University of Cape Town

Faculty of Health Sciences

Knowledge of South African anaesthesia registrars of the theory and practice of spinal anaesthesia for caesarean section

Minor dissertation submitted in partial fulfilment of the requirements for the degree of Master of Medicine (MMed) in the Department of Anaesthesia and Perioperative Medicine

Dr Willem Abraham Prinsloo Ras, MBChB, DA (SA), FCA (SA)

Student No: RSXWIL001

Submitted: 29/06/2023

Principal supervisor:

Prof Dominique van Dyk, MBChB, DA (SA), FCA (SA)

Co- supervisor:

Prof Robert Dyer, MBChB, FCA (SA), PhD

Department of Anaesthesia and Perioperative Medicine, University of Cape Town

University of Cape Town

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

University of Cape Town

Declaration Page

Plagiarism Declaration:

1. I know that plagiarism is a serious form of academic dishonesty.
2. I have read the document about avoiding plagiarism, am familiar with its contents and have avoided all forms of plagiarism mentioned there.
3. Where I have used the words of others, I have indicated this using quotation marks.
4. I have referenced all quotations and properly acknowledged other ideas borrowed from others.
5. I have not and shall not allow others to plagiarise my work.
6. I declare that this is my own work.
7. I am attaching the summary of the Turnitin match overview (when required to do so).

Signature: Signed by candidate Date: 29/06/2022

I, Willem Abraham Prinsloo Ras, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I authorise the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signature: Signed by candidate Date: 29/06/2022

Format:

The contents of this minor dissertation are presented in the ‘publication-ready’ format.

Acknowledgements and contributions.

Primary author and MMed candidate:

Willem Abraham Prinsloo Ras, MBChB, DA (SA), FCA (SA)

Principal supervisor:

Dominique van Dyk, MBChB, DA (SA), FCA (SA)

Co-supervisor:

Robert A. Dyer, MBChB, FCA (SA), PhD

Co-authors:

Dominique van Dyk, MBChB, DA (SA), FCA (SA)

Robert A. Dyer, MBChB, FCA (SA), PhD

Prof David G. Bishop, MBChB, FCA (SA), PhD

The authors would like to thank the following parties in contributing towards the project:

1. South African Anaesthesia Registrars.
2. SASA (South African Society of Anaesthesiologists) for providing a platform for distribution of the questionnaire.
3. SARFA (South African Registrar Forum of Anaesthesiologists) for their assistance in encouraging registrars to complete the questionnaire.
4. Prof JF Coetzee for assistance in statistical analysis.

Contents:

Declaration Page ______ p. 2

Format ______ p. 3

Acknowledgements and contributions ______ p. 4

List of Tables, Figures and Appendices ______ p. 6

Abstract ______ p. 7

Chapter 1: Introduction ______ p. 9

Chapter 2: Publication-ready Paper ______ p. 10

List of Appendices: ______ p. 36

1. Southern African Journal of Anaesthesia and Analgesia (SAJAA) instructions for authors ______ p. 37
2. Human Research Ethics Committee approval ______ p. 43
3. Information letter to participants ______ p. 51
4. Google forms questionnaire ______ p. 54
5. Questionnaire with answers ______ p. 69
6. Statistics ______ p. 76

Contact Information ______ p. 84

List of Tables:

Table 1: Demographic details according to grouping.

List of Figures:

Figure 1: Distribution of the participants' total questionnaire scores.

Figure 2: Proportions of correct answers.

List of Appendices:

Appendix 1: SAJAA instructions for authors.

Appendix 2: Human Research Ethics Committee approval.

Appendix 3: Information letter to participants.

Appendix 4: Google forms questionnaire.

Appendix 5: Questionnaire with answers.

Appendix 6: Statistics:

Table A1: Consolidation of demographic categories into two categories

Table A2: Results of within-category score comparisons (Mann-Whitney nonparametric tests for independent samples

Table A3: Results of the Kruskal-Wallis non-parametric one-way analysis of variance tests

Table A4: Medcalc statistical software output for the final multiple linear regression model

Table A5: Medcalc statistical software output for the final logistic regression model

Abstract

Background

Adequate documentation of details relating to spinal anaesthesia for caesarean section is important, both to ensure a safe and pleasant experience for the parturient, and to provide evidence that an acceptable standard of care was applied in the event of subsequent medicolegal action.

On the basis of recent research conducted at the University of Cape Town, documentation of details of spinal anaesthesia at a level 2 obstetrics hospital was inadequate. In the aforementioned study, 12 main aspects were regarded as essential for documentation. It was hypothesised that a contributing factor to poor record-keeping was inadequate knowledge of the practitioner, of the theory and practice of spinal anaesthesia.

Methods

South African anaesthesia registrars (Universities of Cape Town, Free State, KwaZulu-Natal, Pretoria, Witwatersrand, Sefako Makgatho, Walter Sisulu, Stellenbosch) who are members of the South African Society of Anaesthetists (SASA) were contacted and invited to engage in an online completion of the questionnaire. A single best answer multiple choice questionnaire (20 questions) encompassing the following important aspects of documentation was utilised to assess knowledge of spinal anaesthesia for caesarean section:

1 Applied anatomy and physiology.

2 Equipment considerations.

3 Factors influencing block height.

4 Testing of the block, including management of breakthrough pain.

5 Pharmacology.

Demographic details of participants were also documented.

Data were transcribed from the questionnaires to an Excel spreadsheet, and coded appropriately for analysis by statistical software (MedCalc® Statistical Software version 20.218 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2023). The Shapiro-Wilk test tested for normal distribution. Subgroup comparisons within demographic

categories were performed using non-parametric tests (Mann-Whitney-U test for two independent samples and the Kruskal-Wallis one-way analysis of variance test for multiple independent groups). An alpha value < 0.05 was regarded as indicating statistical significance. Backward multiple linear regression analysis was performed with participant scores as the dependent variable and demographic variables as the independent variables. Backward logistic regression analysis was performed with passed/failed as the dependent variable and demographic variables as the independent variables.

Results

A total of 126/400 responses were received, with a response rate of 31% and margin of error 7.3%. Participants' questionnaire scores were not normally distributed. The median score was 50% (95% confidence interval (CI) 45% to 50%; range 20% to 75%). Overall, a knowledge score greater than 50% was achieved by 51.5% of registrars and 48.4% achieved lower than 50% average score. Secondary analysis showed weak associations between demographic variables and the scores achieved.

Conclusions

This questionnaire revealed a considerable knowledge deficit amongst anaesthesia registrars in South Africa of various aspects of the practice of SA for CS. Areas of training, including applied anatomy and physiology, equipment considerations, factors affecting block height, testing of block height and management of breakthrough pain, and pharmacology, require focused educational intervention, including simulation. This would improve documentation on the anaesthesia record and the quality of the experience of SA for CS for patients, and reduce medicolegal proceedings and ultimately patient morbidity and mortality.

Chapter 1: Introduction

Adequate documentation of details relating to spinal anaesthesia for caesarean section is important, both to ensure a safe and pleasant experience for the parturient, and to provide evidence that an acceptable standard of care was applied in the event of subsequent medicolegal action.

The quality of documentation of details of the procedure and block level during spinal anaesthesia for caesarean section at a level 2 obstetrics hospital was inadequate.[1] In this retrospective folder analysis, 12 main aspects were regarded as essential for documentation. Of the 12 variables, 7 or 8 were recorded in 23% and 32% of the charts respectively, and 90% of the anaesthesia charts had inadequate documentation.[1] It was hypothesised that a contributing factor to this poor record-keeping was inadequate knowledge by the practitioner.

The purpose of this research project was therefore to evaluate the knowledge of South African anaesthesia registrars of the theory and practice of spinal anaesthesia for caesarean section.

Chapter 2: Publication-ready Paper

The manuscript “Knowledge of South African anaesthesia registrars of the theory and practice of spinal anaesthesia for caesarean section” has been prepared according to the instructions to authors of SAJAA.

Instructions to authors for SAJAA can be found online at https://www.sajaa.co.za/index.php/sajaa/about/submissions, and are reproduced in Appendix1.

Knowledge of South African anaesthesia registrars of the theory and practice of spinal anaesthesia for caesarean section.

Willem AP Ras, FCA (SA),[*] Robert A. Dyer, FCA (SA), PhD, [#]David G Bishop, FCA (SA), PhD,[*] Dominique van Dyk, FCA (SA).

[*] Department of Anaesthesia and Perioperative Medicine, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa

[#]Department of Anaesthesia, School of Clinical Medicine, College of Health Sciences, University of KwaZulu-Natal, Pietermaritzburg, South Africa

Corresponding author: Dr. Willem AP Ras

Mailing address: D23 Department of Anaesthesia and Perioperative Medicine, Groote Schuur Hospital, Anzio Road, Observatory 7925, Cape Town, South Africa

Phone Number: +27 21 404 5001

E-mail address: rsxwil001@myuct.ac.za

Financial Disclosures: None

Conflicts of interest: None

Word Count:

- Abstract: 486 words
- Introduction: 157 words
- Discussion: 1428 words
- Overall (excluding abstract and references): 4310 words

Abstract

Background

Adequate documentation of details relating to spinal anaesthesia for caesarean section is important, both to ensure a safe and pleasant experience for the parturient, and to provide evidence that an acceptable standard of care was applied in the event of subsequent medicolegal action.

On the basis of research conducted at the University of Cape town (M du Toit), documentation of details of spinal anaesthesia at a level 2 obstetrics hospital was inadequate.[1] In this study, 12 main aspects were regarded as essential for documentation. It was hypothesised that a contributing factor to poor record-keeping was inadequate knowledge of the practitioner of the theory and practice of spinal anaesthesia for caesarean section.

Methods

South African anaesthesia registrars (Universities of Cape Town, Free State, KwaZulu-Natal, Pretoria, Witwatersrand, Sefako Makgatho, Walter Sisulu, Stellenbosch) who are members of the South African Society of Anaesthetists (SASA) were contacted and invited to engage in an online completion of the questionnaire.

A single best answer multiple choice questionnaire (20 questions) encompassing the following important aspects of documentation was utilised to assess knowledge of spinal anaesthesia for caesarean section:

1 Applied anatomy and physiology.

2 Equipment considerations.

3 Factors influencing block height.

4 Testing of the block, including management of breakthrough pain.

5 Pharmacology.

Data were transcribed from the questionnaires to an Excel spreadsheet. Reporting was anonymous and did not distinguish between universities. The response rate was noted, and results calculated (percentage correct answers). Demographic details of participants were also documented. Subgroup comparisons within demographic categories were performed.

Results

A total of 126/400 responses were received, with a response rate of 31% and margin of error 7.3%. Participants' questionnaire scores were not normally distributed. The median score was 50% (95% confidence interval (CI) 45% to 50%; range 20% to 75%). Overall, a knowledge score greater than 50% was achieved by 51.5% of registrars and 48.4% achieved lower than 50% average score. Secondary analysis showed weak associations between demographic variables and the scores achieved.

Conclusions

This questionnaire revealed a considerable knowledge deficit amongst anaesthesia registrars in South Africa of various aspects of the practice of SA for CS. Areas of training, including applied anatomy and physiology, equipment considerations, factors affecting block height, testing of block height and management of breakthrough pain, and pharmacology, require focused educational intervention, including simulation. This would improve documentation on the anaesthesia record and the quality of the experience of SA for CS for patients, and reduce medicolegal proceedings and ultimately patient morbidity and mortality.

