Preoperative fasting practices and incidence of hypoglycaemia in patients presenting for caesarean section at a central hospital

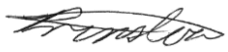
Nathalie Prinsloo

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

Johannesburg, 2023

Declaration

I, Nathalie Prinsloo declare that this research report is my own unaided work. It is being submitted for the Degree of Master of Medicine in the branch of Anaesthesiology at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



13 April 2023

Abstract

Background

Prolonged preoperative fasting times have a negative impact on parturients and may have a negative impact on the neonate. This study aimed to describe the preoperative fasting practices and incidence of hypoglycaemia in obstetric patients undergoing caesarean section, as well as the incidence of neonatal hypoglycaemia at Chris Hani Baragwanath Academic Hospital.

Methods

This prospective, cross-sectional study was conducted in 2021 over six months at Chris Hani Baragwanath Academic Hospital, a tertiary referral hospital in Johannesburg, South Africa. The sample consisted of 213 adult parturients who presented for emergency or elective caesarean section and excluded those who could not provide a history of fasting practices. Maternal blood glucose levels were measured prior to anaesthesia and neonatal blood glucose levels were measured immediately after delivery.

Results

Mean (SD) fasting times to solids and fluids were 18 h, 19 min (12 h, 4 min) and 13 h, 2 min (8 h, 31 min), respectively. Maternal hypoglycaemia occurred in 24.4% of the parturients and was associated with longer periods of fasting to solids (P=0.049). The incidence of neonatal hypoglycaemia was 1.8% and maternal blood glucose level was significantly positively correlated with neonatal blood glucose level (r=0.59, P<0.001).

Conclusion

Preoperative starvation times were excessive and should be addressed to avoid maternal hypoglycaemia. The impact of maternal hypoglycaemia on the neonate is less clear and further research is required before a protocol can be developed. It may be prudent to check the blood glucose levels of all parturients prior to caesarean section.

Acknowledgements

The author would like to thank the following people:

The supervisor, Dr Tristan Leonard, for his support, guidance, and motivation.

Professor Palesa Motshabi, for her vested interest in my progress and her ongoing motivation to meet deadlines.

The Chris Hani Baragwanath Academic Hospital Department of Obstetrics and Gynaecology, for being so accommodating throughout this process and allowing me to conduct my research in their maternity complex.

Professor Neville Pillay for helping me make sense of my data.

The participants, for being so willing to take part in my research, while going through a life-changing event.

My family and friends, for their unwavering support.

Kevin and Ryan, the loves of my life.

Table of contents

List of figures

List of tables

Abbreviations

ANOVA	Analysis of variance
ASA	American Society of Anesthesiologists
BMI	Body mass index
CHBAH	Chris Hani Baragwanath Academic Hospital
CMJAH	Charlotte Maxeke Johannesburg Academic Hospital
CS	Caesarean section
DDI	Decision-to-delivery interval
ERAS®	Enhanced Recovery After Surgery
GDM	Gestational diabetes mellitus
HIV	Human immunodeficiency virus
IV	Intravenous
NPO	Nil per os
RCT	Randomized controlled trial
RSII	Rapid sequence induction and intubation
SASA	South African Society of Anaesthesiologists

Statement

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

The formatting of this Research Report complies with the University of the Witwatersrand's Style Guide for Theses, Dissertations and Research Reports. The formatting of the draft article may differ from the author guidelines of the International Journal of Obstetric Anesthesia, the journal to which it is intended to be submitted, in order to comply with the university's style guide.

Section 1: Review of the literature

In this section the literature regarding maternal preoperative fasting guidelines maternal hypoglycaemia and neonatal hypoglycaemia will be reviewed.

1.1 Introduction

The first documented guidelines for preoperative fasting, the practice of not allowing patients oral intake of liquids or solids for a defined period prior to a procedure, can be traced back to the mid-1800's (1, 2). Dr John Snow, then an anaesthetist to Queen Victoria, stated that the only instruction a patient should receive prior to the inhalation of chloroform is to avoid taking a meal. His reasoning was that chloroform would lead to emesis if food was present in the stomach and this would be both unpleasant and inconvenient (2).

The current feared complication of a full stomach prior to anaesthesia, namely perioperative pulmonary aspiration – the aspiration of gastric contents following anaesthetic induction – was only described in 1862 at a medical meeting in Edinburgh (1, 2). It was reported that an autopsy, performed on a soldier who passed away in 1853 under chloroform anaesthesia, revealed gastric contents in the patient's trachea. Preoperative fasting periods, as outlined in published guidelines that were developed over the century that followed, changed regularly – from the 2 hour fasting period to fluids and the recommendation that a stomach be empty, advised by Lister (2) in 1883, to the recommendation that patients be kept nil per os (NPO) to both solids and clear fluid from midnight, as published in guidelines by Dripps et al (3) in 1982.

Perioperative pulmonary aspiration is a rare event, albeit one associated with significant morbidity and mortality. Sequelae include aspiration pneumonia, acute respiratory distress syndrome or respiratory failure, and even death (4, 5). Pulmonary aspiration is one of the four recognized possible causes of the first documented anaesthetic death that occurred in a healthy 15-year-old girl presenting for a toenail removal in 1848 (6). Preoperative fasting guidelines were developed to reduce both aspiration risk and the severity of the pulmonary sequelae should aspiration occur. Acidic gastric contents of a large volume and of

a particulate nature may be associated with worse outcomes following aspiration. As such, guidelines aim to reduce the volume and acidity of gastric contents, in addition to eliminating particulate matter at the time of surgery (4).

1.2 Preoperative fasting guidelines

Preoperative fasting guidelines are intended for patients undergoing any form of anaesthesia – general, regional or monitored anaesthesia care – for an elective procedure (4). International anaesthesia societies have developed these guidelines based on expert opinion and knowledge of gastric physiology, with little to no evidence that clinical outcomes are improved by following said recommendations. The American Society of Anesthesiologists (ASA) currently recommends the following fasting intervals prior to induction of anaesthesia: 2 hours for clear fluids, 4 hours for breast milk, 6 hours for nonhuman milk, formula, or a light meal and 8 hours for fatty or fried food, or meat. Other international anaesthesia societies have similar guidelines (4).

Clear fluids include water, milk-free tea or coffee, clear juices, and carbohydrate drinks. An additional hour should be given for carbohydrate drinks rich in protein (4). The ASA further elaborates that clear fluids include carbonated beverages but exclude alcohol (1). Various randomized controlled trials (RCTs) have shown that patients that consumed clear fluids within 2 to 4 hours of their procedure, had less thirst and hunger, when compared to patients who consumed clear fluids more than 4 hours pre-procedure (4). Furthermore, patients who ingested carbohydrate-rich clear fluids up to 2 hours pre-procedure experienced less thirst, hunger and anxiety, compared to those who ingested water or no fluids in the same time period (4, 7). The gastric residual volumes in patients who consumed clear fluids 2 hours prior to their procedures, were unchanged compared to those in patients who were kept NPO to all fluids overnight (4).

Non-clear liquids, other than breast milk, should not be consumed within 6 hours of the elective procedure. Gastric emptying times are prolonged with these substances, and there is a higher risk of residual particulate matter in the stomach (4). Further recommendations regarding medication, chewing gum and other fluids, such as bowel preparation, are made but shall not be elaborated upon. The

ASA does not restrict the volume of clear fluids allowed pre-procedure, only the fasting interval (4). Other international anaesthesia societies do place a restriction on the volume of clear fluids allowed, with the Australian and New Zealand College of Anaesthetists regarding up to 400 ml as safe (8). The Scandinavian Society of Anaesthesiology and Intensive Care Medicine specifies that a maximum of 150 ml of water may be given up to 1 hour prior to anaesthetic Induction (9).

The standard fasting guidelines apply to those patients who do not have comorbidities that delay gastric emptying or increase their risk of aspiration. In such circumstances the above guidelines may need to be modified (4).

1.3 Preoperative fasting guidelines specific to parturients

Fasting guidelines make further recommendations for special populations such as paediatrics, patients with obesity or diabetes mellitus, and pregnant patients. Obese and nonobese parturients who are not in labour have been found to have normal gastric emptying (4). Popivanov et al (10) conducted an observational study on forty non-labouring parturients who were awaiting elective caesarean section (CS) delivery and had completed an overnight fast. Gastric volumes were measured using ultrasound, at baseline and serially, following the ingestion of 400 ml of a carbohydrate-rich beverage. At 120 min post-ingestion, there was no significant difference between the gastric volume then and the baseline gastric volume (10). A study conducted in Iran has demonstrated that women who consumed clear fluids one hour before their CS did not have an increased risk of regurgitation (11).

Non-labouring parturients should follow the ASA standard fasting guidelines for elective surgery, before the induction of any type of anaesthesia (4, 12). This recommendation also forms an important part of the Enhanced Recovery After Surgery (ERAS®) for caesarean delivery programme, a standardized, perioperative care programme developed by the ERAS® Society that aims to improve maternal and neonatal outcomes through enhanced quality and safety of the CS delivery (13, 14). Based on a high-quality level of evidence, the guideline strongly recommends that parturients be encouraged to consume clear fluids until 2 hours prior to their surgery, and a light meal until 6 hours prior to their surgery. A

carbohydrate drink, rich in calories, up to 2 hours before surgery, may be given to nondiabetic women but the evidence for this is low and so the recommendation by the ERAS® Society is weak (14).

Wendling et al (15) conducted a double-blinded RCT on 47 low-risk parturients undergoing elective CS under spinal anaesthesia. This two-year study aimed to determine whether the preoperative oral consumption of a higher-dose carbohydrate drink would improve patient outcomes, when compared to commercial oral rehydration solutions and fasted controls. The primary outcomes measured included hunger, thirst, anxiety, fatigue, and nausea and these were essentially a surrogate for patient well-being. Measures were taken pre- and post-beverage consumption. The study showed that both groups of beverage-consuming parturients had significant improvements in patient well-being when compared to the fasted control group (15).

Gastric emptying in the labouring parturient is delayed and so different fasting guidelines are recommended. Of note, the intake of solid food should be avoided, especially when the patient has received opioid analgesics parenterally or via the neuraxial route (4). Regarding clear fluids, a more liberal approach has been put forth by the ASA, who state that uncomplicated labouring parturients may consume moderate amounts of clear fluid. However, labouring parturients who are further at risk of aspiration or who may require CS delivery, should be assessed on a case-by-case basis and may require further restrictions with regard to oral intake (12).

The standard ASA fasting guidelines are applicable to patients undergoing elective procedures. Non-fasted patients who require elective surgery may have their procedure delayed or rescheduled to avoid the risk of aspiration. Non-fasted patients presenting for emergency surgery are at an increased risk of aspiration, as the protective airway reflexes that prevent passive regurgitation of gastric contents are either diminished or abolished by anaesthetic medication (4). Patients that fall within this category are usually assessed as requiring a rapid sequence induction and intubation (RSII), a technique that aims to minimize the risk of perioperative pulmonary aspiration in patients at a higher-than-normal risk for this, should general anaesthesia be the anaesthetic of choice. Regardless of fasting

status, a pregnant patient with a gestational age of greater than 20 weeks is considered a full stomach and warrants an RSII should she require a general anaesthetic (16).

1.4 South African preoperative fasting guidelines and practices

Currently, preoperative fasting guidelines specific to South Africa do not exist. The South African Society of Anaesthesiologists (SASA) recommends that the ASA fasting guidelines be followed (17). There exist limited data on perioperative fasting practices in South Africa. A literature search revealed three studies conducted in the last six years regarding adult patients undergoing elective surgery – of various surgical disciplines. Unpublished data from a study by Herbst (18) conducted at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) described the preoperative fasting practices in adult patients undergoing elective gynaecological, orthopaedic, urological, and general surgical procedures at this institution. It was found that there was a difference between instructed and actual fasting times – with the median instructed fasting time being 10 hours (with a range of 8 to 12 hours) and the mean actual fasting time being 15 hours (18).

Lamacraft et al (19) conducted a similar study on 105 patients presenting for elective ophthalmic or orthopaedic surgery at Universitas Hospital Annex in Bloemfontein, South Africa. They found that patients were most frequently instructed to be kept NPO to solids from 22h00 to 00h00. In addition, no patient had a fasting time of less than 8 hours. In fact, the median duration of fasting to solids was 14 hours and 45 minutes. The instructed fasting time to fluids was most frequently from 05h00, whereas the median actual fasting time for fluids was 13 hours and 35 minutes (19).

A recent addition to South African obstetric anaesthesia research is the study conducted by Morgan et al (20) at Tygerberg Hospital in Cape Town, which aimed to assess whether documented starvation times in parturients undergoing elective CS delivery conformed to the ASA guidelines. Furthermore, Morgan et al (20) set out to evaluate whether prolonged starvation times were associated with adverse metabolic consequences, specifically hypoglycaemia and ketonuria. They found

the median fasting times for solids and fluids to be 15 hours and 14 hours, respectively, both significantly longer than recommended (20).

Shedding further light on the current obstetric fasting practices in a tertiary hospital, Morgan et al (20) found that one third of the subjects had undergone repeated periods of fasting in the week prior to their procedure, with the median cumulative fasting time being 40 hours and the longest cumulative fasting time being 133 hours. The above findings were attributed to an unfortunate and ongoing situation whereby parturients awaiting elective CS deliveries are fasted in anticipation of the delivery the following day. However, owing to both limited human and physical resources, a finite number of CS deliveries can be performed per day and emergency cases often take precedence over the elective cases to prevent maternal and foetal morbidity and mortality. Those elective procedures that are not done as planned, are carried over to the following day and so the cycle of prolonged starvation is repeated (20, 21).

No South African studies describing the preoperative fasting practices of emergency obstetric patients could be found.

1.5 Hypoglycaemia

Established deleterious effects of prolonged fasting include hypoglycaemia, dehydration, ketoacidosis, delayed recovery, and reduced patient satisfaction (22). Furthermore, parturients with preoperative hypovolaemia owing to decreased fluid intake may be at higher risk of hypotension after spinal anaesthesia (22). Prolonged fasting activates a metabolic response, with resultant gluconeogenesis, and enhances the organic response to trauma. A prolonged preoperative fasting period leads to a significant increase in insulin resistance that can be demonstrated immediately after surgery, lasts for 2 to 4 weeks following surgery, and positively correlates with length of hospital stay (23). As such, shortening the preoperative fasting period is beneficial in the reduction of insulin resistance and organic response to trauma (23).

