a difficult airway
- ☐ Use of benzodiazepines
- ☐ Other
- ☐ None

11.1 If other, please specify in the textbox provided.

_____

Positioning for airway management during general anaesthesia for caesarean deliveries

12	How do you position the patients for airway management and intubation?	◯ Ramped /head-elevated laryngoscopy position (HELP) position ◯ Neutral supine position ◯ Other
12.1	If other, please specify in the textbox provided.	_____
13	Which position do you commonly extubate your patients?	◯ Semi-recumbent/ Head-up position ◯ Left lateral position ◯ Neutral supine position ◯ Other
13.1	If other, please specify in the textbox provided.	_____

	Preoxygenation during general anaesthesia for caesarean delivery	
14	What is your preferred endpoint of preoxygenation?	◯ End-tidal oxygen concentration ≥ 90% ◯ End-tidal oxygen concentration ≥ 80% ◯ End-tidal oxygen concentration ≥ 70% ◯ End-tidal Nitrogen concentration < 5% ◯ SPO2 ≥ 99% ◯ 8 vital capacity breaths ◯ 3- 5 minutes of tidal breaths breathing
15	Do you routinely give nasal prong (≤5 L/min) supplementary oxygen during preoxygenation and during intubation?	◯ Yes ◯ No
16	Do you routinely give high-flow nasal prong oxygen (≥10-15 L/min) during preoxygenation and during intubation?	◯ Yes ◯ No
17	For an anticipated difficult airway, do you routinely give nasal prong supplementary oxygen during preoxygenation and during intubation?	◯ Yes ◯ No
18	If freely available, would you include Humidified High Flow Nasal Oxygen (HFNO) (≥30 L/min) in your airway management practices?	◯ Yes ◯ No

	Airway management during general anaesthesia for caesarean deliveries	
19	Do you routinely use cricoid pressure?	◯ Yes ◯ No
20	How do you routinely perform laryngoscopy?	◯ Direct laryngoscopy ◯ Video laryngoscopy
21	Which of the following drugs do you commonly use to blunt the intubation response? (More than one choice is acceptable)	☐ Intravenous lignocaine ☐ Magnesium sulphate ☐ Short-acting opioid ☐ Beta-blocker ☐ None ☐ Other
21.1	If other, please specify in the text box provided.	_____

General anaesthesia for caesarean delivery scenario

The following questions (22.1-22.8) relate to the following scenario:
You are performing a general anaesthetic for an emergency caesarean delivery for which neuraxial techniques are contraindicated. During your preoperative assessment, you evaluated the patient as not having a difficult airway.

22.1 After how many attempts would you declare a failed intubation?

- ○ 1
- ○ 2
- ○ 3 (your own 3rd attempt)
- ○ 3 (3rd attempt by a senior colleague or experienced colleague

22.2 During your first laryngoscopy and intubation attempt, you encounter difficult visualisation. What are your actions next? (More than one choice is acceptable)

- ☐ Reduce/remove cricoid pressure if applied
- ☐ External laryngeal manipulation
- ☐ Reposition the head/neck
- ☐ Use a stylet/Bougie
- ☐ Request for a video laryngoscope

22.3 Your first attempt is unsuccessful, do you use the facemask to ventilate the patient until your second attempt at intubation?

- ○ Yes
- ○ No

22.3.1 At which SPO2 would you start face mask ventilation prior to the second intubation?

- ○ < 92%
- ○ < 88%
- ○ < 80%

22.4 During your second intubation attempt, what are your actions to maximize your intubation success? (All your chosen actions from your first attempt are already in place) (More than one choice is acceptable)

- ☐ Remove cricoid pressure
- ☐ Request for a video laryngoscope
- ☐ Request for next laryngoscopy to be done by a senior colleague or experienced colleagues

22.5 After the 3rd attempt is unsuccessful, what are your actions next? (More than one choice is acceptable)

- ☐ Declare an emergency
- ☐ Call for assistance including the intensivist or the ENT surgeon
- ☐ Another attempt at intubation
- ☐ Oxygenate with a facemask
- ☐ Oxygenate with a supraglottic airway device (SAD)
- ☐ Front of neck access (FONA)