Introduction

Adequate documentation of details relating to spinal anaesthesia (SA) for caesarean section (CS) is important, both to ensure a safe and pleasant experience for the parturient, and to provide evidence that an acceptable standard of care was applied in the event of subsequent medicolegal action.

The quality of documentation of details of the procedure and block level during spinal anaesthesia for caesarean section at a level 2 obstetrics hospital was inadequate.[1] In this retrospective folder analysis, 12 main aspects were regarded as essential for documentation. The 12 variables that contribute to patient safety and comfort were the following:

1. Report of an aseptic technique
2. Needle type, gauge and length
3. Lumbar vertebral level at which the dura was punctured
4. Number of passes of the needle at each level attempted
5. Experience of paraesthesia
6. Clear cerebrospinal fluid flow after dural puncture
7. Local anaesthetic and dose administered
8. Opioid and dose administered
9. Method used for testing the block
10. Dermatomal level of sensory block
11. Adequate surgical anaesthesia, or intervention if surgical anaesthesia was inadequate, including unilateral block
12. Documentation in recovery area of ability to lift legs, or dermatomal level of sensory block.

Of the 12 variables, 7 or 8 were recorded in 23% and 32% of the charts respectively, and 90% of the anaesthesia charts had inadequate documentation.[1] It was hypothesised that a contributing factor to this poor record-keeping was inadequate knowledge by the practitioner. The purpose of this study was to assess the knowledge of South African anaesthesia registrars pertaining to the theory and practice of spinal anaesthesia for caesarean section.

Methods

This cross- sectional study was conducted amongst South African anaesthesia registrars, from the following universities: University of Cape Town, University of Free State, University of Kwa-Zulu Natal, University of Pretoria, University of Witwatersrand, Sefako Makgatho Health Sciences University, Walter Sisulu University and University of Stellenbosch. Ethics Approval was obtained from the Human Research Ethics Committee of the Faculty of Health Sciences of the University of Cape Town (HREC ref 763/2021, Appendix 2).

A total of 400 anaesthesia registrars were identified at commencement of the study. Each university was contacted to identify their number of registrar training posts.

Registrars who were members of the South African Society of Anaesthetists (SASA) were contacted via email through SASA and the South African Registrar Forum of Anaesthesiologists and invited to complete an online questionnaire.

An electronic link was published weekly in the SASA newsletter to improve awareness of the project conducted during a 4 month period from August 2022 to December 2022.

Google Forms, a secure platform for creating and managing web -based databases and surveys, was utilised for this purpose. The electronic link also contained an information letter to participants explaining the rationale of the study and that de-identified data was securely collected and captured. Participation was voluntary and completing the questionnaire indicated implicit consent.

For the purposes of the study, a single best answer multiple choice questionnaire (20 questions) was designed. This modality of testing has established educational validity, used by the Colleges of Medicine of South Africa. Encompassing the following important aspects of documentation:

1. Applied anatomy and physiology.

2. Equipment considerations.

3. Testing of the block, including management of breakthrough pain.

4. Factors influencing block height.

5. Pharmacology.

Furthermore, demographic details of participants were also documented by completing 5 questions.

A time period of 75 minutes was suggested for completion of responses to the 20 questions.

The response rate was noted, and results calculated (percentage correct answers). Reporting was anonymous and did not distinguish between universities. The pass mark was set at 50% percent.

A free online webinar will be conducted by Professors D van Dyk (UCT), DG Bishop (UKZN) and RA Dyer (UCT) upon publication of this study. Each question in the questionnaire will serve as a discussion point in the webinar. Feedback will be requested from participants as to their perceived benefit of the overall educational exercise.

Overall, it is intended that documentation will be improved, and that aspects of training requiring attention will be identified, thus ultimately benefitting patient care.

Questionnaire: Single shot spinal anaesthesia for caesarean section (correct answers are indicated)

Participant demographics

Age, sex, years of anaesthesia experience, years of registrar experience, training institution

Applied anatomy

Q1 What is the highest vertebral interspace at which a spinal needle should be inserted?

a L1-L2

b L2-L3

c L3-L4 ✓

d L4-L5

Q2 Concerning the intercristal line (Tuffier's line):

a The palpated level agrees with that in the non-pregnant state

b Local anaesthetic is more commonly administered at a higher level than estimated by the anaesthetist ✓

c The level is at L2-L3 on a radiological image

d It is safe to inject local anaesthetic at the L2-L3 level

Q3 What is the sympathetic/sensory innervation of the uterus?

a T5-T9

b T10-L1 ✓

c T10-L4

d L1-L4

Q4 The sensory outflow from the peritoneal cavity travels mainly via the:

a Vagus nerve

b Phrenic nerve

c Greater splanchnic nerve ✓

d Coeliac nerve

Q5 What is the uppermost dermatome which gives sensory supply to the peritoneal cavity?

a T2

b T3

c T4

d T5 ✓

Q6 With respect to high spinal anaesthesia:

a There is complete paralysis of the phrenic nerve

b There is predominantly ventilatory failure

c Cardiac afferents T2-T6 are blocked

d Bradycardia is frequent ✓

Equipment considerations

Q7 As regards aseptic technique:

a Povidine iodine is superior to chlorhexidine in alcohol

b The alcohol component of chlorhexidine in alcohol is neurotoxic ✓

c Both iodine and alcohol are inactivated by blood

d The wearing of gloves and mask is not essential

Q8 Concerning spinal needles:

a Quincke needles are atraumatic

b The incidence of post-dural puncture headache is closely related to needle gauge when Whitacre needles are used

c The incidence of post-dural puncture headache is closely related to needle gauge when Quincke needles are used ✓

d There are no available 22G atraumatic needles

Q9 For spinal anaesthesia in morbidly obese parturients:

a 25G x 90 mm atraumatic needles are usually adequate

b Quincke needles are advised

c The next longest available needle after the 25G x 90 mm needle is 96 mm

d 25G x 103 mm needles usually suffice ✓

e 25 x 120 mm needles are easy to insert without using an epidural needle as a conduit

Q10 Concerning the use of uterine displacement devices:

a Maternal cardiac output is not affected by their use

b Unilateral block is likely if the device is placed immediately after performance of spinal anaesthesia

c Neonatal acid base status is unaffected by their use ✓

d The benefits of these devices are limited to the period after surgery has commenced

Factors affecting block height

Q11 Concerning the position of the operating table after the performance of spinal anaesthesia:

a Adoption of the head-down position is ineffective in achieving a higher block when using hyperbaric bupivacaine

b Adoption of the anti-Trendelenburg position is advisable in response to early spinal hypotension

c The head-up position reduces block height when isobaric bupivacaine is used

d Adoption of the neutral table position with a support beneath the shoulders reduces upward spread of hyperbaric bupivacaine ✓

Q12 With respect to the baricity of local anaesthetic bupivacaine in obstetrics:

a The baricity of a solution is the ratio of the specific gravity of the solution to that of water

b Isobaric bupivacaine does not change in baricity when injected into CSF

c Isobaric bupivacaine is associated with a block level on average 2 dermatomes higher than the hyperbaric solution

d Isobaric bupivacaine is associated with a higher incidence of cervical blocks than the hyperbaric solution ✓

Pharmacology

Q13 Considering dosing of spinal bupivacaine and fentanyl:

a Seven mg of 0.5% hyperbaric bupivacaine plus 10 µg fentanyl is usually an adequate dose for spinal anaesthesia for caesarean section

b Incremental doses of spinal fentanyl until 50 µg result in proportionally increasing analgesic effect

c	The dose of hyperbaric spinal bupivacaine should be reduced in morbidly obese patients

d	At standard spinal doses, the odds of inadequate spinal anaesthesia are higher in preterm parturients ✓

Q14	With respect to intrathecal morphine for caesarean section:

a	Peak analgesic effect is at 30 minutes

b	The ideal dose is 250 µg

c	Side effects in theatre are common

d	In high-income countries, the incidence of clinically significant respiratory depression is 1/10,000 ✓

e	Monitoring in South African state hospital wards is adequate for the detection of delayed respiratory depression

Testing of the block

Q15	Concerning modalities of sensory block testing:

a	Loss of sensation to light touch appears to be the best predictor of adequate surgical anaesthesia ✓

b	Testing of a single modality is regarded as adequate

c	The time to onset of sensory blockade of touch, cold and pinprick is similar

d	The dermatomal level of sensory blockade to cold is lower than that of light touch and pinprick

Q16 What is the best site at which to test a sensory block to the T1 level?

a Immediately above nipple level

b Suprasternal notch

c Manubriosternal angle

d Upper inner aspect of the arm ✓

Q17 With respect to the Bromage Score:

a Grade 1: Unable to move ankles or toes = complete block (100%)

b Grade 2: Unable to flex the knee, but free movement of feet = almost complete block (66%)✓

c Grade 3: Just able to flex the hip with free movement of the knee = partial block (33%)

d Grade 4: Free movement of ankles and toes = no block (0%)

Q18 With respect to motor block:

a Immobility of the legs indicates adequate surgical anaesthesia

b Ability to flex the hips suggests inadequate surgical anaesthesia ✓

c Adequate surgical anaesthesia is associated with a 40% reduction in forced expiratory manoeuvres

d A weak hand grip indicates motor block to T1-T2

Management of breakthrough pain

Q19 With respect to management of breakthrough pain by a specialist anaesthetist:

a Successful medico-legal claims for awareness under general anaesthesia are commoner than for pain during caesarean section under spinal anaesthesia

b Breakthrough pain experienced before delivery is usually easily resolved using intravenous opiates

c Ketamine is an ideal agent for managing breakthrough pain

d Discomfort after delivery is best managed with small doses of propofol, short-acting opiate and nitrous oxide ✓

Q20 Also related to breakthrough pain:

a Midazolam has great benefit in the setting of intraoperative pain

b Full documentation of the event is not necessary

c The administration of face mask oxygen following supplemental analgesia is not recommended

d Follow-up consultation with a patient experiencing intraoperative discomfort is essential ✓

Data Analysis:

Data were transcribed from the questionnaires to an Excel spreadsheet, and coded appropriately for analysis by statistical software (MedCalc® Statistical Software version 20.218 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2023). The Shapiro-Wilk test tested for normal distribution. Subgroup comparisons within demographic categories were performed using non-parametric tests (Mann-Whitney-U test for two independent samples and the Kruskal-Wallis one-way analysis of variance test for multiple independent groups). An alpha value < 0.05 was regarded as indicating statistical significance. Backward multiple linear

regression analysis was performed with participant scores as the dependent variable and demographic variables as the independent variables. Backward logistic regression analysis was performed with passed/failed as the dependent variable and demographic variables as the independent variables.

Results

A total of 126/400 responses were received, with a response rate of 31% and margin of error 7.3%. The majority of registrars were aged between 31 and 35 years (52.3%), 50.8% were female; 66.7% were in their first and second year of anaesthesia training, and 32.5% were in their third and final year; 10.4% had passed their final FCA part 2 examination; 89.6% had not completed their training. Regarding previous experience in anaesthesia (post- community service), 26.9 % had more than 2 years' experience, and 81% had less than 4 years' experience. 57.9 % of registrars rated their knowledge of spinal anaesthesia for caesarean section as above average and, 34% rated their knowledge as average, and 1.6% as insufficient or limited. Table 1 displays the demographic properties of the respondents.