Hypoglycaemia as defined by the American Diabetes Association is a blood glucose of < 3.9 mmol/L (24). This is the level at which treatment with glucose

should be initiated to prevent clinical or symptomatic hypoglycaemia. Symptoms that occur as a result of the autonomic response include hunger, sweating, paraesthesia, tremors, anxiety, and palpitations. Neuroglycopaenic symptoms, which occur as a result of brain deprivation of glucose, tend to occur at glucose levels < 3.0 mmol/L (24). These symptoms include: weakness, dizziness or tiredness, inappropriate behaviour, difficulty concentrating, confusion, blurry vision, and in severe cases coma, and death (25). It is important to note that asymptomatic hypoglycaemia can occur with glucose levels as low as 1.7 mmol/L during fasting in normal women and during pregnancy (26). Li et al (5) conducted a study of 1599 parturients in China over a period of three years with the aim of evaluating the effect of various preoperative fasting intervals on both women and neonates through a retrospective analysis. They found an incidence of maternal hypoglycaemia of 2.3 to 6.5% which correlated with the duration of fasting intervals (5).

Morgan et al (20) found the mean whole blood glucose level to be 4.05 mmol/L and the incidence of maternal hypoglycaemia to be 39.3%. The relationship between fasting time and the probability of maternal hypoglycaemia was sigmoid in nature i.e., within the first 9 hours of fasting there was not an increased risk of maternal hypoglycaemia, but after 9 hours, each additional hour of fasting increased the relative risk of maternal hypoglycaemia linearly 1.5-fold. At a fasting time of 36 hours, the probability of maternal hypoglycaemia was 100% (20).

Pregnancy represents a unique state of altered physiology, whereby the metabolic needs of the foetus are prioritized over that of the parturient. Over 50 years ago, Metzer et al (27) described a state of “accelerated starvation” that is unmasked in pregnancy following brief periods of starvation. After both 12 and 18 hours of starvation, insulin and glucose levels in parturients in their third trimester of pregnancy, were significantly lower and free fatty acids and ketones significantly higher than their non pregnant counterparts (27). Just two years later Felig et al (28) demonstrated a similar finding in patients in their second trimester of pregnancy. The mechanism of ketonaemia of starvation in mid-pregnancy was postulated to be owing to the lack of insulin following hypoglycaemia which, in turn, resulted from increased foetal glucose utilization (28).

Insulin resistance and enhanced ketogenesis and lipolysis predispose parturients to the rapid development of ketosis (29). This process is further exacerbated by the glucose-raising hormones produced and secreted by the placenta. Chausse et al (29) describe a case of starvation ketoacidosis in a parturient so severe that it necessitated intensive care unit admission, mechanical ventilation and an intravenous infusion of dextrose with rapid resolution 6 hours later (29). Morgan et al (20) found a significant association between hypoglycaemia and ketonuria, which occurred together in 30.4% of the participants. Furthermore, this combination of abnormal sequelae was associated with longer fasting times (20).

A single-blind RCT conducted by Clark et al (30) found that carbohydrate preloading, in women undergoing elective CS delivery, reduced the incidence of urinary ketones prior to surgery and that the number needed to treat to prevent urinary ketosis was three, suggesting that the introduction of a preoperative carbohydrate drink may ameliorate the effects of preoperative fasting (30).

1.6 Neonatal hypoglycaemia

Li et al (5) determined whether the various fasting times of the parturients influenced the health of the neonate, with the following outcomes being measured: APGAR scores, foetal acidosis and neonatal hypoglycaemia (5). Neonatal hypoglycaemia is the most common metabolic disturbance found in newborns and its sequelae are well known and corroborated by various studies (31, 32). These complications, which are positively correlated with severity and duration of hypoglycaemia, include neurological damage such as cerebral palsy, intellectual impairment, visual impairment, occipital lobe epilepsy, personality disorders, muscle weakness and impaired cardiac performance (5, 31). The definition of neonatal hypoglycaemia does not have a universally agreed upon specific blood glucose concentration (31, 32). The following classification has been used in various studies: a blood glucose concentration ≥ 2.5 mmol/L is normal, whereas mild neonatal hypoglycaemia is 2.2 to 2.4 mmol/L, moderate neonatal hypoglycaemia is 1.6 to 2.1 mmol/L and severe neonatal hypoglycaemia is a blood glucose concentration < 1.6 mmol/L (31, 33).

There are very few studies demonstrating a link between maternal hypoglycaemia and neonatal hypoglycaemia. Li et al (5) demonstrated that the incidence of neonatal hypoglycaemia in neonates born to parturients that fasted for more than 8 hours to solid food and for more than 2 hours to clear fluids was significantly higher than the incidence of neonatal hypoglycaemia in groups fasted for a shorter period suggesting that long-term fasting can have an important impact on the well-being of the neonate. They further demonstrated that the preoperative fasting of solid food for ≥ 6 hours but < 8 hours and clear fluids < 2 hours in parturients reduces the incidence of both neonatal hypoglycaemia and foetal acidosis (5).

The study conducted by Wendling et al (15) whereby parturients were randomized to either receive carbohydrate-containing drinks, oral rehydration solution or nothing on the morning of their CS, measured neonatal outcomes as a secondary objective. These outcomes included, amongst others, umbilical cord blood glucose levels and hypoglycaemia. Regarding these parameters, there were no differences among the groups, implying that neonatal insulin levels were not impacted at the time of delivery (15).

He et al (34) conducted a RCT on 88 parturients undergoing scheduled elective CS delivery in order to determine whether maternal and neonatal outcomes were affected by the preoperative intake of a carbohydrate-rich drink. The groups to which the women were randomized were the carbohydrate-rich group, a placebo group, and a fasting group. The main maternal primary outcome measured was postoperative insulin resistance as determined by plasma glucose and insulin levels. The neonatal outcomes measured were blood glucose level measured via a heel-prick within 20 minutes of birth and 1-minute APGAR score. Although there was no significant difference in immediate postoperative maternal glucose level among the groups, the carbohydrate-rich group had a lower incidence of postoperative insulin resistance. Regarding the neonatal outcomes, babies born to mothers in the carbohydrate-rich group had higher capillary blood glucose levels. The 1-minute APGAR scores were not significantly different between the three groups (34).

1.7 Summary

Prolonged fasting intervals have a negative impact on parturients and may have a negative impact on the newborn. Little is known about the preoperative fasting practices in obstetric patients presenting for CS delivery in South Africa.

Preoperative fasting guidelines aim to reduce the risk and sequelae of perioperative pulmonary aspiration. These guidelines, developed over the last 170 years, have aimed to strike a balance between the ‘empty stomach’ and the negative impact of prolonged fasting (2, 4). The recommended period for fasting before induction of any type of anaesthetic in obstetric patients is 6 to 8 hours for solids and up to 2 hours for clear oral fluids (4, 12). Multiple recent studies conducted on obstetric patients awaiting elective CS delivery suggest that the routine use of a carbohydrate-rich drink up to 2 hours prior to the procedure is beneficial and should become routine (15, 30, 34). Established deleterious effects of prolonged fasting include hypoglycaemia, dehydration, ketoacidosis, delayed recovery, reduced patient satisfaction, post-neuraxial hypotension, increased insulin resistance, and an enhanced organic response to trauma (22, 23).

Two studies describing preoperative fasting practices of elective non-obstetric patients (including adherence to current fasting guidelines) in South Africa have been conducted. These studies demonstrated a significant difference between instructed and actual fasting periods, both of which were longer than that recommended by the ASA guidelines (4, 18, 19). A recent South African study conducted on elective obstetric patients yielded similar results and shed light on the possible extent of starvation-induced hypoglycaemia and urinary ketosis in this population (20). However, no data regarding obstetric patients presenting for emergency surgery in developing countries, including South Africa, could be found.

Both maternal hypoglycaemia and neonatal hypoglycaemia carry significant morbidity. While the link between maternal hyperglycaemia and neonatal hypoglycaemia is well-established it is less clear whether there is a link between maternal hypoglycaemia and neonatal glucose levels and this needs to be explored (5, 31, 32).

Little is known about the preoperative fasting practices in obstetric patients in South Africa. Prolonged fasting intervals have a negative impact on parturients and can have a negative impact on the newborn. Therefore, there is a need to quantify these fasting practices. This could lead to improved perioperative patient care.

1.8 References

1. Practice Guidelines for Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration: Application to Healthy Patients Undergoing Elective Procedures: An Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration. Anesthesiology. 2017;126(3):376-93. doi: 10.1097/ALN.0000000000001452

2. Maltby JR. Fasting from midnight--the history behind the dogma. Best Pract Res Clin Anaesthesiol. 2006;20(3):363-78. doi: 10.1016/j.bpa.2006.02.001

3. Dripps RD, Eckenhoff JD, Vandam LD. Introduction to Anaesthesia. Philadelphia: WB Sauders Company; 1961. ISBN 0721635253

4. Crowley M. Preoperative fasting guidelines. UpToDate, Inc. Wolters Kluwer. Available from: https://www.uptodate.com/contents/preoperative-fasting-guidelines. [Accessed: 06 January 2020].

5. Li Y, Su D, Sun Y, Hu Z, Wei Z, Jia J. Influence of different preoperative fasting times on women and neonates in cesarean section: a retrospective analysis. BMC Pregnancy Childbirth. 2019;19(1):104. doi: 10.1186/s12884-019-2254-2

6. Knight PR, Bacon DR. An unexplained death: Hannah Greener and chloroform. Anesthesiology. 2002;96(5):1250-3. doi: 10.1097/00000542-200205000-00030

7. Hausel J, Nygren J, Lagerkranser M, Hellstrom PM, Hammarqvist F, Almstrom C, et al. A carbohydrate-rich drink reduces preoperative discomfort in elective surgery patients. Anesth Analg. 2001;93(5):1344-50. doi: 10.1097/00000539-200111000-00063

8. Australian and New Zealand College of Anaesthetists. Guideline on pre-anaesthesia consultation and patient preparation. Melbourne, Victoria, 3004, Australia. 2017.

9. Soreide E, Eriksson LI, Hirlekar G, Eriksson H, Henneberg SW, Sandin R, et al. Pre-operative fasting guidelines: an update. Acta Anaesthesiol Scand. 2005;49(8):1041-7. doi: 10.1111/j.1399-6576.2005.00781.x

10. Popivanov P, Irwin R, Walsh M, Leonard M, Tan T. Gastric emptying of carbohydrate drinks in term parturients before elective caesarean delivery: an observational study. Int J Obstet Anesth. 2020;41:29-34. doi: 10.1016/j.ijoa.2019.07.010

11. Ghorashi Z, Ashori V, Aminzadeh F, Mokhtari M. The effects of oral fluid intake an hour before cesarean section on regurgitation incidence. Iran J Nurs Midwifery Res. 2014;19(4):439-42. Available from: https://www.ncbi.nlm.nih.gov/pubmed/25183988

12. Practice Guidelines for Obstetric Anesthesia: An Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology. Anesthesiology. 2016;124(2):270-300. doi: 10.1097/ALN.0000000000000935

13. Ituk U, Habib AS. Enhanced recovery after cesarean delivery. F1000Res. 2018;7. doi: 10.12688/f1000research.13895.1

14. Wilson RD, Caughey AB, Wood SL, Macones GA, Wrench IJ, Huang J, et al. Guidelines for Antenatal and Preoperative care in Cesarean Delivery: Enhanced Recovery After Surgery Society Recommendations (Part 1). Am J Obstet Gynecol. 2018;219(6):523 e1- e15. doi: 10.1016/j.ajog.2018.09.015

15. Wendling AL, Byun SY, Koenig M, Vasilopoulos T. Impact of oral carbohydrate consumption prior to cesarean delivery on preoperative well-being: a randomized interventional study. Arch Gynecol Obstet. 2020;301(1):179-87. doi: 10.1007/s00404-020-05455-z

16. Berkow L. Rapid sequence induction and intubation (RSII) for anesthesia.2019. UpToDate, Inc. Wolters Kluwer. Available from: https://www.uptodate.com/contents/rapid-sequence-induction-and-intubation-rsii-for-anesthesia?topicRef=15698&source=see_link#H211963066.

17. South African Society of Anaesthesiologists. SASA Practice Guidelines 2018 Revision. SAJAA. 2018;24(2):S1-119. Available from: http://www.sajaa.co.za/index.php/sajaa/issue/view/126

18. Herbst J. Preoperative fasting practices in adult elective surgery patients at Charlotte Maxeke Johannesburg academic hospital [Research report]: University of the Witwatersrand; 2016.

19. Lamacraft G, Labuschagne C, Pretorius S, Prinsloo MC, Smit MD, Steyn JR. Preoperative fasting times: Prescribed and actual fasting times at Universitas Hospital Annex, Bloemfontein, South Africa. S Afr Med J. 2017;107(10):910-4. doi: 10.7196/SAMJ.2017.v107i10.10930

20. Morgan K, Levin A, Esterhuizen T. The incidence of maternal hypoglycaemia with prolonged fasting before elective caesarean section. Southern African Journal of Anaesthesia and Analgesia. 2021;27(4):175-9. doi: 10.36303/SAJAA.2021.27.4.2585

21. van Dyk D. Starvation in the midst of plenty... of caesarean deliveries. Southern African Journal of Anaesthesia and Analgesia. 2021;27(4):164-6. doi: 10.36303/SAJAA.2021.27.4.2661

22. Yurashevich M, Chow A, Kowalczyk JJ, Traynor AJ, Carvalho B. Preoperative Fasting Times for Patients Undergoing Caesarean Delivery: Before and After a Patient Educational Initiative. Turk J Anaesthesiol Reanim. 2019;47(4):282-6. doi: 10.5152/TJAR.2019.95770

23. de Aguilar-Nascimento JE, Dock-Nascimento DB. Reducing preoperative fasting time: A trend based on evidence. World J Gastrointest Surg. 2010;2(3):57-60. doi: 10.4240/wjgs.v2.i3.57

24. American Diabetes Association. 6. Glycemic Targets: Standards of Medical Care in Diabetes—2021. Diabetes Care. 2020;44(Supplement_1):S73-S84. doi: 10.2337/dc21-S006

25. Hamdy O. Hypoglycemia Clinical Presentation. WebMD LLC. Available from: https://emedicine.medscape.com/article/122122-clinical. [Accessed: 17 January 2020].

26. Vincent J, Abraham E, Kochanek P, Moore FA and Fink MP. Textbook of Critical Care E-Book: Elsevier Health Sciences; 2016.