22.6 How many times would you attempt at inserting a supraglottic airway device (SAD)?

- ○ 1
- ○ 2
- ○ 3
- ○ 4

22.7 After failed intubations and supraglottic airway device (SAD) insertions, which action(s) would you perform to optimize face mask oxygenation? (More than one choice is acceptable)

- ☐ Two-person technique
- ☐ Adequate muscle relaxation
- ☐ Simple airway adjuncts
- ☐ None

22.8 Are you comfortable performing front of neck access (FONA) if the occasion arose?

- ○ Yes
- ○ No

Pharmacology

23	Which intravenous induction agent do you use the most for general anaesthesia for caesarean delivery?	◯ Propofol ◯ Thiopentone ◯ Ketamine ◯ Etomidate
24	If all intravenous induction agents are accessible to you, which would be your preferred agent?	◯ Propofol ◯ Thiopentone ◯ Ketamine ◯ Etomidate
25	What is the commonest induction dose of propofol that you use for caesarean deliveries?	◯ 1 mg/kg ◯ 1.5 mg/kg ◯ 2 mg/kg ◯ 2.5 mg/kg ◯ 3 mg/kg
26	Which neuromuscular blocking agent do you use the most in general anesthesia for caesarean delivery?	◯ Suxamethonium ◯ Rocuronium ◯ Cisatracurium ◯ Atracurium ◯ Vecuronium ◯ Other
26.1	If other, please specify in textbox provided.	_____
27	If all neuromuscular blocking agents are available with the appropriate reversal agents, which would you use?	◯ Suxamethonium ◯ Rocuronium ◯ Cisatracurium ◯ Atracurium ◯ Vecuronium ◯ Other
27.1	If other, please specify in textbox provided.	_____
28	Do you routinely administer agents for postoperative nausea and vomiting (PONV)?	◯ Yes ◯ No
29	Which agents do you use for PONV? (More than one choice is acceptable)	☐ Ondansetron ☐ Droperidol ☐ Metoclopramide ☐ Promethazine ☐ Dexamethasone ☐ Other
29.1	If other, please specify in textbox provided.	_____

Analgesia

30 In an ideal setting before cord clamping which opioid would you routinely use?

- ◯ None
- ◯ Alfentanil
- ◯ Remifentanil
- ◯ Fentanyl
- ◯ Sufentanil
- ◯ Other

30.1 If other, please specify in the textbox provided.

_____

31 In actual practice which opioid would you routinely use prior to cord clamping?

- ◯ None
- ◯ Alfentanil
- ◯ Remifentanil
- ◯ Fentanyl
- ◯ Sufentanil
- ◯ Other

31.1 If other, please specify in the text box provided.

_____

32 What are your analgesic practices prior to cord clamping? (More than one choice is acceptable)

- ☐ Short-acting opioids
- ☐ Ketamine
- ☐ Alpha -2-agonist
- ☐ Magnesium Sulphate
- ☐ Intravenous Lignocaine
- ☐ Paracetamol
- ☐ Regional technique
- ☐ Other

32.1 If a regional technique is used, which regional technique?

- ☐ Bilateral Transverse Abdominis Plane (TAP) blocks
- ☐ Bilateral Erector Spinae Plane (ESP) blocks
- ☐ Bilateral Quadratus Lumborum (QL) blocks

32.2 If other, please specify in the textbox provided.

_____

33 What are your intraoperative analgesia practices after cord clamping? (More than one choice is acceptable)

- ☐ Short -acting opioid
- ☐ Long-acting opioid
- ☐ Ketamine
- ☐ Magnesium Sulphate
- ☐ Intravenous Lignocaine
- ☐ Paracetamol
- ☐ Nonsteroidal anti-inflammatory drugs (NSAID)
- ☐ Other

33.1 If other, please specify in the textbox provided.

_____

34 Which of the following do you administer to the patient for postoperative analgesia? (More than one choice is acceptable)