Table 1: Demographic details according to grouping:

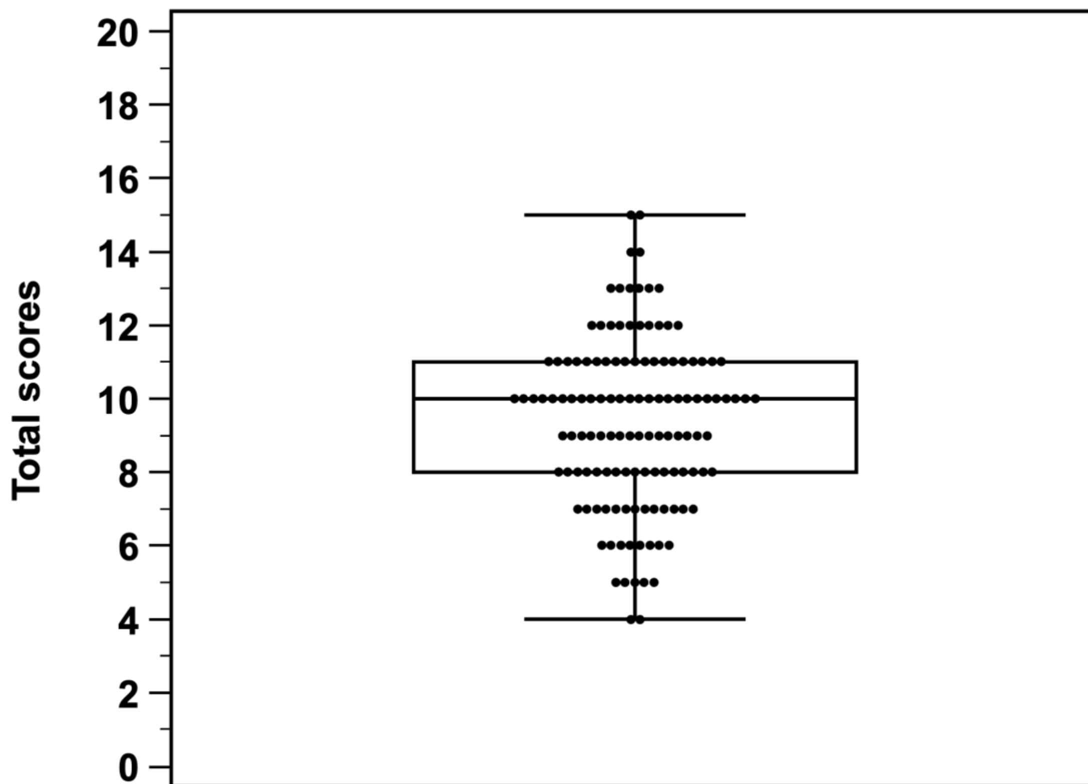
	Label	Groups	Number of Participants	Proportion
Age (years)	0	No response	1	0.8%
	1	0	1	0.8%
	2	27-30 y	30	23.8%
	3	31-35 y	66	52.4%
	4	36-39 y	23	18.3%
	5	>40 y	5	4.0%
Experience (years)	0	0	1	0.8%
	1	1-2 y	53	42.1%
	2	3-4 y	38	30.2%
	3	4-5 y	16	12.7%
	4	>5 y	18	14.3%
Rate knowledge	0	0	1	0.8%

	1	Excellent	7	5.6%
	2	Above average	73	58.4%
	3	Average	43	34.4%
	4	Insufficient	1	0.8%
	5	Limited	1	0.8%
Gender	0	No answer	1	0.8%
	1	Prefer not to say	3	2.4%
	2	Male	58	46.0%
	3	Female	64	50.8%
Training year	0	No response	1	0.8%
	1	Year 1	50	39.7%
	2	Year 2	34	27.0%
	3	Year 3	17	13.5%
	4	Year 4	24	19.0%
Passed FCA	No	No	112	89.6%
	Yes	Yes	13	10.4%
Requiring Additional training	0	No response	1	0.8%
	1	Strongly agree	8	6.3%
	2	Agree	48	38.1%
	3	Neutral	34	27.0%
	4	Disagree	29	23.0%
	5	Strongly disagree	6	4.8%

Note: One participant did not provide demographic information (Grouping zero in the table)

Participants' questionnaire scores were not normally distributed. The overall median score was 50% (95% confidence interval (CI) 45% to 50%; range 20% to 75%) (Figure 1). A knowledge score greater than 50% was achieved by 51.5% of registrars.

Figure 1: Distribution of the participants' total questionnaire scores (N=126).



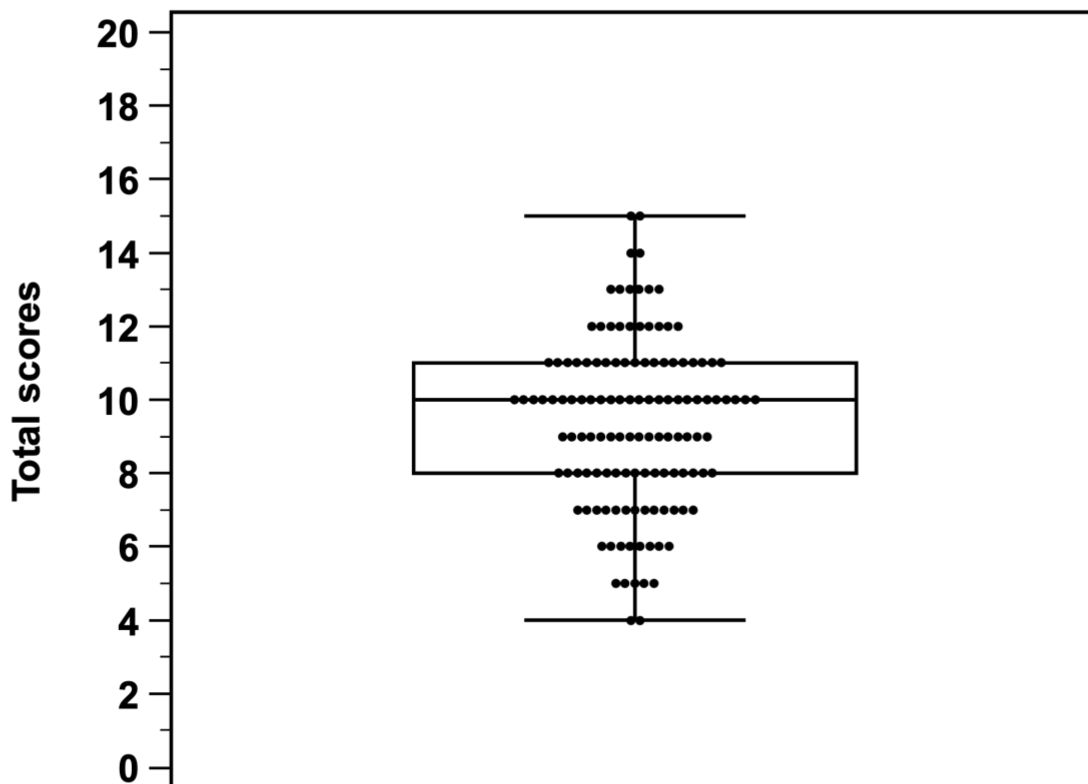
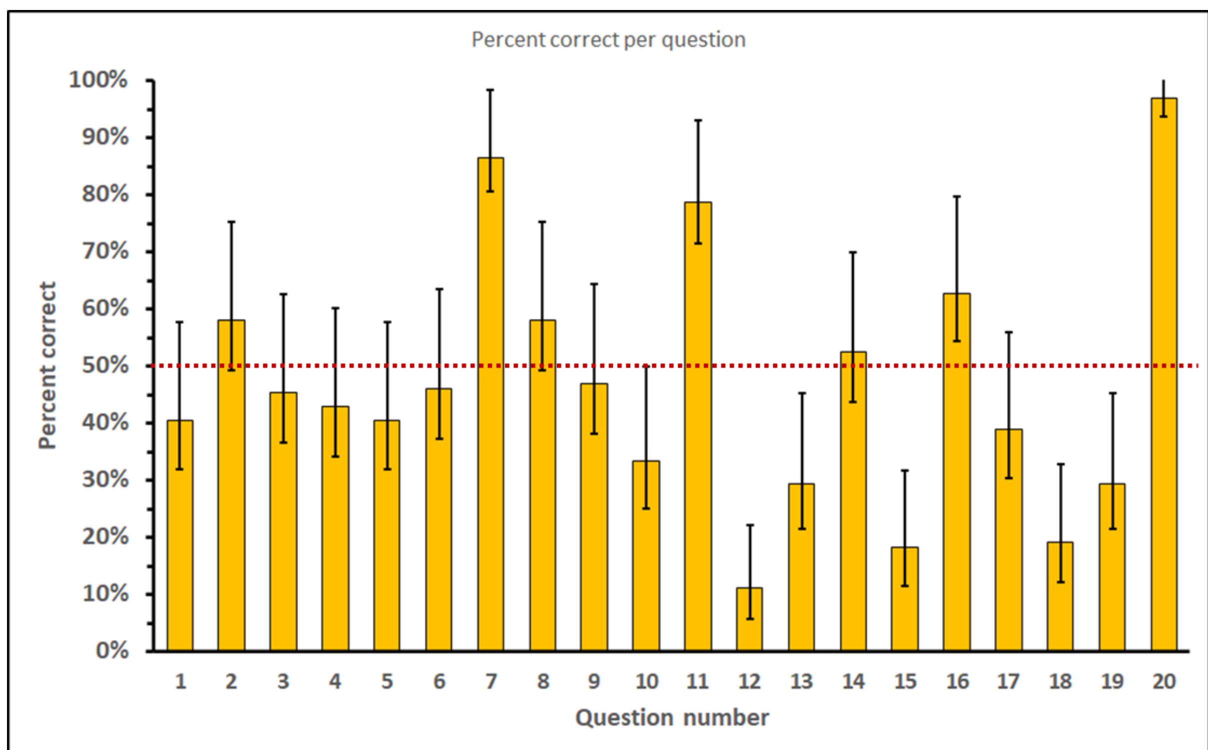


Figure 2 portray the proportions of correct answers by the 126 participants to the 20 questions.

Figure 2: Proportions of correct answers.



Error bars indicate 95% confidence intervals.

(Note: Error bars that do not include the 50% dotted line are statistically significantly different from a 50% score ($p<0.05$).

Subgroup analysis:

Of the 126 respondents, 13 had passed the FCA examinations. Of these, 10 (76.9%, 95% CI 46.1% to 95.0%) scored 50% or greater. The median score was 50% (95% CI 47.7% to 62.3%; range 40% to 70%). For the 112 without the FCA examination, the median score was 45%, 95% CI 45 to 50%, range 20-75%). The Hodges-Lehmann median difference was 5% (95% CI 0 to 15%), P=0.0477. In several demographic categories, there were small numbers of participants in the extremes of the categorical scales. These were Age, Experience, Rated_Knowledge and Additional_Training. These were consolidated into two groups per category, for comparative purposes, as portrayed in Table A1 in the Appendix. Small, statistically significant, score differences (5%) were found between the following two consolidated demographic groups: Levels 1 & 2 of experience, Levels 1 & 2 of Self rated knowledge. Details of the subgroup analyses are presented in Tables A2 and A3 of the Appendix.