27. Metzger BE, Ravnikar V, Vileisis RA, Freinkel N. "Accelerated starvation" and the skipped breakfast in late normal pregnancy. Lancet. 1982;1(8272):588-92. doi: 10.1016/s0140-6736(82)91750-0

28. Felig P, Lynch V. Starvation in human pregnancy: hypoglycemia, hypoinsulinemia, and hyperketonemia. Science. 1970;170(3961):990-2. doi: 10.1126/science.170.3961.990

29. Chausse JM, Paruk F, Motilall S, Soma-Pillay P, Ndaba S. Starvation ketoacidosis in pregnancy presenting as euglycaemic, high anion gap metabolic acidosis: A case report highlighting the significance of early recognition and prompt intervention. S Afr Med J. 2018;108(8):636-9. doi: 10.7196/SAMJ.2018.v108i8.13082

30. Clark A, Litchfield K, Hannah S, Love C, Slade K, Lake K, et al. Pre-operative carbohydrate loading prior to elective caesarean delivery: a randomised controlled trial. Int J Obstet Anesth. 2021;45:21-7. doi: 10.1016/j.ijoa.2020.10.008

31. Stomnaroska O, Petkovska E, Jancevska S, Danilovski D. Neonatal Hypoglycemia: Risk Factors and Outcomes. Pril (Makedon Akad Nauk Umet Odd Med Nauki). 2017;38(1):97-101. doi: 10.1515/prilozi-2017-0013

32. Adamkin DH. Postnatal glucose homeostasis in late-preterm and term infants. Pediatrics. 2011;127(3):575-9. doi: 10.1542/peds.2010-3851

33. Flores-le Roux JA, Sagarra E, Benaiges D, Hernandez-Rivas E, Chillaron JJ, Puig de Dou J, et al. A prospective evaluation of neonatal hypoglycaemia in infants of women with gestational diabetes mellitus. Diabetes Res Clin Pract. 2012;97(2):217-22. doi: 10.1016/j.diabres.2012.03.011

34. He Y, Liu C, Han Y, Huang Y, Zhou J, Xie Q. The impact of oral carbohydrate-rich supplement taken two hours before caesarean delivery on maternal and neonatal perioperative outcomes -- a randomized clinical trial. BMC Pregnancy Childbirth. 2021;21(1):682. doi: 10.1186/s12884-021-04155-z

Section 2: Author's guidelines

Contents

2.1 Introduction

2.1.1 Types of article

The International Journal of Obstetric Anesthesia welcomes original articles on **clinical topics**, **laboratory research**, **perinatal physiology** and **pharmacology**; and on all subjects of relevance and importance to obstetric anaesthesia. We welcome submissions related to global health, maternal safety and inequalities of care.

Original articles include randomised controlled trials, observational prospective and retrospective studies, meta-analyses, case-controlled studies, case series, systematic and narrative reviews. Short reports will also be considered for an original article when the aim, outcome and findings are presented succinctly with one illustrative Table or Figure. Each of these is associated with specific guidelines with regard to content and construct, such as provided by the CONSORT and STROBE guidelines. Please see Registration of clinical trials and journal governance. Int J Obstet Anesth 2014;23:204-5.

Submitting case reports

As discussed in Case reports and consent to publication. Int J Obstet Anesth 2016;28:1-2, the International Journal of Obstetric Anesthesia understands the importance of case reports in our sub-specialised field. To be accepted for publication, individual case reports need to have important and novel learning points; a simple narrative of a complex or challenging patient(s) or a patient with a rare condition is insufficient. Case series dealing with important areas of practice

with a thorough review of the relevant literature will be considered. When writing the case report it is recommended that authors describe the salient features of the case, their novel clinical/technical solutions or features, and a short review of prior knowledge of these cases. Please see guidelines such as those at www.CARE-statement.org . Authors may choose to combine a number of similar cases (usually greater than 3) and write a case series and review article. Submissions of case reports, or correspondence in which a potentially identifiable patient is described, without written consent of the patient, will not be considered for publication (see Ethics in Publishing below).

Invited review articles

The journal publishes review articles and debates on topical and controversial subjects in the area of obstetric anaesthesia. Reviews are often commissioned, although authors may contact the Editor-in-Chief if they wish to discuss potential topics.

Surveys

Surveys will be considered provided they are likely to be of broad interest, well designed and conducted, adequately representative of the anaesthesia community, and have a response rate that is approximately 70% or more. Surveys with a lower response rate will be considered for publication as a letter or occasionally considered for publication as an article, depending on the importance of the topic surveyed and at the editors' discretion.

2.1.2 Contact details for submission

Authors may send queries concerning the submission process, manuscript status, or journal procedures to the Editorial Office.

Please visit our Support Center.

Submission Checklist

You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

Ensure that the following items are present:

One author has been designated as the corresponding author with contact details:
• E-mail address
• Full postal address

All necessary files have been uploaded:
Manuscript:
• Include keywords
• Include highlights - 3 to 5 bullet points, with no more than 85 characters each, including spaces.
• All figures (include relevant captions)
• All tables (including titles, description, footnotes)
• Ensure all figure and table citations in the text match the files provided
• Indicate clearly if color should be used for any figures in print
Graphical Abstracts / Highlights files (where applicable)
Supplemental files (where applicable)

Further considerations
• Manuscript has been 'spell checked' and 'grammar checked'
• All references mentioned in the Reference List are cited in the text, and vice versa
• Permission has been obtained for use of copyrighted material from other sources (including the Internet)
• Relevant declarations of interest have been made
• Journal policies detailed in this guide have been reviewed
• Referee suggestions and contact details provided, based on journal requirements

For further information, visit our Support Center.

2.1.3 Reporting guidelines

The editors require that manuscripts adhere to recognized reporting guidelines relevant to the research design used and require authors to submit a checklist verifying that essential elements have been reported for all primary research and systematic reviews.

Reporting guidelines endorsed by the journal are listed below:

- *Observational cohort, case control and cross sectional studies* - STROBE - Strengthening the Reporting of Observational Studies in Epidemiology, http://www.equator-network.org/reporting-guidelines/strobe/
- *Systematic Reviews* - PROSPERO - International register of systematic reviews, https://www.crd.york.ac.uk/prospero/#aboutregpage
- *Qualitative studies* - COREQ - Consolidated criteria for reporting qualitative research, http://www.equator-network.org/reporting-guidelines/coreq
- *Quasi-experimental/non-randomised evaluations* - TREND - Transparent Reporting of Evaluations with Non-randomized Designs, http://www.cdc.gov/trendstatement/
- *Case Reports* - CARE Guidelines- https://www.care-statement.org/
- *Randomised (and quasi-randomised) controlled trial* - CONSORT - Consolidated Standards of Reporting Trials, http://www.equator-network.org/reporting-guidelines/consort/
- *Animal Research* - ARRIVE- https://www.nc3rs.org.uk/arrive-guidelines
- *Study of Diagnostic accuracy/assessment scale* - STARD - Standards for the Reporting of Diagnostic Accuracy Studies, http://www.equator-network.org/reporting-guidelines/stard/
- *Systematic Review of Controlled Trials* - PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses, http://www.equator-network.org/reporting-guidelines/prisma/
- *SRQR checklist is for qualitative studies* http://www.equator-network.org/reporting-guidelines/srqr/
- *AGREE checklist is for clinical guidelines* type of articles http://www.equator-network.org/reporting-guidelines/the-agree-

reporting-checklist-a-tool-to-improve-reporting-of-clinical-practice-guidelines/

You are required to adhere to these guidelines (or a suitable recognized alternative) and to submit a completed checklist from the reporting guideline to assist the editors and reviewers of your paper. You can search for the correct guideline for your study using the tools provided by the EQUATOR network: http://www.equator-network.org/ The guideline used must be indicated in the **Author Checklist** and the completed Standards of Reporting Checklist must also be included in your submission.

2.2 Before You Begin

2.2.1 Ethics in publishing

Please see our information on **Ethics in publishing**.

A paper that contains the results of human and/or animal studies will only be accepted for publication if it is made clear that a high standard of ethics was applied in carrying out the investigation. All clinical investigators must follow the Ethical Principles for Medical Research Involving Human Subjects outlined in the **Declaration of Helsinki** In the case of invasive studies of humans, the text should include a statement that the research protocol was approved by a local institutional review board or ethics committee (with specific details such as reference number) and that written consent was obtained from all subjects.

2.2.2 Informed consent and patient details

Studies on patients or volunteers require ethics committee approval and informed consent, which should be documented in the paper. Appropriate consents, permissions and releases must be obtained where an author wishes to include case details or other personal information or images of patients and any other individuals in an Elsevier publication. Written consents must be retained by the author but copies should not be provided to the journal. Only if specifically requested by the journal in exceptional circumstances (for example if a legal issue arises) the author must provide copies of the consents or evidence that such

consents have been obtained. For more information, please review the Elsevier Policy on the Use of Images or Personal Information of Patients or other Individuals. Unless you have written permission from the patient (or, where applicable, the next of kin), the personal details of any patient included in any part of the article and in any supplementary materials (including all illustrations and videos) must be removed before submission.

2.2.3 Declaration of interests

All authors must disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential competing interests include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding. Authors must disclose any interests in two places: 1. A summary declaration of interest statement in the title page file (if double-blind) or the manuscript file (if single-blind). If there are no interests to declare then please state this: 'Declarations of interest: none'. This summary statement will be ultimately published if the article is accepted. 2. Detailed disclosures as part of a separate Declaration of Interest form, which forms part of the journal's official records. It is important for potential interests to be declared in both places and that the information matches. More information.

2.2.4 Submission declaration

Submission of an article implies that the work described has not been published previously (except in the form of an abstract, a published lecture or academic thesis, see 'Multiple, redundant or concurrent publication' for more information), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder.

Preprints

Please note that preprints can be shared anywhere at any time, in line with

Elsevier's sharing policy. Sharing your preprints e.g. on a preprint server will not count as prior publication (see 'Multiple, redundant or concurrent publication' for more information).

2.2.5 Use of inclusive language

Inclusive language acknowledges diversity, conveys respect to all people, is sensitive to differences, and promotes equal opportunities. Content should make no assumptions about the beliefs or commitments of any reader; contain nothing which might imply that one individual is superior to another on the grounds of age, gender, race, ethnicity, culture, sexual orientation, disability or health condition; and use inclusive language throughout. Authors should ensure that writing is free from bias, stereotypes, slang, reference to dominant culture and/or cultural assumptions. We advise to seek gender neutrality by using plural nouns ("clinicians, patients/clients") as default/wherever possible to avoid using "he, she," or "he/she." We recommend avoiding the use of descriptors that refer to personal attributes such as age, gender, race, ethnicity, culture, sexual orientation, disability or health condition unless they are relevant and valid. When coding terminology is used, we recommend to avoid offensive or exclusionary terms such as "master", "slave", "blacklist" and "whitelist". We suggest using alternatives that are more appropriate and (self-) explanatory such as "primary", "secondary", "blocklist" and "allowlist". These guidelines are meant as a point of reference to help identify appropriate language but are by no means exhaustive or definitive.

2.2.6 Changes to authorship

Authors are expected to consider carefully the list and order of author **before** submitting their manuscript and provide the definitive list of authors at the time of the original submission. Any addition, deletion or rearrangement of author names in the authorship list should be made only **before** the manuscript has been accepted and only if approved by the journal Editor. To request such a change, the Editor must receive the following from the **corresponding author**: (a) the reason for the change in author list and (b) written confirmation (e-mail, letter) from all authors that they agree with the addition, removal or rearrangement. In the case of

addition or removal of authors, this includes confirmation from the author being added or removed.

Only in exceptional circumstances will the Editor consider the addition, deletion or rearrangement of authors **after** the manuscript has been accepted. While the Editor considers the request, publication of the manuscript will be suspended. If the manuscript has already been published in an online issue, any requests approved by the Editor will result in a corrigendum.

2.2.7 Reporting clinical trials

Researchers must pre-register clinical trials involving an intervention on a public registry at or before the time of first recruitment. Many web-based public registries are now available including http://www.clinicaltrials.gov. Please see http://www.who.int/ictrp/network/primary/en/ for a detailed list. We will not accept interventional studies that have not been pre-registered on a trial registration site prior to enrollment. Submissions of clinical trials that do not specifically identify the registry and state the registry number will not be considered for review.

2.2.8 Copyright

Upon acceptance of an article, authors will be asked to complete a 'Journal Publishing Agreement' (see more information on this). An e-mail will be sent to the corresponding author confirming receipt of the manuscript together with a 'Journal Publishing Agreement' form or a link to the online version of this agreement.

Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. Permission of the Publisher is required for resale or distribution outside the institution and for all other derivative works, including compilations and translations. If excerpts from other copyrighted works are included, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has preprinted forms for use by authors in these cases.

For gold open access articles: Upon acceptance of an article, authors will be asked to complete a 'License Agreement' (more information). Permitted third party

reuse of gold open access articles is determined by the author's choice of user license.

Author rights

As an author you (or your employer or institution) have certain rights to reuse your work. More information.

Elsevier supports responsible sharing

Find out how you can share your research published in Elsevier journals.

2.2.9 Role of the funding source

You are requested to identify who provided financial support for the conduct of the research and/or preparation of the article and to briefly describe the role of the sponsor(s), if any, in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. If the funding source(s) had no such involvement then this should be stated.

2.2.10 Open access

Please visit our Open Access page for more information.

Language (usage and editing services)

Please write your text in good English (American or British usage is accepted, but not a mixture of these). Authors who feel their English language manuscript may require editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the English Language Editing service available from Elsevier's Author Services.

2.2.11 Submission

Our online submission system guides you stepwise through the process of entering your article details and uploading your files. The system converts your article files to a single PDF file used in the peer-review process. Editable files (e.g., Word, LaTeX) are required to typeset your article for final publication. All

correspondence, including notification of the Editor's decision and requests for revision, is sent by e-mail.

Submission of an article implies that the work described has not been published previously (except as an abstract or part of a published lecture or academic thesis), that it is not under consideration (in whole or in part) for publication elsewhere, that its publication is approved by all Authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, without the written consent from the *International Journal of Obstetric Anesthesia*, the copyright-holder.

Please submit your article via
https://www.editorialmanager.com/yijoa/default.aspx.

2.2.12 Queries

For questions about the editorial process (including the status of manuscripts under review) or for technical support on submissions, please visit our Support Center.

Use of word processing software

It is important that the file be saved in the native format of the word processor used. The text should be in single-column format. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. In particular, do not use the word processor's options to justify text or to hyphenate words. However, do use bold face, italics, subscripts, superscripts etc. When preparing tables, if you are using a table grid, use only one grid for each individual table and not a grid for each row. If no grid is used, use tabs, not spaces, to align columns. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). Note that source files of figures, tables and text graphics will be required whether or not you embed your figures in the text. See also the section on Electronic artwork.