- ☐ Regional technique if not done prior to surgery
- ☐ Local anaesthetic infiltration by surgeon
- ☐ NSAID
- ☐ Long-acting opioid
- ☐ Patient-controlled analgesia (PCA)
- ☐ Paracetamol
- ☐ Other

34.1 If a regional, technique is used, which of the following do you perform?

- ◯ Bilateral Transverse Abdominis Plane (TAP) blocks
- ◯ Bilateral Erector Spinae Plane (ESP) blocks
- ◯ Bilateral Quadratus Lumborum (QL) blocks

34.2 If other, please specify in the textbox provided.

_____

Appendix 4: Information sheet for participants

Dear Colleagues

My name is Alice Fan. I am an Anaesthetics registrar at the University of Witwatersrand. I would like to invite you to participate in the research for my MMed titled: "General Anaesthesia Practices for Caesarean Deliveries in Johannesburg Academic Hospitals".

The aim of the study is to describe the current general anaesthesia (GA) practices and experiences of University of Witwatersrand Anaesthetists with respect to performing GA for caesarean deliveries (C/d) and managing complications associated with performing GA.

The data obtained from the study will be analysed and compared to international best practices. Furthermore, the information gained from the study will establish a need for producing locally relevant guidelines.

Permission to conduct this study has been obtained from the Anaesthesiology Head of Department, the University of Witwatersrand Human Research Ethics Committee, as well as the Postgraduate committee.

Participation in the study is on a voluntary and anonymous basis. Consent will be implied with the completion and return of this questionnaire. The data obtained will be confidential and will only be accessible to the principal researcher, supervisors, and the biostatistician.

Completion of this questionnaire should not take longer than 10 minutes. There are no incentives for completing this questionnaire and you will not be penalized for not taking part in this study.

If there are any queries or concerns prior, during or after completing this questionnaire, please feel free to contact me.

Kindest regards,
Alice Fan (Principal Researcher)
Cell: 071 868 6094
Email: aliceyulinfan@gmail.com

Appendix 5: Letter of permission from Head of Department

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

07 March 2023

Postgrad Office

School of Clinical Medicine

Faculty of Health Sciences

University of the Witwatersrand

To Whom It May Concern

Permission To Conduct Research: Dr Alice Fan- Student Number:352992

This is to confirm that I have read and given permission for **Dr Alice Fan** to conduct research at in the Department of Anaesthesiology towards his/her Mmed project titled ***"General Anaesthesia for Caesarean deliveries in Johannesburg Academic Hospitals"***

Thank you.

Assoc. Prof. P Motshabi Chakane

Ass Prof P. Motshabi Chakane
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HOU Cardiac Anaesthesia
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Appendix 6: Human Research Ethics Committee Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr Alice Fan

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M230337 MED23-03-031

NAME: (Principal Investigator)	Dr Alice Fan
DEPARTMENT:	Anaesthesia Research Electronic Data Capture (REDCap ®)
PROJECT TITLE:	*General Anaesthesia Practices for Caesarean Deliveries in Johannesburg Academic Hospitals*
DATE CONSIDERED:	31/03/2023
DECISION:	Approved unconditionally
CONDITIONS:	
NOTE:	
SUPERVISOR:	Dr Janine Wagner and Dr Thomas Kleyenstuber
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	18/05/2023 **EXPIRY DATE:** 18/05/2028

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions.Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.** The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **March** and will therefore be due in the month of **March** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature — Date: 22/05/2023

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix 7: Approval from the postgraduate committee

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

13 March 2023
Person No: 352992
PAG

Dr A Fan
84a 5th Avenue
Melville
Melville
2092
South Africa

Dear Dr Alice Fan

Master of Medicine in Anaesthesia: Approval of Title

We have pleasure in advising that your proposal entitled *General Anaesthesia Practices for Caesarean Deliveries in Johannesburg Academic Hospitals* 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 8: Turnitin report

Draft article-General Anaesthesia Practices for Caesarean Deliveries in Johannesburg Academic Hospitals.pdf

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