In the regression analyses, the following independent variables were strongly correlated: Passed_FCA and Training_Year (r=0.495), as well as Experience and Age (r=0.448). Thus the variables Passed_FCA and Age were not entered into the analyses. The multiple linear regression final model was:

$$\%Score = 0.41 + (0.057 * RatedKnowledge) - (0.051 * Experience) + (0.020 * TrainingYear)$$

The strength of the association was weak (Adjusted R^2=0.103, Multiple correlation coefficient 0.354). Table A4 in the Appendix depicts the computer software output of the final model.

Regarding a score of 50% or greater as a “pass” mark, backward logistic regression also indicated that Rated_Knowledge and Training_Year were predictive of a “pass”. The logit equation was:

$$logit(pass) = -1.562 + (0.734 * RatedKnowledge) + (0.290 * TrainingYear)$$

The association was weak (R^2=0.054; C-statistic 0.624, 95% CI 0.533 to 0.709). Table A5 in the Appendix displays the computer software output for the final model.

Discussion

This single best answer multiple choice questionnaire encompassing applied anatomy and physiology, equipment considerations, factors affecting block height, testing of the block, including management of breakthrough pain, and relevant pharmacology, were utilised to assess South African anaesthesia registrars' knowledge of these aspects of SA for CS. A total of 126/400 responses were received, with a response rate of 31% and a margin of error of 7.3%.

Following a recent publication concerning documentation in the anaesthesia record, of details of SA for CS at a level 2 obstetrics hospital in South Africa,[1] which found that records were inadequate, it was hypothesised that a contributing factor was inadequate knowledge of the practitioner of the theory and practice of spinal anaesthesia for caesarean section. A good score in response to the questions compiled by 3 content experts, DvD, DGB and RAD, would likely result in improved documentation and hence management of patients, including breakthrough pain, during SA for CS. A webinar is to be presented, with each question serving as a learning focus for the participants. The evidence for the correct answers to the questions posed, was provided after the survey, and consisted mostly of pertinent publications in each case, together with some expert opinion.

Data collection was done over a 4-month period, to allow ample time between major examination dates and holiday periods. Regular reminders from the South African Society of Anaesthesiologists and the South African Registrars' Forum of Anaesthesiologists were issued on a weekly basis to improve registrar participation.

The median score was poor; 50% for the 20 questions, and a knowledge score greater than 50% was achieved by only 51.5% of registrars.

Knowledge scores regarding *applied anatomy and physiology* revealed that the majority of registrars were unable to correctly answer that L3-L4 is the highest vertebral interspace at which a spinal needle should be inserted.[2] Although the cord commonly ends opposite the lower border of L1 or at the L1-L2 interspace, it may extend as low as L3. It was found that the cord reached L2 in 43% of women but only 27% of men.[2] Only 58% of registrars correctly answered the question concerning the intercristal line. Also known as Tuffier's line, this surface marking joins the iliac crests and is commonly used to identify lumbar interspaces, but is not an entirely reliable method. Although the mode is the lower border of

L4 to the L4-L5 interspace, the level may vary from L3-L4 to L5-S1, resulting in a major source of error.[2] Ultrasound examination has shown that in 50% of patients the puncture level is more cephalad than documented in the anaesthesia record.[3] Improved understanding of these anatomical landmarks could protect patients from inadvertent spinal cord damage.

Regarding the sympathetic/ sensory innervation of the uterus, only 45% of registrars correctly answered T10-L1.[4] The sensory outflow from the peritoneal cavity, via the greater splanchnic nerve,[4] was only correctly answered by 43% of registrars. 41% correctly answered T5 as the uppermost dermatome which gives sensory supply to the peritoneal cavity.[5] Clearly, accurate knowledge of these details of innervation is crucial for the provision of surgical anaesthesia during SA for CS.

High spinal anaesthesia is a rare, but potentially devastating complication during CS. With respect to this clinical scenario, only 46% correctly indicated that bradycardia is frequent. Clinical teaching is thus required to reduce maternal mortality due to high spinal anaesthesia and, given its rarity, additional education on a simulator is advisable. A recent guideline on the management of this condition should serve as a useful adjunct to such teaching.[6]

With respect to *equipment*, evaluation of registrars' knowledge regarding aseptic technique showed that most (86 %) were aware that the alcohol component of chlorhexidine in alcohol is neurotoxic. Alcohol induced neurolysis is well established and is used therapeutically in a number of procedures.[7]

Concerning spinal needles, only 58% correctly answered that the incidence of post-dural puncture headache is closely related to needle gauge only when Quincke needles are used. Vallejo et al showed that the Quincke needle, introduced with its cutting bevel parallel to the direction of the dural fibers, still results in a higher frequency of post- dural puncture headache, as well as an increased requirement for epidural blood patch compared with atraumatic pencil point needles.[8] The use of Quincke needles should thus be contraindicated in obstetric anaesthesia. Morbid obesity poses a major challenge in obstetric anaesthesia in South Africa. For spinal anaesthesia in morbidly obese parturients, only 47% of registrars correctly identified that 25G × 103 mm needles usually suffice, and there appeared to be sparse knowledge of the challenges associated with 25G × 120 mm needles. A detailed knowledge is required of the availability and techniques required for successful spinal- or

combined spinal-epidural anaesthesia for CS, and detailed guidelines should be established in this regard. Engagement with- and education of hospital procurement committees in the matter of pencil point needles and the necessity for the availability of the full range of needles for the morbidly obese, is urgently required throughout South Africa.

Only 33% of registrars correctly answered that neonatal acid base status is unaffected by the use of uterine displacement devices. A recent randomized trial in healthy term pregnant women undergoing elective CS under SA, with a crystalloid co-load and prophylactic phenylephrine infusion, showed no difference in umbilical artery base excess between those placed in the supine horizontal position or with 15 degrees left tilt of the surgical table. However, phenylephrine requirements were higher and maternal cardiac output was lower in patients without tilt.[9] An improved knowledge of the exact effects of the use of lateral tilt devices is thus essential.

In the matter of *factors affecting block height*, 79% of registrars correctly answered that after performance of SA, adoption of the neutral table position with a support beneath the shoulders reduces upward spread of hyperbaric bupivacaine. Of concern is the fact that only 11% correctly answered that isobaric bupivacaine is associated with a higher incidence of cervical blocks than the hyperbaric solution. Hallworth et al demonstrated that changes in baricity of the spinal injection are more important than the posture the patient adopts during the induction of SA, with decreasing baricity causing higher sensory block and increasing hypotension.[10] Clearly, the knowledge of these aspects is currently deficient, and essential for safe practice.

Concerning modalities of *testing of the* sensory *block*, only 18% of registrars correctly answered that loss of sensation to light touch appears to be the best predictor of adequate surgical anaesthesia.[1] Regarding the best site at which to test a sensory block to the T1 level, 63% correctly stated that it was the upper inner aspect of the arm.[4] It was disturbing that not all registrars knew how to test for a block at T1, because any block higher than this level amounts to high spinal anaesthesia, with increased morbidity and mortality.

With respect to the Bromage score, only 39% were aware that Grade 2 (the inability to flex the knee but free movement of the knee) indicates almost complete block.[11 12]

With respect to motor block only 19% correctly answered that the ability to flex the hips suggests inadequate surgical anaesthesia.[13] Correct interpretation of motor block is essential, because this may serve as a guide to inadequacy of the sensory block. Regarding the management of breakthrough pain, only 29% of registrars correctly answered that discomfort after delivery is best managed with small doses of propofol, short-acting opiate and nitrous oxide.[14] It was encouraging that 97% of registrars correctly answered that in the event of intraoperative breakthrough pain, follow-up consultation with the patient is essential. A recent report describes the medicolegal consequences of inappropriate or inadequate management of this situation in the United Kingdom.[15]

Considering knowledge of the relevant *pharmacology*, in the matter of dosing of spinal bupivacaine and fentanyl, only 29% correctly answered that at standard spinal doses, the odds of inadequate spinal anaesthesia are higher in preterm parturients.[16] With respect to intrathecal morphine for caesarean section, 52% correctly answered that in high-income countries, the incidence of clinically significant respiratory depression is 1/10,000.[17] [18] Clearly, understanding the consequences of the dose of local anaesthetic and opiate is crucial to patient outcomes, in terms of block height, postoperative analgesia, and side effects, including respiratory depression.

Analysis of associations between the demographic variables (age, gender, years of experience, completion of FCA 2 examination, self-identified requirement for further education/training in SA, and self-rating of knowledge) and test score, with 50% as the "pass" mark, showed that there were mostly weak associations. The study was however not powered for these comparisons.

Conclusion

This questionnaire revealed a considerable knowledge deficit amongst anaesthesia registrars in South Africa of various aspects of the practice of SA for CS. It is of concern that a total of 13 questions in the questionnaire were associated with a score less than 50%. Areas of training, including applied anatomy and physiology, equipment considerations, factors affecting block height, testing of block height and management of breakthrough pain, and pharmacology, require focused educational intervention, including simulation. This would improve documentation on the anaesthesia record and the quality of the experience of SA for

CS for patients, and reduce medicolegal proceedings and ultimately patient morbidity and mortality.

Acknowledgements

The authors would like to thank SASA and SARFA for their contribution in reaching and motivating anaesthesia registrars to participate in the study. We are also grateful for Prof J Coetzee for his assistance with statistical interpretation and analysis.

Disclosures

Financial Disclosures: None
Conflicts of interest: None

Ethics approval: Ethics approval was obtained from Human Research Ethics Committee (HREC) of the Faculty of Health Sciences of the University of Cape Town.

UCT HREC Reference number: 763/2021

Author Contributions

Name: Willem AP. Ras
Contribution: This author provided substantial contributions toward the conception or design of the work; analysis and interpretation of data for the work; and drafting and revising the work critically for important intellectual content; and final approval of the version to be published.
Name: Robert A. Dyer
Contribution: This author provided substantial contributions toward the conception or design of the work; analysis and interpretation of data for the work; and drafting and revising the work critically for important intellectual content; and final approval of the version to be published.
Name: Dominique van Dyk
Contribution: This author provided substantial contributions toward the interpretation of data for the work; formation of the figures in the work; and drafting and revising the work critically for important intellectual content; and final approval of the version to be published.
Name: David G. Bishop.

Contribution: This author provided substantial contributions toward the conception or design of the work; analysis and interpretation of data for the work; and drafting and revising the work critically for important intellectual content; and final approval of the version to be published.