To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

Manuscripts should have 1.0 line spacing, including tables and references. Pages should be numbered consecutively. Authors are advised to study recent issues of the *International Journal of Obstetric Anesthesia* to assess the level of detail required for publication. For guidance, original research articles should not exceed 3000 words, case reports 1500 words, reviews 5000 words, editorials 1500 words and correspondence 750 words (excluding references)

2.2.13 Article structure

Abstract. This should consist of not more than 250 words summarising the contents of the article and should contain no references or abbreviations (unless the latter are essential to meet the word count). For submissions other than case reports and reviews, use a structured abstract with the headings: Background, Methods, Results, Conclusions - with all submissions followed by Key Words, with each new one capitalised and in alphabetical order.

Title Page

Title. Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible. State the design of the study if appropriate.

Author names and affiliations. Please clearly indicate the initials (not first names) and family name(s) of each author and check that all names are accurately spelled. Do not include qualifications. Present the authors' affiliation addresses (where the actual work was done, and including the country) below the names. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate address. Authors contributions are not required.

Corresponding author. Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. Ensure that the e-mail address is provided (professional rather than personal if possible). Do not include telephone contact (but ensure that contact details are kept up to date by the corresponding author).

Present/permanent address. If the corresponding author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main affiliation address. Superscript Arabic numerals are used for such footnotes.

2.2.14 Word counts

Each manuscript should comply with the following:

Original Research - 3000 words, with up to 40 references (please note that in-text citations are included in the word count). Maximum of 6 tables and figures (consider supplementary material)

Short Reports - 1500 words, with up to 25 references (please note that in-text citations are included in the word count). Maximum of 4 tables and figures (consider supplementary material)

Case Reports - 1500 words, with up to 25 references (please note that in-text citations are included in the word count). Declarations regarding funding are usually not applicable. Maximum of 4 tables and figures (consider supplementary material).

Reviews - 5000 words, with up to 80 references (please note that in-text citations are included in the word count). Maximum of 6 tables and figures (consider supplementary material)

Editorials - 1500 words, with up to 60 references (please note that in-text citations are included in the word count). Highlights are not required. Declarations regarding funding are usually not applicable. Maximum of 4 tables and figures (consider supplementary material)

Correspondence - 750 words, with up to 10 references (please note that in-text citations are included in the word count). Highlights are not required. Declarations regarding funding are usually not applicable. Maximum of 2 tables and figures (consider supplementary material)

2.2.15 Points of style

Headings should be appropriate to the nature of the paper. In general, those for experimental papers should follow the usual conventions. Introduction, Methods, Results, Discussion etc. and do not need to be on separate sheets. Sub-headings are not used in general but can sometimes improve readability. Do not insert compulsory line breaks within the text; please indent new paragraphs.

Avoid new or unusual abbreviations and only use those in routine use: the abbreviation should be fully explained in parentheses at its first occurrence in the manuscript text. All abbreviations used in tables and figures should be defined in the legend.

All measurements should be expressed in metric units, SI units being preferred except in the case of fluid pressures e.g. mmHg. For more detailed recommendations, authors may consult the Royal Society of Medicine publication: *Units, Symbols and Abbreviations: A Guide for Biological and Medical Editors and Authors.* Propriety names and drugs, instruments etc. if essential, should start with initial capital letters.

In the text, in tables and in figures (use Fig.1, not Figure 1), **please use symbols where possible** e.g. "µg", not mcg; and also use "<", not "less than". Abbreviate time units to "s", "min" and "h". For numbers less than 10, use the word e.g. nine, not 9. For numbers larger than nine thousand nine hundred and ninety-nine, please use a character space rather than a comma e.g. 12 347, not 12,347.

For 95%CIs, please use "to" between values rather than a hyphen e.g. 10 to 17, not 10-17. Use *P* for p-value.

If you have mentioned any **drug name**, please refer to the drug by its generic name. If you feel it is important to include the drug's brand name, please add this in parentheses indicating the drug company name and city, state, and country. For any device or manufacturer mentioned, the full company name, location (city and state for US manufacturers; city and country for international) must also appear the first time it is presented in the manuscript text.

2.2.16 Highlights

"Highlights" are mandatory for this journal as they help increase the discoverability of your article via search engines. They consist of a short collection of bullet points that capture the novel results of your research, as well as new methods that were used during the study (if any). Name and include up to 5 bullet points **(maximum 85 characters, including spaces, per bullet point)**. Please have a look at the examples here: example Highlights.

Highlights should be submitted in a separate editable file in the online submission system.

Graphical abstract

Although a graphical abstract is optional, its use is encouraged as it draws more attention to the online article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of 531 × 1328 pixels (h × w) or proportionally more. The image should be readable at a size of 5 × 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. You can view Example Graphical Abstracts on our information site.

Authors can make use of Elsevier's Illustration Services to ensure the best presentation of their images and in accordance with all technical requirements.

Formatting of funding sources

List funding sources in this standard way to facilitate compliance to funder's requirements:

Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyy]; the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes of Peace [grant number aaaa].

It is not necessary to include detailed descriptions on the program or type of grants and awards. When funding is from a block grant or other resources available to a

university, college, or other research institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, please include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Electronic artwork

General points

• Make sure you use uniform lettering and sizing of your original artwork.
• Embed the used fonts if the application provides that option.
• Aim to use the following fonts in your illustrations: Arial, Courier, Times New Roman, Symbol, or use fonts that look similar.
• Number the illustrations according to their sequence in the text.
• Use a logical naming convention for your artwork files.
• Provide captions to illustrations separately.
• Size the illustrations close to the desired dimensions of the published version.
• Submit each illustration as a separate file.
• Ensure that color images are accessible to all, including those with impaired color vision.

A detailed guide on electronic artwork is available.

You are urged to visit this site; some excerpts from the detailed information are given here.

Formats

If your electronic artwork is created in a Microsoft Office application (Word, PowerPoint, Excel) then please supply 'as is' in the native document format.
Regardless of the application used other than Microsoft Office, when your electronic artwork is finalized, please 'Save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):

EPS (or PDF): Vector drawings, embed all used fonts.
TIFF (or JPEG): Color or grayscale photographs (halftones), keep to a minimum of

300 dpi.
TIFF (or JPEG): Bitmapped (pure black & white pixels) line drawings, keep to a minimum of 1000 dpi.
TIFF (or JPEG): Combinations bitmapped line/half-tone (color or grayscale), keep to a minimum of 500 dpi.

Please do not:

• Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); these typically have a low number of pixels and limited set of colors;
• Supply files that are too low in resolution;
• Submit graphics that are disproportionately large for the content.

Color artwork

Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF), or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. **For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article**. Please indicate your preference for color: in print or online only. Further information on the preparation of electronic artwork.

Figure captions

Ensure that each illustration has a caption. Supply captions separately, not attached to the figure. A caption should comprise a brief title (**not** on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

2.2.17 Tables

Number tables in the order in which they are cited in the text. Place footnotes to tables below the table body and indicate them with superscript lowercase letters. Avoid vertical rules. Ensure that the data presented in tables are not duplicated in the text.

Citation in text

Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Data references

This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

Reference management software

Most Elsevier journals have their reference template available in many of the most popular reference management software products. These include all products that support Citation Style Language styles, such as Mendeley. Using citation plug-ins from these products, authors only need to select the appropriate journal template when preparing their article, after which citations and bibliographies will be automatically formatted in the journal's style. If no template is yet available for this journal, please follow the format of the sample references and citations as shown in this Guide. If you use reference management software, please ensure that you remove all field codes before submitting the electronic manuscript. More information on how to remove field codes from different reference management software.

Reference style

The accuracy of references is the responsibility of the author. **Please do not use reference managers other than Mendeley and edit references into the style**

below. Many studies have found a high percentage of errors in reference lists. There may be errors, often typographical, in the citation itself (e.g., author name, initial; title; volume; page; year) or errors of attribution (e.g., reference fails to document statement attributed to it). Please confirm the accuracy of your references by comparison with original sources, not with someone else's reference lists, and examine your citations for typographical errors.

References to books: should be set out as follows:
Eisenach JC. The pain of childbirth and its effect on the mother and fetus. In: Chestnut DH, ed. Obstetric Anesthesia Principles and Practice. 3rd ed. Philadelphia: Elsevier Mosby; 2004:3288-301.

Citing and listing of Web references. As a minimum, the title of the website or document, the full uniform resource locator (URL) and the accessed date should be given. Any further information, if known (DOI, author names, reference to a source publication, etc.), should also be given. Web references should be included in order of citation, in the reference list. Electronic material from a web site should be set out as follows: National Institutes of Health. NIH guidelines on the inclusion of women as subjects in clinical research. Available at http://grants.nih.gov/grants/guide/not94-100.html. Accessed September 30, 2009

Reference style

Text: Indicate references by (consecutive) superscript arabic numerals in the order in which they appear in the text. The numerals are to be used *outside* periods and commas, *inside* colons and semicolons. For further detail and examples you are referred to the AMA Manual of Style, A Guide for Authors and Editors, 11th Edition.

List: Number the references in the list in the order in which they appear in the text.

Examples:

Reference to a journal publication:

1. Van der Geer J, Hanraads JAJ, Lupton RA. The art of writing a scientific article. *J Sci Commun.* 2010;163:51–59. https://doi.org/10.1016/j.Sc.2010.00372

Reference to a journal publication with an article number:

2. Van der Geer J, Hanraads JAJ, Lupton RA. The art of writing a scientific

article. *Heliyon*. 2018;19:e00205. https://doi.org/10.1016/j.heliyon.2018.e00205
Reference to a book:
3. Strunk W Jr, White EB. *The Elements of Style.* 4th ed. New York, NY: Longman; 2000.
Reference to a chapter in an edited book:
4. Mettam GR, Adams LB. How to prepare an electronic version of your article. In: Jones BS, Smith RZ, eds. *Introduction to the Electronic Age.* New York, NY: E-Publishing Inc; 2009:281–304.
Reference to a website:
5. Cancer Research UK. Cancer statistics reports for the UK. Accessed 13 March 2003. http://www.cancerresearchuk.org/aboutcancer/statistics/cancerstatsreport/; 2003. .
Reference to a dataset:
[dataset] 6. Oguro M, Imahiro S, Saito S, Nakashizuka T. Mortality data for Japanese oak wilt disease and surrounding forest compositions, Mendeley Data, v1; 2015. https://doi.org/10.17632/xwj98nb39r.1
Reference to software:
7. Coon E, Berndt M, Jan A, Svyatsky D, Atchley A, Kikinzon E, Harp D, Manzini G, Shelef E, Lipnikov K, Garimella R, Xu C, Moulton D, Karra S, Painter S, Jafarov E, Molins S. Advanced Terrestrial Simulator (ATS) v0.88 (Version 0.88). Zenodo; 2020, March 25. https://doi.org/10.5281/zenodo.3727209

Journal abbreviations source

Journal names should be abbreviated according to the List of Title Word Abbreviations.

2.2.18 Supplementary material

Supplementary material such as applications, images and sound clips, can be published with your article to enhance it. Submitted supplementary items are published exactly as they are received (Excel or PowerPoint files will appear as such online). Please submit your material together with the article and supply a concise, descriptive caption for each supplementary file. If you wish to make changes to supplementary material during any stage of the process, please make sure to provide an updated file. Do not annotate any corrections on a previous

version. Please switch off the 'Track Changes' option in Microsoft Office files as these will appear in the published version.

2.2.19 Research data

This journal encourages and enables you to share data that supports your research publication where appropriate, and enables you to interlink the data with your published articles. Research data refers to the results of observations or experimentation that validate research findings. To facilitate reproducibility and data reuse, this journal also encourages you to share your software, code, models, algorithms, protocols, methods and other useful materials related to the project.

Below are a number of ways in which you can associate data with your article or make a statement about the availability of your data when submitting your manuscript. If you are sharing data in one of these ways, you are encouraged to cite the data in your manuscript and reference list. Please refer to the "References" section for more information about data citation. For more information on depositing, sharing and using research data and other relevant research materials, visit the research data page.

Data linking

If you have made your research data available in a data repository, you can link your article directly to the dataset. Elsevier collaborates with a number of repositories to link articles on ScienceDirect with relevant repositories, giving readers access to underlying data that gives them a better understanding of the research described.

There are different ways to link your datasets to your article. When available, you can directly link your dataset to your article by providing the relevant information in the submission system. For more information, visit the database linking page.

For supported data repositories a repository banner will automatically appear next to your published article on ScienceDirect.

In addition, you can link to relevant data or entities through identifiers within the text of your manuscript, using the following format: Database: xxxx (e.g., TAIR: AT1G01020; CCDC: 734053; PDB: 1XFN).

Mendeley Data

This journal supports Mendeley Data, enabling you to deposit any research data (including raw and processed data, video, code, software, algorithms, protocols, and methods) associated with your manuscript in a free-to-use, open access repository. During the submission process, after uploading your manuscript, you will have the opportunity to upload your relevant datasets directly to *Mendeley Data*. The datasets will be listed and directly accessible to readers next to your published article online.

For more information, visit the Mendeley Data for journals page.

Data statement

To foster transparency, we encourage you to state the availability of your data in your submission. This may be a requirement of your funding body or institution. If your data is unavailable to access or unsuitable to post, you will have the opportunity to indicate why during the submission process, for example by stating that the research data is confidential. The statement will appear with your published article on ScienceDirect. For more information, visit the Data Statement page.

2.2.20 Peer review

This journal operates a single blind review process. All contributions will be initially assessed by the chief editor for suitability for the journal. Papers deemed suitable are then typically sent to a handling editor, and then potentially to independent expert reviewers to assess the scientific quality of the paper. The chief editor is responsible for the final decision regarding acceptance or rejection of articles. The chief editor's decision is final. More information on types of peer review.

Manuscripts authored by a member of Editorial Board

Editors are not involved in decisions about papers which they have written themselves or have been written by family members or colleagues or which relate to products or services in which the editor has an interest. Any such submission is subject to all of the journal's usual procedures, with peer review handled independently of the relevant editor and their research groups.

2.3 After Acceptance

2.3.1 Proofs

One set of page proofs (as PDF files) will be sent by e-mail to the corresponding author (if we do not have an e-mail address then paper proofs will be sent by post) or a link will be provided in the e-mail so that authors can download the files themselves. To ensure a fast publication process of the article, we kindly ask authors to provide us with their proof corrections within two days. Elsevier now provides authors with PDF proofs which can be annotated; for this you will need to download the free Adobe Reader, version 9 (or higher). Instructions on how to annotate PDF files will accompany the proofs (also given online). The exact system requirements are given at the Adobe site.

If you do not wish to use the PDF annotations function, you may list the corrections (including replies to the Query Form) and return them to Elsevier in an e-mail. Please list your corrections quoting line number. If, for any reason, this is not possible, then mark the corrections and any other comments (including replies to the Query Form) on a printout of your proof and scan the pages and return via e-mail. Please use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor. We will do everything possible to get your article published quickly and accurately. It is important to ensure that all corrections are sent back to us in one communication: please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility.