References

1. du Toit MA, Dyer RA, van Dyk D. Documentation of spinal anaesthesia technique and block level at caesarean section at a secondary-level obstetrics hospital in South Africa. South African J Anaesth Analg. 2022 Sep 1;28(4):137–141. https://doi.org/10.36303/SAJAA.2022.28.4.2792

2. Reynolds F. Damage to the conus medullaris following spinal anaesthesia. Anaesthesia. 2001 (56):238-247.

3. Schlotterbeck H, Schaeffer R, Dow WA, Touret Y et al. Ultrasonographic control of the puncture level for lumbar neuraxial block in obstetric anaesthesia. Br J Anaesth. 2008; 100 (2): 230-234. https://doi.org/10.1093/bja/aem371

4. Nathan N, Wong CA. Spinal, Epidural, and caudal anesthesia: Anatomy, Physiology, and Technique. In Chestnut DH, Wong CA, Tsen LC, Ngan Kee WD et al, editors. Chestnut's Obstetric Anesthesia: Principles and Practice, Sixth Edition. Philadelphia, PA: Elsevier; 2020, p238-270

5. Struller F, Weinreich F, Horvath P, Kokkalis M et al. Peritoneal innervation: embryology and functional anatomy. Pleura and Peritonium. 2017; 2(4):153-161. https://doi.org/10.1515/pp-2017-0024

6. van Rensburg G, van Dyk D, Bishop D, Swanevelder JL et al. The management of high spinal anaesthesia in obstetrics: suggested clinical guideline in the South African context. South Afr J Anaesth Analg. 2016; 22(1) Supplement 1:S1-S5

7. Campbell JP, Plaat F, Checketts MR, Bogod D et al. Safety guideline: skin antisepsis for ventral neuraxial blockade. Anaesthesia. 2014; 69:1279-1286. https://doi.org/10.111/anae.12844

8. Vallejo MC, Mandell GL, Sabo DP, Ramanathan S. Postdural puncture headache: a

randomized comparison of five spinal needles in obstetric patients. Anaesth Analg. 2000; 91:916-920.https://doi.org/10.1097/00000539-200010000-00027

9. Lee A, Landau R, Mattingly JL, Meenan MM et al. Left lateral table tilt for cesarean delivery under spinal anesthesia has no effect on neonatal acid-base status. Anesthesiology. 2017; 127(2):241-249

10. Hallworth SP, Fernando R, Columb MO, Stocks GM. The effect of posture and baricity on the spread of intrathecal bupivacaine for elective cesarean delivery. Anesth Analg. 2005; 100(4):1159-1165. https://doi.org/10.123/01.ANE.0000149548.88029.A2

11. Bromage PR. A comparison of the hydrochloride and carbon dioxide salts of lidocaine and prilocaine in epidural analgesia. Acta Anaesthesiol Scand. 1965; 16:55-69

12. Craig D, Carli F. Bromage motor blockade score – a score that has lasted more than a lifetime. Can J Anesth. 2018; 65:837-838. https://doi.org/10.1007/s12630-018-1101-7

13. Kelly MC, Fitzpatrick KTJ, Hill DA. Respiratory effects of spinal anaesthesia for caesarean section. Anaesthesia. 1996; 51:1120-1122. https://doi.org/10.1111/j.1365-2044.1996.tb15046.x

14. Plaat F, Stanford SER, Lucas DN, Andrade J et al. Prevention and management of intra-operative pain during caesarean section under neuraxial anaesthesia: a technical and interpersonal approach. Anaesthesia. 2022; 77(5):588-597. https://doi.org/10.111/anae.15717

15. McCombe K, Bogod D. Regional anaesthesia: risk, consent and complications. Anaesthesia. 2021; 76 (S1): 18-26. https://doi.org/10.111/anae.15246

16. Adesope OA, Einhorn LM, Olufolabi AJ, Cooter M et al. The impact of gestational age and fetal weight on the risk of failure of spinal anesthesia for cesarean delivery. Int J Obstet Anesth. 2016 May; 26:8-14. https://doi.org/10.1016/j.ijoa.2016.01.007

17. George RB, Carvalho B, Butwick A, Flood P. Postoperative Analgesia. In Chestnut DH, Wong CA, Tsen LC, Ngan Kee WD et al, editors. Chestnut's Obstetric Anesthesia: Principles and Practice, Sixth Edition. Philadelphia, PA: Elsevier; 2020, p 627-669

18. Carvalho B, Butwick AJ. Postcesarean delivery analgesia. Best Practice & Research Clinical Anaesthesiology. 2017; 31(1):69-79. https://doi.org/10.1016/j.bpa.2017.01.003

List of Appendices:

Appendix 1: South African Journal of Anaesthesia and Analgesia Submission Preparation checklist

Appendix 2: Human Research Ethics Committee approvals

Appendix 3: Information letter to participants

Appendix 4: Google forms questionnaire

Appendix 5: Questionnaire with answers

Appendix 6: Statistics

Table A1: Consolidation of demographic categories into two categories

Table A2: Results of within-category score comparisons (Mann-Whitney nonparametric tests for independent samples

Table A3: Results of the Kruskal-Wallis non-parametric one-way analysis of variance tests

Table A4: Medcalc statistical software output for the final multiple linear regression model

Table A5: Medcalc statistical software output for the final logistic regression model

Appendix 1: South African Journal of Anaesthesia and Analgesia Submission Preparation checklist

Submissions
Login or Register to make a submission.

Submission Preparation Checklist

As part of the submission process, authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

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

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

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

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

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

STATISTICAL ANALYSIS
Authors are advised to involve medical statisticians at the protocol stage of their

research project: to plan sample size, and the selection of appropriate statistical tests for analysis and presentation.

PROTECTION OF PATIENT'S RIGHTS TO PRIVACY

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

ETHNIC CLASSIFICATION

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

CATEGORIES OF SUBMISSIONS

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

Original articles

Original articles on research relevant to anaesthesia and analgesia should not exceed 3 200 words, no more than 30 references, with up to 6 tables or figures. 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. 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), Casereport (with no introduction) and Discussion. Case reports will be published online only. The summary and the URL will appear in the printed version.

Scientific Letters

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

Letters to the editor

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

MANUSCRIPT PREPARATION

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

This information must be provided for ALL authors and must be submitted as a supplementary file.
Email addresses of all author must be provided.
ORCID number of ALL authors must be provided - if authors do not have ORCID, please register at https://orcid.org/

Abbreviations

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

Scientific measurements

Scientific measurements must be expressed in SI units except blood pressure (mmHg) and haemoglobin (g/dl). Litres is denoted with a lowercase 'l' e.g. 'ml' for millilitres). Units should be preceded by a space (except for %), e.g. '40 kg' and '20 cm' but '50%'. Greater/smaller than signs (> and 40 years of age) should also be preceded by a space e.g. > 20 years. No spaces should precede ± and °, i.e. '35±6' and '19°C'.
Numbers should be written as grouped per thousand-units, i.e. 4 000, 22 160...
Quotes should be placed in single quotation marks: i.e. The respondent stated: '...' Round brackets (parentheses) should be used, as opposed to square brackets, which are reserved for denoting concentrations or insertions in direct quotes.

General formatting

The manuscript must be in Microsoft Word or RTF document format. Text must be 1,5-spaced, in 12-point Times New Roman font, and contain no unnecessary formatting (such as text in boxes, except for Tables). The manuscript must be free of track changes.
Disclaimers should follow the Conclusion and it should be in the following order: Acknowledgements, Declaration conflict of interest, Funding source, Ethics declaration and ORCID.

ILLUSTRATIONS AND TABLES

If tables or illustrations submitted have been published elsewhere, the author(s) should provide consent to republication obtained from the copyright holder.
Tables may be embedded in the manuscript file and provided as 'supplementary files'. They must be numbered in Arabic numerals (1,2,3...) and referred to consecutively in the text (e.g. 'Table 1'). Tables should be constructed carefully and simply for intelligible data representation. Unnecessarily complicated tables are strongly discouraged. Tables must be cell-based (i.e. not constructed with text boxes, tabs or enters) and accompanied by a concise title and column headings. Footnotes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || then ** †† ‡‡ etc.
Figures must be numbered in Arabic numerals and referred to in the text e.g. '(Figure 1)'. Figure legends: Figure 1: 'Title...'. All illustrations/figures/graphs must be of high resolution/quality: 300 dpi or more is preferable, but images must not be resized to increase resolution. Unformatted and uncompressed images must be attached as 'supplementary files' upon submission (not embedded in the accompanying manuscript). TIFF and PNG formats are preferable; JPEG and PDF formats are accepted, but authors must be wary of image compression.
Illustrations and graphs prepared in Microsoft PowerPoint or Excel must be accompanied by the original workbook.

REFERENCES

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

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

Journal references:

1. Jun BC, Song SW, Park CS, Lee DH. The analysis of maxillary sinus aeration according to aging process: volume assessment by 3-dimensional reconstruction by high-resolutional CT scanning. Otolaryngol Head Neck Surg. 2005 Mar;132(3):429-34.
2. Polgreen PM, Diekema DJ, Vandeberg J, Wiblin RT, et al. Risk factors for groin wound infection after femoral artery catheterization: a case-control study. Infect Control Hosp Epidemiol [Internet]. 2006 Jan [cited 2007 Jan 5];27(1):34-7. Available from: http://www.journals.uchicago.edu/ICHE/journal/issues/v27n1/2004069/2004069.web.pdf.

Book references: Jeffcoate N. Principles of Gynaecology. 4th ed. London: Butterworth, 1975:96-101. Chapter/section in a book: Weinstein L, Swartz MN. Pathogenic Properties of Invading Microorganisms. In: Sodeman WA jun, SodemanWA, eds. Pathologic Physiology: Mechanisms of Disease. Philadelphia: WB Saunders, 1974:457-472.

Internet references: World Health Organization. The World Health Report 2002 - Reducing Risks, Promoting Healthy Life. Geneva: World Health Organization, 2002. http://www.who.int/whr/2002 (accessed 16 January 2010).

Other references (e.g. reports) should follow the same format: Author(s). Title. Publisher place: publisher name, year; pages. Cited manuscripts that have been accepted but not yet published can be included as references followed by '(in press)'. Unpublished observations and personal communications in the text must not appear in the reference list. The full name of the source person must be provided for personal communications e.g. '...(Prof. Michael Jones, personal communication)'.

COVERING LETTER

A covering letter to the editor is mandatory and must include statements that the manuscript has not been published previously and is not under review elsewhere. It should state details of any prior publication of the research in abstract form or in Congress proceedings. The letter must declare if any of the authors have a conflict of interest and that the requirements for submission, including ethics

approval and patient permission for case reports have been fulfilled. All authors must sign the covering letter.

REVIEW PROCESS

Manuscripts, after vetting by the editorial team, are assigned for peer-review to 2 reviewers, conversant with the particular field of research. The reviewers and the authors are blinded to each other's identity. The turn-around time for review and initial editorial decision notification aims to be within 6 weeks of submission.

PROOFS

A PDF proof of an article may be sent to the corresponding author before publication to resolve remaining queries. At that stage, only typographical changes are permitted; the corresponding author is required, having conferred with his/her co-authors, to reply within 2 working days in order for the article to be published in the issue for which it has been scheduled.

CHANGES OF ADDRESS

Please notify the editorial department of any contact detail changes, including email, to facilitate communication.

CHARGES

There is no charge for the publication of manuscripts.
Letters to the Editor
(400-800 words) (1 page)
Original Research
(2800-3200 words) (4-5 pages)
Scientific Letters
(2400 words) (3-4 pages)
Case Studies
(1 800 words) (3 pages)
Clinical reviews
(2 400 words) (3-4 pages)

Copyright Notice

By submitting manuscripts to SAJAA, authors of original articles are assigning copyright to the SA Society of Anaesthesiologists. Authors may use their own work after publication without written permission, provided they acknowledge the original source. Individuals and academic institutions may freely copy and distribute articles published in SAJAA for educational and research purposes without obtaining permission.
The work is licensed under a Creative Commons Attribution-Non-Commercial Works 4.0 South Africa License. The SAJAA does not hold itself responsible for statements made by the authors.

Privacy Statement

The names and email addresses entered in this journal site will be used exclusively for the stated purposes of this journal and will not be made available for any other purpose or to any other party.
This manuscript has currently only been submitted to SAJAA and has not been published previously.
□
This work is original and all third party contributions (images, ideas and results) have been duly attributed to the originator(s).
□
Permission to publish licensed material (tables, figures, graphs) has been obtained and the letter of approval and proof of payment for royalties have been submitted as supplementary files.
□
The submitting/corresponding author is duly authorised to herewith assign copyright to the South African Society of Anaesthesiologists (SASA).
□
All co-authors have made significant contributions to the manuscript to qualify as co-authors.
□
Ethics committee approval has been obtained for original studies and is clearly stated in the methodology as well as provided as a supplementary file.
□
A conflict of interest statement has been included where appropriate.
The submission adheres to the instructions to authors in terms of all technical aspects of the manuscript.
□
Plagiarism: The submitting author acknowledges that the Editorial Board reserves the right to use plagiarism detection software on any submitted material.
□
2 3,4-6
Open Journal Systems Hosting and Support by: OpenJournalSystems.com

Appendix 2: Human Research Ethics Committee approval

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room 45, E-52- Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hrec-enquiries@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

19 January 2022

HREC REF: 763/2021

Dr D van Dyk
Division of Anaesthesia & Perioperative Medicine
D-23, NGSH
Email: domniquevandyk@gmail.com
Student: prinsloo.ras@gmail.com

Dear Dr van Dyk

PROJECT TITLE: KNOWLEDGE OF SOUTH AFRICAN ANAESTHESIA REGISTRARS OF THEORY AND PRACTICE OF SPINAL ANAESTHESIA FOR CAESAREAN SECTION- MMED CANDIDATE-DR WILLEM RAS

Thank you for your response letter, addressing the issues raised by the Faculty of Health Sciences Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

This approval is subject to strict adherence to the HREC recommendations regarding research involving human participants during COVID -19, dated 17 March 2020: 06 July 2020 & 01 July 2021.

Approval is granted for one year until 30 January 2023.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

Please quote the HREC REF 763/2021 in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FACULTY OF HEALTH SCIENCES HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
NHREC-registration number: REC-210208-007
This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use: Good Clinical Practice (ICH GCP), South African Good Clinical Practice Guidelines (DoH 2020), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI), and Declaration of Helsinki (2013) guidelines. The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001938) **This serves as notification of annual approval, including any documentation described below.**			
☑ Approved	Annual progress report	Approved until/next renewal date	30/01/2024
☐ Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee	[signature]	Date Signed	31/1/2023

Note: Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.
Please clarify your plan for research-related activities during COVID-19 lockdown.
Please use the latest form found on our website:
http://www.health.uct.ac.za/fhs/research/humanethics/forms

HUMAN RESEARCH ETHICS COMMITTEE
30 JAN 2023
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

Comments to PI from the HREC

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	30/01/2023		
HREC REF Number	763/2021	Current Ethics Approval was granted until	30/1/2023
Protocol title	Knowledge of South African anaesthesia registrars of theory and practice of spinal anaesthesia for caesarean section		
Protocol number (if applicable)	N/A		
Are there any sub-studies linked to this study?	☐ Yes	X No	
If yes, could you please provide the HREC Reference number for all sub-studies? **Note:** A separate FHS016 must be submitted for each sub-study.	N/A		
Principal Investigator	Associate Professor Dominique van Dyk		

28 February 2022 Page 1 of 7 FHS016

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

Department / Office Internal Mail Address	

1.1 Does this protocol receive US Federal funding?	☐ Yes	X No
1.2 If the study receives US Federal Funding, does the annual report require full committee approval? **Note:** Any annual approvals for **Full Committee** review MUST be submitted on the monthly HREC submission dates. (Please send electronic copy for full committee review to hrec-submission@uct.ac.za)	☐ Yes	X No

If yes in 1.2 please complete section 1.3 below for invoicing purposes

1.3 Ethics Renewal Fee

Please **(tick ✓)**appropriate box for billing purposes:

Submission Type	***Description***	***New fee (Vat Incl.)***	***tick ✓***
Research funded solely from UCT departmental/ divisional/group budget	Annual evaluation of research progress report for re-certification	**R0,00**	☐
Non-sponsored student research for degree purposes at UCT/Other Universities & Colleges	Annual evaluation of research progress report for re-certification	**R0,00**	✓
Annual re-certification / Progress report (FHS016 Form)	Clinical Trial & International Grant Funded Research - Annual evaluation of research progress report for re-certification for Full Committee Approval	**R7000,00**	☐
Annual re-certification / Progress report (FHS016 Form)	Clinical Trial & International Grant Funded Research - Annual evaluation of research progress report for re-certification for Expedited review	**R3 710.00**	☐
Annual re-certification / Progress report (FHS016 Form)	National grant funded research - Annual evaluation of research progress report for re-certification for Full Committee Approval	**R6000.00**	☐
Annual re-certification / Progress report (FHS016 Form)	National Grant funded research for Annual evaluation of research progress report for re-certification for Expedited review	**R1 500,00**	☐

NB: Protocols funded by UCT (e.g. departmental funding / student research) and by certain grant funding organizations (e.g. MRC, NRF, CANSA,) are exempt from these charges.

Please provide details for Invoicing, either complete section 1 or 2 :

1. **Invoice billing – Directly to Sponsor**

Sponsor's name	N/A
Billing Address of Sponsor:	N/A
Vat Number:	N/A

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

Contact person	N/A
Telephone number	N/A
Email Address	N/A
2. **Internal Journal Billing:**	
Fund Number:	N/A
Cost Centre Number:	N/A
Account Holder Name:	N/A
Division of Account Holder:	N/A

2. List of documentation for approval

3. Protocol status (tick ✓)

☐	Open Enrolment
✓	Closed to enrolment (tick ✓)
☐	Research-related activities are ongoing
☐	Research-related activities are complete, long-term follow-up only
✓	Research-related activities are complete, data analysis only
☐	Main study is complete but sub-study research-related activities are ongoing
☐	Study is closed → Please submit a Study Closure Form (FHS010)

4. Enrolment

Number of participants enrolled to date	126
Number of participants enrolled, since last HREC Progress report (continuing review)	126
Additional number of participants still required	0

5. Refusals

Total number of refusals (participants invited to join the study, but refused to take part)	0

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

6. Cumulative summary of participants

Total number of participants who provided consent	126
Number of participants determined to be ineligible (i.e. after screening)	0
Number of participants currently active on the study	0
Number of participants completed study (without events leading to withdrawal)	126
Number of participants withdrawn at participants' request (i.e. changed their mind)	0
Number of participants withdrawn by PI due to toxicity or adverse events	0
Number of participants withdrawn by PI for other reasons (e.g. pregnancy, poor compliance)	0
Number of participants lost to follow-up. Please comment below on reasons for loss of follow-up.	0
N/A	
Number of participants no longer taking part for reasons not listed above. Please provide reasons below:	
N/A	

7. Progress of study

Please provide a brief summary of the research to date including the overall progress and the progress since the last annual report as well as any relevant comments/issues you would like to report to the HREC:
Data collection has been completed, with 126 responses to the online survey obtained. Currently in the process of data analysis.

8. Protocol violations and exceptions (tick ✓ all that apply)

✓	No prior violations or exceptions have occurred since the original approval
☐	Prior violations or exceptions have been reported since the last review and have already been acknowledged or approved
☐	Unreported minor violations that have occurred since the last review, as well as significant deviations not yet reported, are attached for review

9. Amendments (tick ✓ all that apply)

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

✓	No Prior amendments have been made since the original approval
☐	Prior amendments have been reported since the last review and have already been approved
☐	New protocol changes/ amendments are requested as part of this continuing review (See note below)

Note: If new protocol changes are being requested in this review, please complete an amendment form (FHS006).
Specific changes in the amended protocol and consent/assent forms must be **bolded**, *italicised* or tracked and all changes must include a rationale.

10. Adverse events

10.1 Please provide below or attach a narrative summary of serious adverse events and/ or unanticipated problems since the last progress report. Please indicate changes made to the protocol and informed consent document(s) as a result (if not already reported to the HREC). Please comment on whether causality to any study procedure or intervention could be established.
N/A

10.2 Have participants received appropriate treatment/ follow-up/ referral when indicated (e.g. in the case of abnormal or incidental clinical findings, distress or anxiety)?		
☐ Yes	☐ No	✓ Not applicable
If yes, please describe:		

11. Summary of Monitoring and Audit Activities (tick ✓)

11.1 Was this study monitored or audited by an external agency (e.g. SAHPRA, FDA)?		
☐ Yes	☐ No	✓ Not applicable

11.2 Did a Data and Safety Monitoring Board publish a report?		
☐ Yes	☐ No	✓ Not applicable

11.3 If yes, please identify the agency and attach a summary of the findings.					
Agency Name	N/A	Report attached	☐ Yes	☐ No	✓ Not applicable
		DSMB report attached	☐ Yes	☐ No	✓ Not applicable

11.4 Has there been any agency, institutional or other inquiry into non-compliance in this study, or any finding of non-compliance concerning a member of the research team?	
☐ Yes	✓ No

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

If yes, please explain:
N/A

12. Level of risk (tick ✓)

12.1 In light of your experience of this research, please indicate whether the level of risk to participants has:	
☐	Increased
☐	Decreased
✓	Shown no change
If there has been a change, please explain:	
N/A	

12.2 Please provide a narrative summary of recent relevant literature that may have a bearing on the level of risk.
N/A

13. Insurance

Please confirm that valid no fault insurance is still in place? **(tick ✓)**			
☐ Yes	☐ No		✓ Not Applicable – N/A
If yes, please complete the following:			
Insurer's name:	N/A		
Policy no.	N/A	*Coverage Period:	**N/A**
For UCT sponsored studies please liaise the Insurance office via fhs.sponsorship@uct.ac.za regarding the required documentation and information required obtain a renewed UCT No-fault Insurance Certificate.			

14. Statement of conflict of interest

Has there been any change in the conflict of interest status of this protocol since the original approval? (tick ✓)	
☐ Yes	✓ No
If yes, please explain and if necessary, attach a revised conflict of interest statement (Section #7 in the New Protocol Application Form FHS013):	

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

N/A

15. Signature

My signature certifies that the above is complete and correct.			
Signature of PI		Date	27/01/2023

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

Appendix 3: Information letter to participants

Dear Registrar,

Please take a few minutes to read through this letter which explains the purpose and detail of my research project. Your participation would provide very valuable information on the knowledge underpinning the practice of obstetric spinal anaesthesia in this country. If you choose to participate, kindly follow the supplied electronic link.