2.3.2 Offprints

The corresponding author will, at no cost, receive a customized Share Link providing 50 days free access to the final published version of the article on ScienceDirect. The Share Link can be used for sharing the article via any communication channel, including email and social media. For an extra charge, paper offprints can be ordered via the offprint order form which is sent once the article is accepted for publication. Both corresponding and co-authors may order

offprints at any time via Elsevier's Author Services. Corresponding authors who have published their article gold open access do not receive a Share Link as their final published version of the article is available open access on ScienceDirect and can be shared through the article DOI link.

2.4 Author Inquiries

Visit the Elsevier Support Center to find the answers you need. Here you will find everything from Frequently Asked Questions to ways to get in touch.
You can also check the status of your submitted article or find out when your accepted article will be published.

Section 3: Draft article

Preoperative fasting practices and incidence of hypoglycaemia in patients presenting for caesarean section at a central hospital

N. Prinsloo[1], T. Leonard[1]

[1]Department of Anaesthesiology, Chris Hani Baragwanath Academic Hospital, School of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa

Corresponding Author

N. Prinsloo

Email: 0701103r@students.wits.ac.za

Abstract

Background

Prolonged preoperative fasting times have a negative impact on parturients and may have a negative impact on the neonate. This study aimed to describe the preoperative fasting practices and incidence of hypoglycaemia in obstetric patients undergoing caesarean section, as well as the incidence of neonatal hypoglycaemia at Chris Hani Baragwanath Academic Hospital.

Methods

This prospective, cross-sectional study was conducted in 2021 over six months at Chris Hani Baragwanath Academic Hospital, a tertiary referral hospital in Johannesburg, South Africa. The sample consisted of 213 adult parturients who presented for emergency or elective caesarean section and excluded those who could not provide a history of fasting practices. Maternal blood glucose levels were measured prior to anaesthesia and neonatal blood glucose levels were measured immediately after delivery.

Results

Mean (SD) fasting times to solids and fluids were 18 h, 19 min (12 h, 4 min) and 13 h, 2 min (8 h, 31 min), respectively. Maternal hypoglycaemia occurred in 24.4% of the parturients and was associated with longer periods of fasting to solids (P=0.049). The incidence of neonatal hypoglycaemia was 1.8% and maternal blood glucose level was significantly positively correlated with neonatal blood glucose level (r=0.59, P<0.001).

Conclusion

Preoperative starvation times were excessive and should be addressed to avoid maternal hypoglycaemia. The impact of maternal hypoglycaemia on the neonate is less clear and further research is required before a protocol can be developed. It may be prudent to check the blood glucose levels of all parturients prior to caesarean section.

Key words: Caesarean section, Fasting, Hyperglycaemia, Hypoglycaemia

Introduction

Perioperative pulmonary aspiration, although a rare complication, is associated with significant morbidity and mortality.[1] The preoperative fasting guidelines that have been developed to date, aim to strike a balance between an empty stomach, that reduces the risk and sequelae of perioperative pulmonary aspiration, and the negative impact of prolonged fasting.[1] Established deleterious effects of prolonged preoperative fasting include hypoglycaemia, dehydration, ketoacidosis, delayed recovery, reduced patient satisfaction, post-neuraxial hypotension, increased insulin resistance, and an enhanced organic response to trauma.[2]

As no South African fasting guidelines exist currently, the South African Society of Anaesthesiologists (SASA) recommends that the American Society of Anesthesiologists (ASA) guidelines be observed.[3] These guidelines recommend the following preoperative fasting intervals: two hours for clear fluids; four hours for breast milk; six hours for nonhuman milk, formula, or a light meal; and eight hours for fatty or fried food, or meat.[1] This includes non-labouring parturients presenting for elective caesarean section (CS).[1,4] Labouring parturients are subject to less liberal fasting guidelines, owing to an established delay in gastric emptying, and should avoid the intake of solid food, however, clear fluids may be taken in moderate amounts.[1,4] Parturients requiring emergency CS, regardless of fasting status, are treated as a full stomach if they are beyond 20 weeks gestation and will require a rapid sequence induction and intubation (RSII) if they are to undergo general anaesthesia.[1]

Chris Hani Baragwanath Academic Hospital (CHBAH), a 3200-bed tertiary referral hospital located in Soweto, South Africa, is the third largest hospital in the world.[5] Over 23 000 parturients deliver annually at the maternity complex, which has a CS delivery rate of 39.78% that has increased steadily and is higher than the overall reported rate in South Africa.[6,7] Being a public hospital in an upper-middle-income country, with a CS rate 1.5 times that of the provincial public sector, CHBAH maternity complex is oftentimes overburdened with emergency CS deliveries.[8] The number of CS deliveries that can be performed is limited by the hospital's resources – human and physical – and urgent cases are prioritized over semi-urgent and elective cases.

Parturients are kept nil per os (NPO) from the time they are booked for their emergency surgery, but often have not eaten since their admission to labour ward. Patients awaiting their elective CS are kept NPO from the night before their planned procedure, but emergency CS deliveries usually take precedence, necessitating rescheduling of elective procedures and subjecting these parturients to repeated, prolonged fasting. It has been noted in the obstetric theatres that maternal fasting times are prolonged and there are higher than normal levels of fasting hypoglycaemia among parturients. Therefore, a study was conducted to investigate the preoperative fasting of patients undergoing CS, the incidence of maternal hypoglycaemia, and the impact of fasting times on the maternal blood glucose levels.

While the link between maternal hyperglycaemia and neonatal hypoglycaemia is well-established,[9] it is less clear whether there is a link between maternal hypoglycaemia and neonatal blood glucose levels, therefore the researcher set out to describe the glycaemic profile of the neonates and to determine if there was an association between maternal and neonatal blood glucose levels.

Methods

This study was reviewed and approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (reference M20111150). All participants willingly gave written informed consent.

This prospective, contextual, descriptive, cross-sectional study was conducted at the CHBAH maternity complex, over two three-month periods from April 2021 to June 2021 and October 2021 to December 2021.

The study employed a convenience sampling method in the recruitment of participants, who were adult obstetric patients presenting for CS at CHBAH. Participants were recruited upon arrival to theatre and consent was taken prior to their procedure. Parturients over the age of 18, presenting for emergency or elective CS with an ASA status of II and III were included in the study. The physical statuses included in the selection criteria reflect mild to severe systemic co-morbidities that are not a constant threat to life.[10] Parturients have an ASA status of II because pregnancy, although not a disease state, alters the physiological state of the woman significantly.[10] Diabetic patients were also included in the study. Parturients excluded from the study were those from whom a history of fasting practices could not be obtained.

The researcher administered a questionnaire to the patients, prior to their procedure, and further information was obtained from their hospital file and antenatal card. The combined questionnaire and data collection sheet ascertained biographical information, fasting practices, and neonatal characteristics.

The primary outcome, blood glucose level, was measured using a single glucometer (Accu-chek® Active, Roche, Manheim, Germany) from a blood sample obtained from the parturient, either via a separate finger-prick or upon insertion of the intravenous (IV) cannula. The definition of maternal hypoglycaemia was a blood glucose level < 3.9 mmol/L and the definition of maternal hyperglycaemia was a fasting blood glucose level ≥ 5.1 mmol/L.[11] As per the study protocol, any results of hypoglycaemia were acted upon by supplementation with IV dextrose and, where feasible, the maternal blood glucose measurement was repeated prior to delivery of the neonate. Following cord clamping, and handing of the neonate to the midwife, the surgeon obtained a cord blood sample, the blood glucose level of which was measured using the same glucometer and used as a surrogate for neonatal blood glucose levels. Neonatal hypoglycaemia was defined as a blood glucose level < 2.5 mmol/L and was further categorized as mild (2.2 to 2.4 mmol/L), moderate (1.6 to 2.1 mmol/L) and severe (< 1.6 mmol/L).[12] Any results of neonatal hypoglycaemia prompted immediate informing of the midwife and attending paediatric doctor to address the glycaemic abnormality according to standard neonatal unit protocol. Lastly, neonatal characteristics were obtained from the midwife. To minimize bias, the data was collected by a single researcher, using the same calibrated glucometer.

The sample size estimation was based on a retrospective analysis that investigated the effect of various preoperative fasting conditions on 1599 full-term parturients undergoing CS.[13] Furthermore, an informal pilot study previously conducted by the researcher at the study site, contributed toward the sample size estimation. An assessment of z-scores of expected frequencies for variables considered in the study indicated that a sample size of 210 parturients would detect statistical significance at the 5% level at a medium effect size.

The data was captured in Microsoft Excel® and analysed in R software (version 4.0.0). Continuous data were assessed for departure from normality using the Shapiro–Wilk test and by examining Q-Q plots. Continuous data were analysed using Welch's t-tests and a one-way analysis of variance (ANOVA) for two- and three-factor variables, respectively. Categorical data were analysed using Pearson's chi-squared tests to assess whether the distribution of counts per variable deviated from a null model. Simple linear regressions were used to analyse the relationships between continuous variables.

In addition, parturients were divided into two groups based on their blood glucose levels: hypoglycaemia (< 3.9 mmol/L) and normoglycaemia (≥ 3.9 mmol/L). This resulted in 52 parturients that were hypoglycaemic and 161 normoglycaemic parturients. Logistic regression was used to analyse differences between the groups.

Results

Demographic Data

Two-hundred-and-thirteen parturients participated in this study. Their demographic data is summarized in Table 1. The mean (SD) age of the parturients was 29.8 (4.4) years. One parturient was a grand multipara. Seventy-six (35.7%) parturients had no co-morbidities. Hypertensive diseases of pregnancy were the most common co-morbidity (31.9%), followed by human immunodeficiency virus (HIV) (30.0%).

Parturients weighed a mean (SD) of 84.4 (18.8) kg and had a mean (SD) body mass index (BMI) of 33.2 (7.1) kg/m^2. Grouping the parturients into BMI classes showed that a significant number were obese.

Table 1 Characteristics of parturients

Variable	Count	Percentage
Age (n=213)		
≥ 35 years	56	26.3%
< 35 years	157	73.7%
Parity (n=213)		
0	62	29.1%
1	59	27.7%
2	59	27.7%
≥ 3	33	15.5%
Normal booking bloods (n=213)		
Yes	138	64.8%
No	75	35.2%
HIV status (n=213)		
Positive	64	30.0%
Negative	149	70.0%
Diabetes (n=213)		
Yes	10	4.7%
No	203	95.3%
Hypertension (n=213)		
Yes	68	31.9%
No	145	68.1%
BMI class (n=199)		
Normal	24	12.1%
Overweight	47	23.6%
Obese	128	64.3%
Either height or weight measurements were missing for 14 parturients.		

The mean (SD) gestational age in the study population was 37.9 (3.0) weeks. Sixty-three (29.6%) pregnancies were preterm. Three parturients were of unknown gestational age. Fetal distress was present in 137 (64.3%) births and was the most common indication for CS. The majority of parturients (96.2%) had an emergency CS.

The 135 (63.4%) labouring parturients spent a mean (SD) of 26 h, 50 min (17 h, 35 min) in labour. The duration of labour was taken as the time since onset of labour pains as reported by the parturient. Excluding excessively long reported labour times generated a mean (SD) duration of labour of 23 h, 0 min (12 h, 4 min).

Fasting

The mean (SD) fasting time to solids was 18 h, 19 min (12 h, 4 min). The longest fasting time was 67 h, 30 min. Most mothers (81.7%) last consumed a heavy meal rather than a light meal. Ninety percent of parturients were fasted to solids. Two parturients were unable to give a history of last meal intake.

Two-hundred-and-three (97.1%) parturients were fasted to fluids with the mean (SD) fasting time being 13 h, 2 min (8 h, 31 min). Glucose-containing fluid

had been taken by 66 (31.0%) parturients. Four parturients were unable to give a history of fluid intake.

The 211 (99.1%) parturients that had an IV line received a mean (SD) of 270.62 (437.53) ml of IV fluid, the period over which could not be ascertained. Eleven (5.1%) parturients had received glucose-containing IV fluids.

Maternal glycaemic profile

Parturients had a mean (SD) blood glucose level of 4.77 (1.30) mmol/L, which is within the normoglycaemic range. Fifty-two patients had a blood glucose level < 3.9 mmol/L, therefore the study revealed a 24.4% incidence of maternal hypoglycaemia. Fifty-seven (26.8%) patients had a fasting blood glucose level ≥ 5.1 mmol/L, the cut-off for gestational diabetes mellitus (GDM) and for two of these parturients glucose-containing IV fluids had been given, therefore the possibility of iatrogenic hyperglycaemia could not be excluded.[11]

The duration of labour, fasting to solids and fasting to fluids were compared between hypoglycaemic and normoglycaemic parturients (Table 2). The mean duration of labour and the mean duration of fasting to fluid were not significantly different between the two groups.

The mean (SD) duration of fasting to solids for the hypoglycaemic group was 20 h, 24 min (8 h, 9 min) which was longer than that of the normoglycaemic group at 16 h, 31 min (8 h, 38 min). A logistic regression comparing the groups was significant (*P*=0.049). An examination of the model estimates indicated that each one-unit change in fasting increased the log odds of hypoglycaemia by 0.814.

Table 2 Relationship between blood glucose levels, duration of labour and fasting times

Variable (h, min)	Normoglycaemic group (blood glucose level ≥ 3.9 mmol/L)	Hypoglycaemic group (blood glucose level < 3.9 mmol/L)	Significance (z-score and p-value)
Mean duration of labour	26 h, 38 min	29 h, 16 min	*Z*=0.63, *P*=0.537
Mean fasting time to fluids	12 h, 43 min	13 h, 40 min	*Z*=0.66, *P*=0.509
Mean fasting time to solids	16 h, 31 min	20 h, 24 min	*Z*=0.42, *P*=0.049

Maternal blood glucose concentrations were not predicted by advanced maternal age, BMI, pre-existing diabetes and preoperative oral or IV glucose.

Neonatal characteristics and glycaemic profile

The 213 parturients delivered a total of 222 live neonates, including nine sets of twins; two neonates were stillborn and were not included in the study. The sample sizes reported below might vary because of missing or additional data for some variables. The pertinent neonatal data can be seen in Table 3.

The neonates had a mean (SD) blood glucose level of 4.38 (1.08) mmol/L, which is within the normoglycaemic range. Four (1.8%) neonates were hypoglycaemic and of these, one had mild hypoglycaemia, whereas the remaining three had moderate hypoglycaemia. Data for seven neonates was missing.

Table 3 Characteristics of neonates

Variable	Count	Percentage
Premature (n=222)		
Yes	67	30.2%
No	152	68.5%
Unknown	3	1.3%
Severity of prematurity (n=67)		
Moderate to late premature (32 to 37 weeks)	57	85.1%
Very premature (28 to 32 weeks)	6	8.9%
Extremely premature (< 28 weeks)	4	6.0%
Birth weight category (n=222)		
Normal (≥ 2500 g)	156	70.3%
Low birth weight (< 2500 g)	50	22.5%
Very low birth weight (< 1500 g)	10	4.5%
Extremely low birth weight (< 1000 g)	3	1.4%
N/A	2	0.9%
Unknown	1	0.4%
Neonatal hypoglycaemia (n=222)		
Yes	4	1.8%
No	211	95.0%
N/A	2	0.9%
Unknown	5	2.3%

No correlation was found between neonatal blood glucose level and birth weight.

Association between maternal and neonatal blood glucose levels

Sixty-two (29.1%) parturients received IV dextrose, following their low blood glucose readings and 35 (56.5%) were re-sampled thereafter. At times it was not feasible for the researcher to repeat the maternal blood glucose reading just prior to or close to the delivery of the neonate. For the regression between maternal and neonatal blood glucose level, the values for parturients without hypoglycaemia and those that were re-sampled together with their neonates were used. In addition, for parturients with twins, data for one twin was randomly selected to avoid pseudo-replicating the maternal blood glucose reading. This resulted in a sample size of 179. Maternal blood glucose level had a moderate to strong correlation with neonatal blood glucose level (r=0.59, P<0.001) i.e., as maternal blood glucose levels increased so too did that of the neonate (Fig. 1)

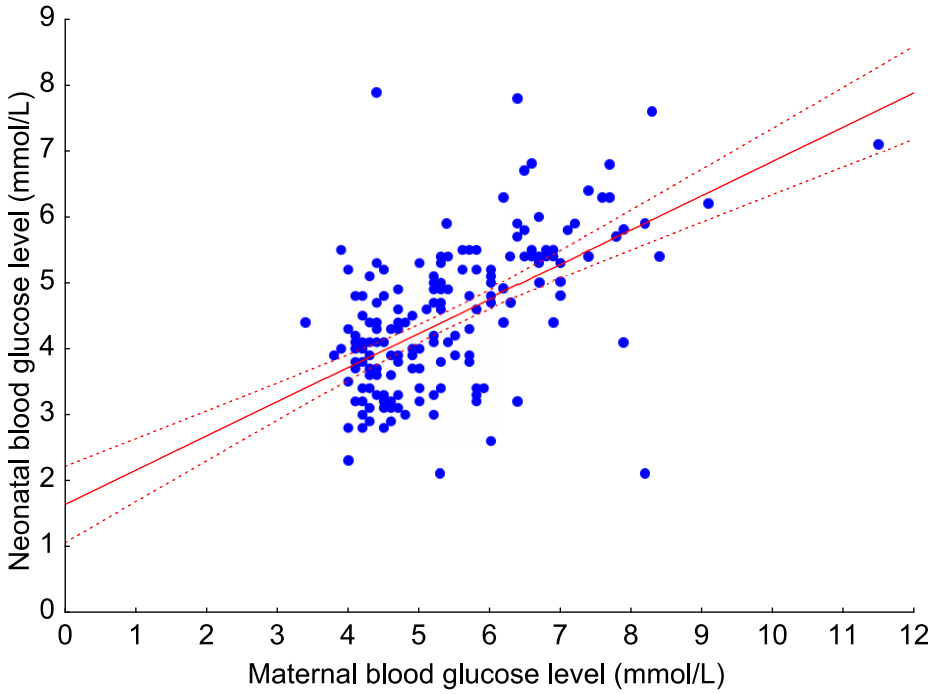


Figure 1. The relationship between maternal blood glucose and neonate blood glucose concentrations.

The regression line (solid line) and 95% confidence intervals (dashed lines) are shown.

Discussion

This study set out to describe the preoperative fasting practices of parturients undergoing CS at CHBAH. The results indicate that fasting times are prolonged with a mean fasting time to solids and fluids of 18 h, 19 min and 13 h, 2 min, respectively. This exceeds the recommended fasting times set out in various anaesthetic association guidelines,[1] and is similar to the findings of local and international studies.[14-17] However, these studies are largely conducted on parturients presenting for elective CS where, typically, fasting periods can be controlled, unlike our study which had a high emergency CS delivery rate (96.2%). An unpublished thesis by Khumalo et al.[18] conducted at CHBAH revealed an emergency CS delivery rate of 92.7%.

Regarding emergency CS deliveries, anaesthetists are generally concerned about a full stomach, assuming no time for fasting has taken place. Two notable issues arise in this regard. Firstly, CHBAH has a high emergency CS rate and, often the many parturients awaiting elective CS become emergency cases. There are on average 20 to 30 parturients awaiting elective CS each day and if their procedures are not done, these patients are rebooked for the following day, subjecting the parturients to repeated and prolonged fasting. Morgan et al.[16] found

this to be the case with 32% of parturients studied. Secondly, prolonged preoperative waiting times (including emergency CS) equate to prolonged starvation times. Khumalo et al.[18] found that of the 395 CS deliveries (for fetal distress) studied, all had a decision-to-delivery interval (DDI) higher than that recommended by the National Institute for Health and Care Excellence guidelines, with the mean (SD) DDI being 411 (291) min.[18,19]

The prolonged starvation times noted in our parturients is likely a culmination of various factors such as fasting prior to being booked for CS and the prolonged DDI during which the patient is kept NPO. It may be beneficial to develop a system whereby patients who are not expected to have their procedure in the following two hours (as governed by the prioritized theatre list) should receive preoperative glucose-containing clear fluid. Subsequent studies could evaluate the effectiveness of such an intervention.

The incidence of maternal hypoglycaemia was 24.4% and it is concerning that ten parturients (4.7%) had significant hypoglycaemia as defined by a blood glucose concentration < 3.0 mmol/L. All hypoglycaemic patients received IV dextrose in accordance with the study protocol. A limitation of this study was the fact that hypoglycaemic patients were not assessed for symptoms thereof and this may serve as a future research question. Our result is lower than the incidence of hypoglycaemia of 39.3% found by Morgan et al.[16] and this is not explained by the slight difference in cut-off values for hypoglycaemia. Of the fasted hypoglycaemic parturients three were known diabetic patients. If details of their peri-operative diabetic management had been obtained, this may have further elucidated the results.

Interestingly, 26.57% of the patients met one of the criteria for GDM (a fasting blood glucose level > 5.1 mmol/L), however, only one of these parturients was a known gestational diabetic and iatrogenic hyperglycaemia could not be excluded for two of the parturients. All the parturients meeting the GDM criteria were referred for an oral glucose tolerance test to be performed 12 weeks post-partum. It is possible that this group of parturients represent missed or undiagnosed gestational diabetic patients and it may be worth looking into the how the protocol for diagnosis of GDM can be better implemented at this institution.

The mean neonatal blood glucose concentration was 4.38 mmol/L and four (1.8%) of the neonates were hypoglycaemic. The three moderately hypoglycaemic neonates had a low birth weight, a known risk factor for neonatal hypoglycaemia owing to diminished glycogen stores.[9] However, this study found no correlation between neonate blood glucose concentration and birth weight, which may reflect an inadequate sample size and therefore study power in this regard. The remaining hypoglycaemic neonate was a post-term macrosomic neonate born to a non-diabetic parturient, but post-maturity is a risk factor for neonatal hypoglycaemia, which may explain our finding.[20]

Analysis of the parturients as two groups (hypoglycaemic vs normoglycaemic) revealed a significant difference between their duration of fasting to solids, a pertinent finding. Similarly, Morgan et al.[16] found that hypoglycaemic parturients had longer overnight fasting times to solids and fluids as compared to normoglycaemic parturients and that a sigmoid relationship exists between the fasting time to fluid and the probability of hypoglycaemia, with the relative risk increasing 1.5 times with each additional hour that the parturient fasted after nine hours.[16]

The findings of our study point to that of Metzer et al.[21] who described a state of “accelerated starvation” that is unmasked in pregnancy following brief periods of starvation. After both 12 and 18 h of starvation, insulin and glucose levels in parturients in their third trimester were significantly lower and free fatty acids and ketones significantly higher than their non-pregnant counterparts.[21] Morgan et al.[16] found a significant association between hypoglycaemia and ketonuria, which occurred together in 30.4% of the participants and this combination of metabolic derangements was associated with longer fasting times.[16]

A randomized controlled trial (RCT) conducted by Clark et al.[22] found that carbohydrate preloading in women undergoing elective CS delivery reduced the incidence of urinary ketones prior to surgery and the number needed to treat was three, suggesting that the introduction of a preoperative carbohydrate drink may ameliorate the effects of preoperative fasting.[22] This intervention, if adopted by our institution, would aim to reduce fasting times to a safe duration and reduce the incidence of maternal hypoglycaemia. Our study indicates that one in four parturients presenting to CHBAH for CS is hypoglycaemic and so it may be reasonable for anaesthetists to measure all maternal blood glucose levels prior to administering an anaesthetic.

A limitation of this study was that, ethically, hypoglycaemic parturients required treatment prior to the anaesthetic and therefore delivery of the neonate. As such, a direct correlation between maternal hypoglycaemia and neonatal blood glucose levels could not be studied, and this may pose a future research question. Our study was, however, able to establish a direct correlation between maternal and neonatal blood glucose levels. This result conflicts with that found by Dias et al.[20] who conducted a prospective study on 100 parturients, four of whom were diabetic. They measured maternal blood glucose levels within half an hour of delivery and neonatal blood glucose levels at birth and found a negative correlation between these measurements.[20]

The above finding is supported by known neonatal transitional physiology. The continuous transplacental glucose supply to the neonate is cut off once the umbilical cord is clamped, and the plasma glucose concentration will fall during the first two hours of life in a healthy term neonate.[9] Glycogen stores are then relied upon to maintain normoglycaemia, but once these are diminished, the newborn will either require milk feeds or rely on gluconeogenesis, otherwise hypoglycaemia ensues.[9]

One explanation for the differing findings is that the samples studied by Dias et al.[20] were taken from the neonate, whereas we obtained umbilical cord blood samples, which reflect maternal-fetal transfer of glucose depending on whether the arteries or vein are sampled. This study was not able to obtain permission from the relevant ethics committee to obtain samples from neonates via a heel-prick. Our findings are in line with that of Singhi et al.[23] who found a direct correlation between maternal blood glucose levels and neonatal cord blood glucose levels (r=0.86, P<0.001). Their RCT demonstrated that maternal hyperglycaemia in parturients who received IV glucose infusions led to transplacental hyperglycaemia.[23]

Intrapartum maternal hyperglycaemia, whether iatrogenic from IV glucose infusions or in poorly controlled diabetic parturients, has been shown to increase the risk of neonatal hypoglycaemia within the first two hours of life, owing to fetal hyperinsulinaemia that follows.[9,20,23] Furthermore, maternal hyperglycaemia before delivery significantly correlates with the risk of fetal hypoxaemia, and therefore

perinatal asphyxia, as it increases the fetal oxygen demand and this has been posited to be the most dangerous complication of maternal hyperglycaemia.[24,25]

Our study highlights the need to avoid prolonged starvation and, therefore, maternal hypoglycaemia, but this must be balanced against the need to avoid both fetal hyperglycaemia and neonatal hypoglycaemia that may arise from maternal hyperglycaemia. The practice of replacing glucose intravenously has implications for the fetal blood glucose level and while no agreed upon intrapartum maternal blood glucose range exists, a reasonable target range of 3.9 mmol/L to 6.9 mmol/L is suggested.[25] Further work needs to be done to examine the correlation between maternal hypoglycaemia and neonatal hypoglycaemia, if ethically possible. In our setting, with limited resources available, it may be prudent to measure the maternal blood glucose level of all parturients awaiting CS, but to replace glucose if the value reveals clinically significant hypoglycaemia, although further research is required.

Conclusion

Mean (SD) fasting times to solids and fluids were 18 h, 19 min (12 h, 4 min) and 13 h, 2 min (8 h, 31 min), respectively. Fasting periods prior to CS, therefore, exceeded those recommended in the ASA guidelines, highlighting the need for interventions that aim to reduce preoperative starvation times among parturients. Prolonged fasting time to solids was associated with hypoglycaemia, which was present in one in four parturients, yet the clinical significance thereof is not known. Close to a quarter of the parturients may have had missed or undiagnosed GDM. To address extremes of blood glucose levels, it may be prudent to measure preoperative maternal blood glucose levels. A positive correlation between maternal and neonatal blood glucose levels was demonstrated, yet further research is required to assess whether maternal hypoglycaemia leads to neonatal hypoglycaemia. The incidence of neonatal hypoglycaemia was low. While maternal hypoglycaemia should be avoided, maternal hyperglycaemia can be deleterious toward the fetus and neonate, therefore it may be reasonable to replace maternal glucose intravenously only if clinically indicated, however further research is required.

Acknowledgements

This research was done in partial fulfilment of a Master of Medicine degree.

Declaration of interests

None.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Crowley M. Preoperative fasting guidelines. UpToDate, Inc. Wolters Kluwer. Available from: https://www.uptodate.com/contents/preoperative-fasting-guidelines. [Accessed: 06 January 2020].
2. Yurashevich M, Chow A, Kowalczyk JJ, Traynor AJ, Carvalho B. Preoperative Fasting Times for Patients Undergoing Caesarean Delivery: Before and After a Patient Educational Initiative. Turk J Anaesthesiol Reanim. 2019;47(4):282-6. doi: 10.5152/TJAR.2019.95770
3. South African Society of Anaesthesiologists. SASA Practice Guidelines 2018 Revision. SAJAA. 2018;24(2):S1-119. Available from: http://www.sajaa.co.za/index.php/sajaa/issue/view/126
4. Practice Guidelines for Obstetric Anesthesia: An Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology. Anesthesiology. 2016;124(2):270-300. doi: 10.1097/ALN.0000000000000935
5. Chris Hani Baragwanath Hospital. Available from: https://www.chrishanibaragwanathhospital.co.za/. [Accessed: 31 January 2022].
6. Adam Y, Mwinyoglee J, Masuku B, Nicolaou E. An evaluation of the indications for caesarean sections at Chris Hani Baragwanath Academic Hospital. South African Journal of Obstetrics and Gynaecology. 2018;24(1):8-11. doi: doi:10.7196/SAJOG.2018.v24i1.1226
7. Ayob R. An Observation of the Caesarean Section Rate at a Teaching Hospital in Johannesburg [Research report]: University of the Witwatersrand; 2014.
8. Solanki GC, Cornell JE, Daviaud E, Fawcus S. Caesarean section rates in South Africa: A case study of the health systems challenges for the proposed National Health Insurance. S Afr Med J. 2020;110(8):747-50. doi: 10.7196/SAMJ.2020.v110i8.14699
9. Rozance PJ. Pathogenesis, screening, and diagnosis of neonatal hypoglycemia.2022. UpToDate, Inc. Wolters Kluwer. [Accessed: 03 March 2022].
10. ASA Physical Status Classification System. 2020. American Society of Anesthesiologists. Committee of Oversight: Economics. Updated 3 January 2023. Available from: https://www.asahq.org/standards-and-guidelines/asa-physical-status-classification-system. [Accessed: 3 April 2023].
11. American Diabetes Association. 6. Glycemic Targets: Standards of Medical Care in Diabetes—2021. Diabetes Care. 2020;44(Supplement_1):S73-S84. doi: 10.2337/dc21-S006
12. Stomnaroska O, Petkovska E, Jancevska S, Danilovski D. Neonatal Hypoglycemia: Risk Factors and Outcomes. Pril (Makedon Akad Nauk Umet Odd Med Nauki). 2017;38(1):97-101. doi: 10.1515/prilozi-2017-0013
13. Li Y, Su D, Sun Y, Hu Z, Wei Z, Jia J. Influence of different preoperative fasting times on women and neonates in cesarean section: a retrospective analysis. BMC Pregnancy Childbirth. 2019;19(1):104. doi: 10.1186/s12884-019-2254-2
14. Herbst J. Preoperative fasting practices in adult elective surgery patients at Charlotte Maxeke Johannesburg academic hospital [Research report]: University of the Witwatersrand; 2016.