Research project:

Knowledge of South African anaesthesia registrars of the theory and practice of spinal anaesthesia for caesarean section

Principal investigator: Dr Dominique van Dyk (Supervisor)

Co- investigator: Dr Willem AP Ras (MMed candidate), Prof RA Dyer (Co- supervisor)

Department of Anaesthesia and Perioperative Medicine

University of Cape Town, South Africa

UCT HREC Reference number: 763/2021

Introduction:

Adequate documentation of details relating to spinal anaesthesia for caesarean section is important, both to ensure a safe and pleasant experience for the parturient, and to provide evidence that an acceptable standard of care was applied, in the event of subsequent medicolegal action. A recent MMed study conducted at a level 2 obstetrics hospital affiliated with UCT, showed that documentation of the details of spinal anaesthesia is inadequate. It was hypothesised that a contributing factor to this poor record-keeping was inadequate knowledge of the practitioner.

Aim of the study:

The aim of my study is to assess the knowledge of South African registrars pertaining to the theory and practice of spinal anaesthesia for caesarean section. The primary aim is to improve training and documentation. Ultimately this would result in improved patient care.

Participation in this study:

Anaesthesia registrars from all South African universities are invited to participate in this study by completing the questionnaire consisting of 20 single best answer multiple choice questions. The following aspects will be covered:

1. Demographic data
2. Applied anatomy and physiology
3. Equipment considerations
4. Testing of the block, including management of breakthrough pain
5. Pharmacology

Participation in the study is entirely voluntary and anonymous. De-identified data will be collected and captured electronically via Google Forms. Data will be secured, password-protected and only available to the investigators of this study. Reporting will not distinguish between universities.

If you choose to participate in my study, please do not do any preparation before attempting to answer the questionnaire. Please provide your best responses based on your existing knowledge.

Benefits of participation

The main benefit to you will be improved knowledge, in that the answers will be made available following completion of the study, and participation will qualify you to attend a free webinar conducted by Dr D van Dyk (UCT), and Professors David Bishop (UKZN) and Robert Dyer (UCT). In addition, references will be provided in the interest of your professional development.

Review of this research project:

This study has been reviewed and approved by the Human Research Ethics Committee of the Health Sciences Faculty of the University of Cape Town Human, who can be contacted at 021 406 6338 in case of any concerns related to ethics, your rights or welfare as a participant. Completion of this online questionnaire constitutes consent, and implies that your answers and responses may be used for research purposes.

Thank you for your participation.

Sincerely

Willem AP Ras (Anaesthetic Registrar UCT Department of Anaesthesia)

Tel no: 082 674 1155

e-mail: prinsloo.ras@gmail.com

Appendix 4: Google forms Questionnaire

Knowledge of South African anaesthesia registrars of the theory and practice of spinal anaesthesia for caesarean section

Principal Investigator: Dr Dominique van Dyk
Co-investigators: Dr Willem AP Ras & Prof Robert Dyer
Department of Anaesthesia and Perioperative Medicine, University of Cape Town, South Africa
UCT HREC Reference number:763/2021

Sign in to Google to save your progress. Learn more

Participant Demographics

Age:

Your answer

Sex:

- ○ Male
- ○ Female
- ○ Prefer not to say

Current anaesthesia training institution:

- ○ Sefako Makgatho Health Sciences University
- ○ University of Cape Town
- ○ University of the Free State
- ○ University of KwaZulu- Natal
- ○ University of Pretoria
- ○ University of Stellenbosch
- ○ University of Witwatersrand
- ○ Walter Sisulu University

Current year of anaesthesia registrar training:

- ○ Year 1
- ○ Year 2
- ○ Year 3
- ○ Year 4

Have you passed your final FCA Part II Examination?

- ◯ Yes
- ◯ No

Years of experience post-community service, prior to anaesthesia registrar training programme

- ◯ 1-2 years
- ◯ 3-4 years
- ◯ 4-5 years
- ◯ >5 years

Please rate your knowledge of the theory and practice of spinal anaesthesia for caesarean section:

- Excellent
- Above average
- Average
- Insufficient
- Limited

Do you feel you require additional training regarding spinal anaesthesia for obstetric caesarean section?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

Single Best Answer Questionnaire

Please provide your best responses based on the knowledge you have on this subject. Choose only one answer per question. Please do not consult any text to assist you with answering the following questions.

We suggest that you complete the following 20 questions within 75 minutes.

Question 1 - What is the highest vertebral interspace at which a spinal needle should be inserted?

- L1-L2
- L2-L3
- L3-L4
- L4-L5

Question 2 - Concerning the intercristal line (Tuffier's line):

- The palpated level agrees with that in the non- pregnant state
- Local anaesthetics are more commonly administered at a higher level than estimated by the anaesthetist
- The level is at L2-L3 on a radiological image
- It is safe to inject local anaesthetic at the L2-L3 level

Question 3 - What is the sympathetic/sensory innervation of the uterus?

- T5-T9
- T10-L1
- T10-L4
- L1-L4

Question 4 - The sensory outflow from the peritoneal cavity travels mainly via the:

- Vagus nerve
- Phrenic nerve
- Greater splanchnic nerve
- Coeliac nerve

Question 5 - What is the uppermost dermatome which gives sensory supply to the peritoneal cavity:

- T2
- T3
- T4

- T5

Question 6 - With respect to high spinal anaesthesia:

- There is complete paralysis of the phrenic nerve
- There is predominantly ventilatory failure, rather than haemodynamic instability
- Cardiac afferents T2-T6 are blocked
- Bradycardia is frequent

Question 7 - As regards aseptic technique:

- Povidine iodine is superior to chlorhexidine in alcohol
- The alcohol component of chlorhexidine in alcohol is neurotoxic
- Both iodine and alcohol are inactivated by blood
- The wearing of gloves and mask is not essential

Question 8 - Concerning spinal needles:

- Quincke needles are atraumatic
- The incidence of post-dural puncture headache is closely related to needle gauge when Whitacre needles are used
- The incidence of post-dural puncture headache is closely related to needle gauge when Quincke needles are used
- There are no available 22G atraumatic needles

Question 9 - For spinal anaesthesia in morbidly obese parturients:

- 25G x 90 mm atraumatic needles are usually adequate
- Quincke needles are advised
- The next longest available needle after the 25G x 90 mm needle is 96 mm
- 25G x 103 mm needles usually suffice
- 25G x 120 mm needles are easy to insert without using an epidural needle as a conduit

Question 10 - Concerning the use of uterine displacement devices:

- Maternal cardiac output is not affected by their use
- Unilateral block is likely if the device is placed immediately after performance of spinal anaesthesia
- Neonatal acid base status is unaffected by their use
- The benefits of these devices are limited to the period after surgery has commenced

Question 11 - Concerning the position of the operating table after the performance of spinal anaesthesia:

- Adoption of the head- down position is ineffective in achieving a higher block when using hyperbaric bupivacaine
- Adoption of the anti- Trendelenburg position is advisable in response to early spinal hypotension
- The head- up position reduces block height when isobaric bupivacaine is used
- Adoption of the neutral table position with a support beneath the shoulders reduces upward spread of hyperbaric bupivacaine

Question 12 - With respect to the baricity of local anaesthetic bupivacaine in obstetrics:

- The baricity of a solution is the ratio of the specific gravity of the solution to that of water
- Isobaric bupivacaine does not change in baricity when injected into CSF
- Isobaric bupivacaine is associated with a block level on average 2 dermatomes higher than the hyperbaric solution
- Isobaric bupivacaine is associated with a higher incidence of cervical blocks than the hyperbaric solution

Question 13 - Considering dosing of spinal bupivacaine and fentanyl:

- Seven mg of 0.5% hyperbaric bupivacaine plus 10 ug fentanyl is usually an adequate dose for spinal anaesthesia for caesarean section
- Incremental doses of spinal fentanyl until 50 ug result in proportionally increasing analgesic effect
- The dose of hyperbaric spinal bupivacaine should be reduced in morbidly obese patients
- At standard spinal doses, the odds of inadequate spinal anaesthesia are higher in preterm parturients

docs.google.com

Question 14 - With respect to intrathecal morphine for caesarean section:

- Peak analgesic effect is at 30 minutes
- The ideal dose is 250 ug
- Side effects in theatre are common
- In high-income countries, the incidence of clinically significant respiratory depression is 1/10,000
- Monitoring in South African state hospital wards is adequate for the detection of delayed respiratory depression

Question 15 - Concerning modalities of sensory block testing:

- Loss of sensation to light touch appears to be the best predictor of adequate surgical anaesthesia
- Testing of a single modality is regarded as adequate
- The time to onset of sensory blockade of touch, cold and pinprick is similar
- The dermatomal level of sensory blockade to cold is lower than that of light touch and pinprick

Question 16 - What is the best site at which to test a sensory block to the T1 level?

- ○ Immediately above nipple level
- ○ Suprasternal notch
- ○ Manubriosternal angle
- ○ Upper inner aspect of the arm

Question 17 - With respect to the Bromage score:

- ○ Grade 1: Unable to move ankles or toes = complete block (100%)
- ○ Grade 2: Unable to flex the knee, but free movement of feet = almost complete block (66%)
- ○ Grade 3: Just able to flex the hip with free movement of the knee = partial block (33%)
- ○ Grade 4: Free movement of ankles and toes = no block (0%)

Question 18 - With respect to motor block:

- ◯ Immobility of the legs indicates adequate surgical anaesthesia
- ◯ Ability to flex the hips suggests inadequate surgical anaesthesia
- ◯ Adequate surgical anaesthesia is associated with a 40% reduction in forced expiratory manoeuvres
- ◯ A weak hand grip indicates motor block to T1-T2

Question 19 - With respect to management of breakthrough pain by a specialist anaesthetist:

- ◯ Successful medico-legal claims for awareness under general anaesthesia are commoner than for pain during Caesarean section under spinal anaesthesia
- ◯ Breakthrough pain experienced before delivery is usually easily resolved using intravenous opiates
- ◯ Ketamine is an ideal agent for managing breakthrough pain
- ◯ Discomfort after delivery is best managed with small doses of propofol, short- acting opiate and nitrous oxide

Appendix 4: Questionnaire with correct answers.