15. Lamacraft G, Labuschagne C, Pretorius S, Prinsloo MC, Smit MD, Steyn JR. Preoperative fasting times: Prescribed and actual fasting times at Universitas Hospital Annex, Bloemfontein, South Africa. S Afr Med J. 2017;107(10):910-4. doi: 10.7196/SAMJ.2017.v107i10.10930
16. Morgan K, Levin A, Esterhuizen T. The incidence of maternal hypoglycaemia with prolonged fasting before elective caesarean section. Southern African Journal of Anaesthesia and Analgesia. 2021;27(4):175-9. doi: 10.36303/SAJAA.2021.27.4.2585
17. Crenshaw JT, Winslow EH. Actual versus instructed fasting times and associated discomforts in women having scheduled cesarean birth. J Obstet Gynecol Neonatal Nurs. 2006;35(2):257-64. doi: 10.1111/j.1552-6909.2006.00029.x
18. Khumalo M. A survey of emergency caesarean delivery for foetal distress at a central hospital [Research report]: University of the Witwatersrand; 2022.
19. NICE guideline [NG192]: Caesarean birth.2021.United Kingdom. National Institute for Health and Care Excellence. Available from: https://www.nice.org.uk/guidance/ng192. [Accessed: 03 March 2022].
20. Dias E, Gada S. Glucose levels in newborns with special reference to hypoglycemia: a study from rural India. J Clin Neonatol. 2014;3(1):35-8. doi: 10.4103/2249-4847.128729
21. Metzger BE, Ravnikar V, Vileisis RA, Freinkel N. "Accelerated starvation" and the skipped breakfast in late normal pregnancy. Lancet. 1982;1(8272):588-92. doi: 10.1016/s0140-6736(82)91750-0
22. Clark A, Litchfield K, Hannah S, Love C, Slade K, Lake K, et al. Pre-operative carbohydrate loading prior to elective caesarean delivery: a randomised controlled trial. Int J Obstet Anesth. 2021;45:21-7. doi: 10.1016/j.ijoa.2020.10.008
23. Singhi S. Effect of maternal intrapartum glucose therapy on neonatal blood glucose levels and neurobehavioral status of hypoglycemic term newborn infants. J Perinat Med. 1988;16(3):217-24. doi: 10.1515/jpme.1988.16.3.217
24. Mimouni F, Miodovnik M, Siddiqi TA, Khoury J, Tsang RC. Perinatal asphyxia in infants of insulin-dependent diabetic mothers. J Pediatr. 1988;113(2):345-53. doi: 10.1016/s0022-3476(88)80282-8
25. Kjos SL. Pregestational (preexisting) and gestational diabetes: Intrapartum and postpartum glycemic control. UpToDate, Inc. Wolters Kluwer. Available from: https://www.uptodate.com/contents/pregestational-preexisting-and-gestational-diabetes-intrapartum-and-postpartum-glycemic-control. [Accessed: 03 March 2022].

Section 4: Proposal

Preoperative fasting practices and incidence of hypoglycaemia in patients presenting for caesarean section at a central hospital

Nathalie Prinsloo

0701103R

Supervisor: Dr Tristan Leonard

Department of Anaesthesiology

4.1 Introduction

The first documented guidelines for preoperative fasting, the practice of not allowing patients oral intake of liquids or solids for a defined period prior to a procedure, can be traced back to the mid-1800's (1). Dr John Snow, then an anaesthetist to Queen Victoria, stated that the only instruction a patient should receive prior to the inhalation of chloroform is to avoid taking a meal. His reasoning was that chloroform would lead to emesis if food was present in the stomach and this would be both unpleasant and inconvenient (2).

The current feared complication of a full stomach prior to anaesthesia, namely perioperative pulmonary aspiration – the aspiration of gastric contents following anaesthetic induction – was only described in 1862 at a medical meeting in Edinburgh (1). It was reported that an autopsy, performed on a soldier who passed away in 1853 under chloroform anaesthesia, revealed gastric contents in the patient's trachea. Preoperative fasting periods, as outlined in published guidelines that were developed over the century that followed, changed regularly – from the 2 hour fasting period to fluids and the recommendation that a stomach be empty, advised by Lister (2) in 1883, to the recommendation that patients be kept nil per os (NPO) to both solids and clear fluid from midnight, as published in guidelines by Dripps et al. (3) in 1982.

Perioperative pulmonary aspiration is a rare event, albeit one associated with significant morbidity and mortality. Sequelae include aspiration pneumonia, acute respiratory distress syndrome or respiratory failure, and even death (4, 5). Pulmonary aspiration is one of the four recognized possible causes of the first documented anaesthetic death that occurred in a healthy 15-year-old girl presenting for a toenail removal in 1848 (6). Preoperative fasting guidelines were developed to reduce both aspiration risk and the severity of the pulmonary sequelae should aspiration occur. Acidic gastric contents of a large volume of a particulate nature may be associated with worse outcomes following aspiration. As such, guidelines aim to reduce the volume and acidity of gastric contents, in addition to eliminating particulate matter at the time of surgery (4).

Preoperative fasting guidelines are intended for patients undergoing any form of anaesthesia – general, regional or monitored anaesthesia care – for an elective procedure (4). International anaesthesia societies have developed these guidelines based on expert opinion and knowledge of gastric physiology, with little to no evidence that clinical outcomes are improved by following said recommendations. The American Society of Anesthesiologists (ASA) currently recommends the following fasting intervals prior to induction of anaesthesia: 2 hours for clear fluids; 4 hours for breast milk; 6 hours for nonhuman milk, formula, or a light meal; and 8 hours for fatty or fried food, or meat. Clear fluids include water, milk-less tea or coffee, clear juices, and carbohydrate drinks (4).

The gastric residual volumes in patients who consumed these fluids 2 hours prior to their procedures, were unchanged compared to patients who were kept NPO to all fluids overnight (4). An additional hour should be given for carbohydrate drinks rich in protein. There is currently no restriction on the volume of clear fluids, only the fasting interval. Non-clear liquids, other than breast milk, should not be consumed within 6 hours of the elective procedure. Gastric emptying times are prolonged with these substances, and there is a higher risk of residual particulate matter. Although these are the current fasting guidelines of the ASA; other international anaesthesia societies have very similar guidelines (4).

Fasting guidelines make further recommendations for special populations such as paediatrics, patients with obesity or diabetes mellitus, and pregnant patients. Non-obese and non-labouring parturients should follow the ASA standard fasting guidelines above for elective surgery, before the induction of any type of anaesthesia (4, 7). This recommendation also forms an important part of Enhanced Recovery After Surgery (ERAS) for caesarean delivery programmes (8). This includes preoperative consumption of a carbohydrate drink, rich in calories, up to 2 hours before surgery. This has been shown not only to reduce preoperative thirst and hunger, but also decrease anxiety in these patients (9). Although one might worry about a parturient being fasted for such a short time, a study conducted in Iran has demonstrated that women who consumed clear fluids an hour before their caesarean section did not have an increased risk of regurgitation (10).

The above fasting guidelines are applicable to patients undergoing elective procedures. Non-fasted patients who require elective surgery may have their procedure delayed or rescheduled in order to avoid the risk of aspiration. Non-fasted patients presenting for emergency surgery are at an increased risk of aspiration, as the protective airway reflexes that prevent passive regurgitation of gastric contents are either diminished or abolished by anaesthetic medication (4). Patients that fall within this category are usually assessed as requiring a rapid sequence induction and intubation (RSII), a technique that aims to minimize the risk of perioperative pulmonary aspiration in patients at a higher than normal risk for this, should general anaesthesia be the anaesthetic of choice. Regardless of fasting status, a pregnant patient with a gestational age of greater than 20 weeks is considered a full stomach and warrants an RSII should she require a general anaesthetic (11).

Currently, preoperative fasting guidelines specific to South Africa do not exist. The South African Society of Anaesthesiologists (SASA) recommends that the ASA fasting guidelines be followed (12). There exist limited data on perioperative fasting practices in South Africa. A literature search revealed two studies conducted in the last four years regarding adult patients undergoing elective surgery – of various surgical disciplines. Unpublished data from a study by Herbst (13) conducted at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) described the preoperative fasting practices in adult patients undergoing elective gynaecological, orthopaedic, urological, and general surgical procedures at this institution. It was found that there was a difference between instructed and actual fasting times – with the median instructed fasting time being 10 hours (with a range of 8 to 12 hours) and the mean actual fasting time being 15 hours (13).

Lamacraft et al. (14) conducted a similar study on 105 patients presenting for elective ophthalmic or orthopaedic surgery at Universitas Hospital Annex in Bloemfontein, South Africa. It was found that patients were most frequently instructed to be kept NPO to solids from 22h00 to 00h00. In addition, no patient had a fasting time of less than 8 hours. In fact, the median duration of fasting to solids was 14 hours and 45 minutes. The instructed fasting time to fluids was most frequently from 05h00, whereas the median actual fasting time for fluids was 13

hours and 35 minutes (14). No South African studies describing the preoperative fasting practices of elective and emergency obstetric patients could be found.

Established deleterious effects of prolonged fasting include hypoglycaemia, dehydration, ketoacidosis, delayed recovery, and reduced patient satisfaction (15). Furthermore, parturients with preoperative hypovolaemia owing to decreased fluid intake may be at higher risk of hypotension after spinal anaesthesia (15). Prolonged fasting activates a metabolic response with resultant gluconeogenesis, and enhances the organic response to trauma. A prolonged preoperative fasting period leads to a significant increase in insulin resistance that can be demonstrated immediately after surgery, lasts for 2 to 4 weeks following surgery, and positively correlates with length of hospital stay (16). As such, shortening the preoperative fasting period is beneficial in the reduction of insulin resistance and organic response to trauma (16).

Hypoglycaemia as defined by the American Diabetes Association is a blood glucose of ≤ 3.9 mmol/L. This is the level at which treatment with glucose should be initiated in order to prevent clinical or symptomatic hypoglycaemia. Symptoms that occur as a result of the autonomic response include hunger, sweating, paraesthesia, tremors, anxiety and palpitations. Neuroglycopaenic symptoms, which occur as a result of brain deprivation of glucose, tend to occur at glucose levels < 3.0 mmol/L (17). These symptoms include: weakness, dizziness or tiredness, inappropriate behaviour, difficulty concentrating, confusion, blurry vision, and (in severe cases) coma, and death (18). It is important to note that asymptomatic hypoglycaemia can occur with glucose levels as low as 1.7 mmol/L during fasting in normal women and during pregnancy (19). Li et al. (5) conducted a study of 1599 parturients in China over a period of three years with the aim of evaluating the effect of various preoperative fasting intervals on both women and neonates through a retrospective analysis. They found an incidence of maternal hypoglycaemia (MH) of 2.3 to 6.5% which correlated with the duration of fasting intervals (5).

Li et al. (5) determined whether the various fasting times of the parturients influenced the health of the neonate, with the following outcomes being measured: APGAR scores, fetal acidosis and neonatal hypoglycaemia (NH) (5). NH is the

most common form of metabolic disturbance found in newborns and its sequelae are well known and corroborated by various studies (20, 21). These complications (which are positively correlated with severity and duration of hypoglycaemia) include, but are not limited to: neurologic damage including cerebral palsy, intellectual impairment, visual impairment, occipital lobe epilepsy, personality disorders, muscle weakness and impaired cardiac performance (5, 20). The definition of NH does not have a universally agreed upon specific blood glucose concentration (20, 21). The following classification has been used in various studies: a blood glucose concentration ≥ 2.5 mmol/L is normal, whereas mild NH is 2.2 to 2.4 mmol/L, moderate NH is 1.6 to 2.1 mmol/L and severe NH is a blood glucose concentration <1.6 mmol/L (20, 22). This definition is in line with that set out in the neonatal protocols at Chris Hani Baragwanath Academic Hospital (CHBAH), the proposed study field (23).

There are very few studies demonstrating a link between MH and NH. Li et al. (5) demonstrated that the incidence of NH in neonates born to parturients that fasted for more than 8 hours to solid food and for more than 2 hours to clear fluids was significantly higher than the incidence of NH in groups fasted for a shorter period suggesting that long-term fasting can have an important impact on the well-being of the neonate. It was further demonstrated that the preoperative fasting of solid food for ≥ 6 hours but < 8 hours and clear fluids < 2 hours in parturients reduces the incidence of both NH and fetal acidosis (5).

Prolonged fasting intervals have a negative impact on parturients and can have a negative impact on the newborn. Little is known about the preoperative fasting practices in obstetric patients presenting for caesarean section in South Africa.

4.2 Problem statement

Preoperative fasting guidelines aim to reduce the risk and sequelae of perioperative pulmonary aspiration. These guidelines, developed over the last 170 years, have aimed to strike a balance between the ‘empty stomach’ and the negative impact of prolonged fasting (2, 4). The recommended period for fasting before induction of any type of anaesthetic in obstetric patients is 6 to 8 hours for solids and up to 2 hours for clear oral fluids (4, 7). Established deleterious effects

of prolonged fasting include: hypoglycaemia, dehydration, ketoacidosis, delayed recovery, reduced patient satisfaction, post-neuraxial hypotension, increased insulin resistance, and an enhanced organic response to trauma (15, 16).