Questions

Single shot spinal anaesthesia for caesarean section

Participant demographics

Age, sex, years of anaesthesia experience, years of registrar experience, training institution

Applied anatomy

Q1 What is the highest vertebral interspace at which a spinal needle should be inserted?

a L1-L2

b L2-L3

c L3-L4 ✓

d L4-L5

Q2 Concerning the intercristal line (Tuffier's line):

a The palpated level agrees with that in the non-pregnant state

b Local anaesthetic is more commonly administered at a higher level than estimated by the anaesthetist ✓

c The level is at L2-L3 on a radiological image

d It is safe to inject local anaesthetic at the L2-L3 level

Q3 What is the sympathetic/sensory innervation of the uterus?

a T5-T9

b T10-L1 ✓

c T10-L4

d L1-L4

Q4 The sensory outflow from the peritoneal cavity travels mainly via the:

a Vagus nerve

b Phrenic nerve

c Greater splanchnic nerve ✓

d Coeliac nerve

Q5 What is the uppermost dermatome which gives sensory supply to the peritoneal cavity?

a T2

b T3

c T4

d T5 ✓

Q6 With respect to high spinal anaesthesia:

a There is complete paralysis of the phrenic nerve

b There is predominantly ventilatory failure

c Cardiac afferents T2-T6 are blocked

d Bradycardia is frequent ✓

Equipment considerations

Q7 As regards aseptic technique:

a Povidine iodine is superior to chlorhexidine in alcohol

b The alcohol component of chlorhexidine in alcohol is neurotoxic ✓

c Both iodine and alcohol are inactivated by blood

d The wearing of gloves and mask is not essential

Q8 Concerning spinal needles:

a Quincke needles are atraumatic

b The incidence of post-dural puncture headache is closely related to needle gauge when Whitacre needles are used

c The incidence of post-dural puncture headache is closely related to needle gauge when Quincke needles are used ✓

d There are no available 22G atraumatic needles

Q9 For spinal anaesthesia in morbidly obese parturients:

a 25G x 90 mm atraumatic needles are usually adequate

b Quincke needles are advised

c The next longest available needle after the 25G x 90 mm needle is 96 mm

d 25G x 103 mm needles usually suffice ✓

e 25 x 120 mm needles are easy to insert without using an epidural needle as a conduit

Q10 Concerning the use of uterine displacement devices:

a Maternal cardiac output is not affected by their use

b Unilateral block is likely if the device is placed immediately after performance of spinal anaesthesia

c Neonatal acid base status is unaffected by their use ✓

d The benefits of these devices are limited to the period after surgery has commenced

Factors affecting block height

Q11 Concerning the position of the operating table after the performance of spinal anaesthesia:

a Adoption of the head-down position is ineffective in achieving a higher block when using hyperbaric bupivacaine

b Adoption of the anti-Trendelenburg position is advisable in response to early spinal hypotension

c The head-up position reduces block height when isobaric bupivacaine is used

d Adoption of the neutral table position with a support beneath the shoulders reduces upward spread of hyperbaric bupivacaine ✓

Q12 With respect to the baricity of local anaesthetic bupivacaine in obstetrics:

a The baricity of a solution is the ratio of the specific gravity of the solution to that of water

b Isobaric bupivacaine does not change in baricity when injected into CSF

c Isobaric bupivacaine is associated with a block level on average 2 dermatomes higher than the hyperbaric solution

d Isobaric bupivacaine is associated with a higher incidence of cervical blocks than the hyperbaric solution ✓

Pharmacology

Q13 Considering dosing of spinal bupivacaine and fentanyl:

a Seven mg of 0.5% hyperbaric bupivacaine plus 10 µg fentanyl is usually an adequate dose for spinal anaesthesia for caesarean section

b Incremental doses of spinal fentanyl until 50 µg result in proportionally increasing analgesic effect

c The dose of hyperbaric spinal bupivacaine should be reduced in morbidly obese patients

d At standard spinal doses, the odds of inadequate spinal anaesthesia are higher in preterm parturients ✓

Q14 With respect to intrathecal morphine for caesarean section:

a Peak analgesic effect is at 30 minutes

b The ideal dose is 250 µg

c Side effects in theatre are common

d In high-income countries, the incidence of clinically significant respiratory depression is 1/10,000 ✓

e Monitoring in South African state hospital wards is adequate for the detection of delayed respiratory depression

Testing of the block

Q15 Concerning modalities of sensory block testing:

a Loss of sensation to light touch appears to be the best predictor of adequate surgical anaesthesia ✓

b Testing of a single modality is regarded as adequate

c The time to onset of sensory blockade of touch, cold and pinprick is similar

d The dermatomal level of sensory blockade to cold is lower than that of light touch and pinprick

Q16 What is the best site at which to test a sensory block to the T1 level?

a Immediately above nipple level

b Suprasternal notch

c Manubriosternal angle

d Upper inner aspect of the arm ✓

Q17 With respect to the Bromage Score:

a Grade 1: Unable to move ankles or toes = complete block (100%)

b Grade 2: Unable to flex the knee, but free movement of feet = almost complete block (66%)✓

c Grade 3: Just able to flex the hip with free movement of the knee = partial block (33%)

d Grade 4: Free movement of ankles and toes = no block (0%)

Q18 With respect to motor block:

a Immobility of the legs indicates adequate surgical anaesthesia

b Ability to flex the hips suggests inadequate surgical anaesthesia ✓

c Adequate surgical anaesthesia is associated with a 40% reduction in forced expiratory manoeuvres

d A weak hand grip indicates motor block to T1-T2

Management of breakthrough pain

Q19 With respect to management of breakthrough pain by a specialist anaesthetist:

a Successful medico-legal claims for awareness under general anaesthesia are commoner than for pain during caesarean section under spinal anaesthesia

b Breakthrough pain experienced before delivery is usually easily resolved using intravenous opiates

c Ketamine is an ideal agent for managing breakthrough pain

d Discomfort after delivery is best managed with small doses of propofol, short-acting opiate and nitrous oxide ✓

Q20 Also related to breakthrough pain:

a Midazolam has great benefit in the setting of intraoperative pain

b Full documentation of the event is not necessary

c The administration of face mask oxygen following supplemental analgesia is not recommended

d Follow-up consultation with a patient experiencing intraoperative discomfort is essential ✓

Appendix 6: Statistics

Table A1: Consolidation of demographic categories into two categories.

Demographic	Original subgroups	N	New subgroups		N
Age	1	1	1	27 – 35 y	97
	2	30			
	3	66			
	4	23	2	> 40 y	28
	5	5			
Experience	1	53	1	1 – 4 y	91
	2	38			
	3	16	2	> 4 y	34
	4	18			
Rated_Knowledge	1	7	1	Above average to excellent	80
	2	73			
	3	43	2	Limited & insufficient	45
	4	1			
	5	1			
Requiring Additional_Training	1	8	1	Strongly agree to agree	56
	2	48			
	3	34	2	Neutral to strongly disagree	69
	4	29			
	5	6			

Table A2: Results of within-category score comparisons (Mann-Whitney nonparametric tests for independent samples)

Demographic	Subgroup	N	Median score (IQR)	95% CI (%)	Score Range (%)	H-L Median difference (95% CI)	P (M-W)
Passed FCA	Yes	13	50% (48.8 to 61.3)	(47.7 to 62.3)	(40 to 70)	5% (0.0 to 15)	0.0477
	No	112	45 (37.5 to 55)	(45 to 50)	(20 to 75)		
Requiring Additional Training	Agree	56	50% (35 to 53)	(40 to 50)	(20 to 75)	0.0% (-5 to 5)	0.984
	Disagree	69	50% (40 to 55)	(45 to 50)	(20 to 75)		
Age group	27 – 35 y	97	50% (40 to 50)	(45 to 55)	(20 to 75)	0.0% (-5 to 5)	0.689
	>40 y	28	47.5% (40 to 50)	(40 to 50)	(20 to 75)		
Experience	1 – 4 y	91	50% (40 to 55)	(45 to 50)	(25 to 75)	-5% (-10 to 0.0)	0.0135
	>4 y	34	45% (35 to 50)	(39.1 to 50)	(20 to 75)		
Rated_Knowledge	Above average to excellent	80	45% (35 to 50)	(40 to 50)	(20 to 75)	5% (0.0 to 10)	0.0129
	Limited & insufficient	45	50%	(45 to 55)	(25 to 75)		

			(45 to 56.3)				

IQR = Interquartile range; 95% CI = 95% confidence interval; H-L = Hodges-Lehmann; M-W = Mann-Whitney test

Table A3: Results of the Kruskal-Wallis non-parametric one-way analysis of variance tests.

Demographic	Factor	N	Median score (IQR)	Score range (%)	P
Gender	1	3	55% (47.5 to 58.9)	(45 to 60)	0.299
	2	58	50% (40 to 55)	(20 to 75)	
	3	64	45% (37.5 to 52.5)	(20 to 70)	
Training_Year	1	50	45% (35 to 55)	(20 to 75)	0.500
	2	34	45 (40 to 55)	(20 to 70)	
	3	17	45% (38.8 to 55)	(25 to 70)	
	4	24	50% (45 to 55)	(25 to 70)	

Table A4: Medcalc Statistical Software output for the final multiple linear regression model.

Multiple regression

Dependent Y	Percent score

Least squares multiple regression

Method	Backward
Enter variable if P<	0.05
Remove variable if P>	0.1

Sample size	125
Coefficient of determination R^2	0.1252
R^2-adjusted	0.1036
Multiple correlation coefficient	0.3539
Residual standard deviation	0.1092

Regression Equation

Independent variables	Coefficient	Std. Error	t	P	$r_{partial}$	$r_{semipartial}$	VIF
(Constant)	0.4095						
RateKnowledge	0.05728	0.02120	2.701	0.0079	0.2385	0.2297	1.087
ExperienceGroup	-0.05094	0.02222	-2.292	0.0236	-0.2040	0.1949	1.026
Training_year	0.02046	0.008858	2.310	0.0226	0.2055	0.1964	1.062

Analysis of Variance

Source	DF	Sum of Squares	Mean Square
Regression	3	0.2064	0.06880
Residual	121	1.4416	0.01191

F-ratio	5.7749
Significance level	P=0.0010

Zero order and simple correlation coefficients

Variable	Percent_score	RateKnowledge	ExperienceGroup
RateKnowledge	0.2221		

ExperienceGroup	-0.2261	-0.1588	
Training_year	0.1356	-0.2407	0.04623

Residuals

Shapiro-Wilk test for Normal distribution	W=0.9895 accept Normality (P=0.4594)

Tuesday, March 7, 2023 16:08

MedCalc® Statistical Software version 20.218 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2023)

Table A5: Medcalc Statistical Software output for the final logistic regression model.

Dependent Y	Pass_Fail_50

Method	Backward
Enter variable if P<	0.05
Remove variable if P>	0.1

Sample size	125
Positive cases [a]	64 (51.20%)
Negative cases [b]	61 (48.80%)

[a] Pass_Fail_50 = 1
[b] Pass_Fail_50 = 0

Overall Model Fit

Null model -2 Log Likelihood	173.215
Full model -2 Log Likelihood	167.992
Chi-squared	5.223
DF	2
Significance level	P = 0.0734
Cox & Snell R^2	0.04092
Nagelkerke R^2	0.05457

Coefficients and Standard Errors

Variable	Coefficient	Std. Error	Wald	P
RateKnowledge	0.73431	0.39826	3.3996	0.0652
Training_year	0.28981	0.16893	2.9431	0.0862
Constant	-1.56183	0.74823	4.3571	0.0369

Variables not included in the model
ExperienceGroup

Odds Ratios and 95% Confidence Intervals

Variable	Odds ratio	95% CI
RateKnowledge	2.0840	0.9548 to 4.5489

Training_year	1.3362	0.9595 to 1.8606

Hosmer & Lemeshow test

Chi-squared	1.9860
DF	5
Significance level	P = 0.8511

Classification table (cut-off value p=0.5)

Actual group	Predicted group		Percent correct
	0	1	
Y = 0	29	32	47.54%
Y = 1	18	46	71.87%
Percent of cases correctly classified			60.00%

ROC curve analysis

Area under the ROC curve (AUC)	0.624
Standard Error	0.0502
95% Confidence interval	0.533 to 0.709

Contact information

Corresponding author: Dr. Willem AP Ras

Mailing address: D23 Department of Anaesthesia and Perioperative Medicine, Groote Schuur Hospital, Anzio Road, Observatory 7925, Cape Town, South Africa

Phone Number: +27 21 404 5001

E-mail address: rsxwil001@myuct.ac.za