Two studies describing preoperative fasting practices of elective non-obstetric patients (including adherence to current fasting guidelines) in South Africa have been conducted. These studies demonstrated a significant difference between instructed and actual fasting periods, both of which were longer than that recommended by the ASA guidelines (4, 13, 14). However, no data regarding obstetric patients presenting for elective and emergency surgery in developing countries, including South Africa, could be found.

Both MH and NH carry significant morbidity. While the link between maternal hyperglycaemia and NH is well-established it is less clear whether there is a link between MH and neonatal glucose levels and this needs to be explored (5, 20, 21).

Little is known about the preoperative fasting practices in obstetric patients in South Africa. Prolonged fasting intervals have a negative impact on parturients and can have a negative impact on the newborn. Therefore, there is a need to quantify these fasting practices. This could lead to improved perioperative patient care.

4.3 Aim and Objectives

4.3.1 Aim

The aim of the study is to describe the preoperative fasting practices and incidence of hypoglycaemia in obstetric patients undergoing caesarean section, as well as the incidence of neonatal hypoglycaemia at Chris Hani Baragwanath Academic Hospital.

4.3.2 Objectives

The primary objectives of this study are to:

- describe the incidence of hypoglycaemia in parturients
- describe the preoperative fasting of obstetric patients undergoing caesarean section at CHBAH
- describe the glycaemic profile of neonates
- determine the association between maternal and neonatal glucose levels.
- determine the correlation between the duration of fasting with maternal and neonatal glucose levels

4.4 Research assumptions

The following definitions will be used in the study:

Fasting: is abstaining from ingesting solids and liquids.

Fasting period/practice: is the period from which the patient is kept nil per os (NPO) up until the time of presentation for her surgery.

Maternal hypoglycaemia: is a blood glucose ≤ 3.9 mmol/L (17).

Neonatal hypoglycaemia: is a blood glucose concentration < 2.6 mmol/L in the first 24 hours of life (23).

Registrar: is a qualified doctor who is registered with the Health Professions Council of South Africa as a trainee anaesthetist.

Day shift: is a defined period specific to work in the Department of Anaesthesiology. A day shift at CHBAH is from 07h30 to 16h00.

4.5 Demarcation of study field

This study will be conducted in the maternity theatre complex of the Department of Obstetrics and Gynaecology at CHBAH. CHBAH is a 2888-bed central hospital located in the Soweto area of Johannesburg, South Africa. Between 19 000 and 20 000 women deliver annually, 35 to 45% of which undergo caesarean section in the two-theatre complex.

4.6 Ethical considerations

Approval to conduct the study will be obtained from the Human Research Ethics Committee (Medical) and the Graduate Studies Committee of the University of the Witwatersrand. Furthermore, approval will be obtained from the following entities:

- Medical advisory committee at CHBAH (Appendix 1)
- Head of Department of Anaesthesiology at CHBAH (Appendix 2)
- Head of Department of Obstetrics and Gynaecology at CHBAH (Appendix 3)

The patients to be included in the study will be approached by the sole investigator (NP). The study will be explained to the patients in a way they can understand (i.e. appropriate language, using a translator if necessary, and without the use of jargon), and they will be invited to participate. Those who agree to participate will be given an information letter to read (Appendix 4), and will be asked to sign a consent form (Appendix 5).

The study will include a brief history obtained from the patient upon her arrival at theatre reception, as well as a finger prick test of the patient's blood glucose level using a single glucometer. The blood glucose result will be written in the patient's file. Upon delivery of the neonate the first clamp will be applied to the cord by the obstetrician. The obstetrician will then place a second clamp on the cord either proximal or distal to the first clamp. The portion between the two clamps is then cut and the neonate is handed to the midwife. This is standard practice. The remaining portion of the cord connected to the placenta will be cut distal to the clamp and the principal investigator will be given this cord segment in order to obtain the blood sample to test the glucose level. This blood sample will be

neonatal blood. The glucose level of the sample will be tested by NP using the same glucometer.

Should the parturient have hypoglycaemia, both the attending anaesthetist and obstetrician will be informed, and it will be corrected according to standard guidelines (17). In the event of a maternal glucose > 7.8 mmol/L, the patient will have hourly glucose testing with management of hyperglycaemia by use of an insulin sliding scale. In the event of hyperglycaemia of between 5.2 and 7.8 mmol/L, the patient will be given a note to have an oral glucose tolerance test (OGTT) in 12 weeks. Should the neonatal glucose reading be abnormal, the attending midwife and paediatrician will be informed. If there is no attending paediatrician, the paediatrician on call will be contacted and informed.

The information will be recorded on a data collection sheet (Appendix 6) which will include a section for demographics but will exclude identifying information. Each patient will be allocated a study number and the data will be collected anonymously. A separate list of patient names, hospital numbers, and corresponding study numbers will be compiled and filed separately. To ensure that confidentiality is maintained throughout the process, only the researcher and supervisor will have access to the raw data. The data will be captured and then stored electronically on a password protected device. Data will be stored securely for six years after completion of the study.

The study will be conducted according to the principles of the Declaration of Helsinki (24) and the South African Guidelines for Good Clinical Practice (25).

4.7 Data collection

4.7.1 Research design

The study design is prospective, contextual, and descriptive.

A prospective study is one in which data about an exposure of interest are collected at a time preceding the measurement of the effect or outcome (26).

A contextual study focuses on a particular population or a small-scale world (27). As this study will be conducted on caesarean section patients at CHBAH, it is contextual.

The term descriptive design refers to a non-experimental design employed by the researcher whereby information is gathered from a representative sample of the population in order to describe the variable of interest as it naturally occurs (28). Variables are not manipulated by the researcher, nor does the researcher aim to determine cause-effect relationships (26). Although both fasting times and blood glucose levels will be described and measured respectively, no attempt will be made to establish a causal link between the two.

4.7.2 Study population

The study population consists of adult obstetric patients presenting for caesarean section at CHBAH over the data collection period.

4.7.3 Study sample

Sample method

This study will employ a convenience sampling method. Convenience sampling refers to a method of non-probability sampling, whereby the most readily available participants are enrolled in the study (27). In this instance, on the days allocated to data collection, all patients fulfilling the study criteria and consenting to participate in the study will be included, and so data will be collected when convenient for the researcher.

Sample size

The sample size was determined in consultation with a biostatistician. There is limited available evidence to determine sample size. During routine screening by NP in her personal practice, an incidence of MH before caesarean section of 49% was found. Assuming an incidence of 50% and a variance of 15% a sample size of 340 was calculated to give a power of 80% and a 95% confidence interval.

Inclusion and exclusion criteria

The inclusion criteria for this study are parturients:

- age ≥ 18 years
- ASA II and lll
- presenting for emergency or elective caesarean section.

The exclusion criteria in this study are:

- patients from whom a history of fasting practices cannot be obtained.

4.7.4 Collection of data

Following the approval to conduct the research by all necessary parties, the data will be collected at CHBAH. All data will be collected by the sole investigator, over the data collection period, at the CHBAH maternity theatre complex. Data collection will occur during a day shift.

The patients will be approached in the theatre reception and invited to participate as outlined in the ethical considerations section above. Once consent is obtained the patient will be asked questions according to the data collection sheet (Appendix 6). The data collection sheet will be reviewed by the study supervisor.

Each data collection sheet will be assigned a study number, which will be recorded together with the patient's name and hospital number on a separate form that will be captured onto an electronic spreadsheet.

A single glucometer (to be purchased by the sole investigator) will be used to obtain all maternal and neonatal blood glucose measurements. The glucometer will be selected based on its validation for the use of research, and the cost of the device and consumables.

Once all the information has been obtained from the parturient, the investigator will obtain a finger prick sample of blood to measure the glucose. It will be done aseptically on the patient's non-dominant hand, once the patient has been transferred to the theatre table and monitors attached, but prior to the anaesthetic.

Upon delivery of the neonate the first clamp will be applied to the cord by the obstetrician. The obstetrician will then place a second clamp on the cord either proximal or distal to the first clamp. The portion between the two clamps is then cut and the neonate is handed to the midwife. This is standard practice. The remaining portion of the cord connected to the placenta will be cut distal to the clamp and the principal investigator will be given this cord segment in order to obtain the blood sample to test the glucose level. This blood sample will be neonatal blood. The glucose level of the sample will be tested by NP using the same glucometer.

Any abnormal readings obtained from either will be acted upon as outlined in the ethical considerations section above.

4.7.5 Data analysis

All data obtained and written on the data collection sheet will be captured onto a Microsoft Excel™ spreadsheet. The study number, patient name, and hospital number will be recorded on a separate list and captured onto a second spreadsheet.

Data will be analysed in consultation with a biostatistician using the statistical program STATA® (StataCorp, USA) 13.1. Descriptive statistics will be used to analyse the data. Categorical variables will be summarised using percentages and frequencies. Continuous variables that are normally distributed will be summarised using means and standard deviations. Those that are not normally distributed will be summarised using medians and interquartile ranges. Comparisons between groups will be done using t-tests or Mann-Whitney tests as appropriate. Comparison between groups of categorical variables will be done using the chi-squared test or the Fisher's exact test. Correlation will be described using Pearson or Spearman's correlation co-efficient where appropriate. A p value of ≤ 0.05 will be considered statistically significant.

4.8 Significance of the study

The study will provide insight as to whether the CHBAH obstetric preoperative fasting practices deviate from current recommendations and, if so, to what extent.

The study will further provide insight as to whether current fasting practices are adversely affecting the glycaemic profile of parturients and, if so, provide an opportunity for correction of such abnormalities to avoid symptomatic hypoglycaemia and the sequelae thereof.

The results of the study may provide insight into the neonate glycaemic profile, and a correlation between maternal and neonatal hypoglycaemia may be obtained.

The overall goal of the study is to identify deficiencies in preoperative fasting practices for parturients undergoing caesarean section in order to act upon these, and improve patient care.

4.9 Validity and reliability of the study

Validity refers to the degree to which a measurement represents the true value and indicates whether the conclusions of the study are justified based on the design and interpretation. Reliability is the consistency of the measure achieved, and indicates the extent of random error in the measurement method (28).

The following measures will be taken to ensure validity and reliability of the study:

- the use of an appropriate study design
- using an ideal sample size as determined in consultation with a biostatistician
- the use of only one validated glucometer for all glucose measurements
- data will be collected by a single researcher
- data analysis will be done in consultation with a biostatistician.

4.10 Potential limitations of the study

Limitations are deficiencies in the various components of the study including the design, sample, method of data collection, and analysis (28).

The contextual nature of the study may preclude the results being generalisable to the obstetrics departments of other teaching hospitals affiliated to the University of the Witwatersrand or to other hospitals in South Africa.

Should a parturient have hypoglycaemia, it is unethical to leave it untreated and so the investigator will intervene as necessary. This, however, may impact the neonatal blood glucose reading and may render the neonatal glycaemic profile results meaningless.

4.11 Project outline

Activity	Nov 2019 - Feb 2020	Feb 2020 - Dec 2020	Jan 2021 – Jul 2021	Aug 2021 – Sep 2021	Sep 2021 – Dec 2021
Proposal preparation					
Literature review					
Proposal submission					
Ethics approval					
Postgraduate approval					
Data collection					
Data analysis					
Draft article					
Submission					

4.12 Financial plan

The University of the Witwatersrand will bear the costs of printing and paper for the proposal, ethics and post graduate approvals. A glucometer and all necessary disposables will be purchased at the researcher's cost.

Item	Cost per page/ item	No. of pages/ items	Copies	Total
Proposal	R1	25	10	R250
Postgraduate application form	R1	1	6	R6
Ethics application form	R1	10	25	R250
Completed research report	R1	100	4	R400
Glucometer	R1000	1	-	R1000
Glucometer disposables	R1700	1	-	R1700
Miscellaneous	R150	1	3	R450
Grand total				R4056

4.13 References

1. Practice Guidelines for Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration: Application to Healthy Patients Undergoing Elective Procedures: An Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration. Anesthesiology. 2017;126(3):376-93. DOI:10.1097/ALN.0000000000001452.

2. Maltby JR. Fasting from midnight--the history behind the dogma. Best Pract Res Clin Anaesthesiol. 2006;20(3):363-78. DOI:10.1016/j.bpa.2006.02.001.

3. Dripps RD, Eckenhoff JD, Vandam LD. Introduction to Anaesthesia. Philadelphia: WB Sauders Company; 1961.

4. Crowley M. Preoperative fasting guidelines: UpToDate, Inc. Wolters Kluwer; 2020; Available from: https://www.uptodate.com/contents/preoperative-fasting-guidelines. [Accessed: 06 January 2020].

5. Li Y, Su D, Sun Y, Hu Z, Wei Z, Jia J. Influence of different preoperative fasting times on women and neonates in cesarean section: a retrospective analysis. BMC Pregnancy Childbirth. 2019;19(1):104. DOI:10.1186/s12884-019-2254-2.

6. Knight PR, Bacon DR. An unexplained death: Hannah Greener and chloroform. Anesthesiology. 2002;96(5):1250-3. DOI:10.1097/00000542-200205000-00030.

7. Practice Guidelines for Obstetric Anesthesia: An Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology. Anesthesiology. 2016;124(2):270-300. DOI:10.1097/ALN.0000000000000935.

8. Ituk U, Habib AS. Enhanced recovery after cesarean delivery. F1000Res. 2018;7. DOI:10.12688/f1000research.13895.1.

9. Hausel J, Nygren J, Lagerkranser M, Hellstrom PM, Hammarqvist F, Almstrom C, et al. A carbohydrate-rich drink reduces preoperative discomfort in elective

surgery patients. Anesth Analg. 2001;93(5):1344-50. DOI:10.1097/00000539-200111000-00063.

10. Ghorashi Z, Ashori V, Aminzadeh F, Mokhtari M. The effects of oral fluid intake an hour before cesarean section on regurgitation incidence. Iran J Nurs Midwifery Res. 2014;19(4):439-42.

11. Berkow L. Rapid sequence induction and intubation (RSII) for anesthesia: UpToDate, Inc. Wolters Kluwer; 2019; Available from: https://www.uptodate.com/contents/rapid-sequence-induction-and-intubation-rsii-for-anesthesia?topicRef=15698&source=see_link#H211963066.

12. South African Society of Anaesthesiologists. SASA Practice Guidelines 2018 Revision. SAJAA. 2018;24(2):S1-119.

13. Herbst J. Preoperative fasting practices in adult elective surgery patients at Charlotte Maxeke Johannesburg academic hospital [Research report]: University of the Witwatersrand; 2016; Available from: http://wiredspace.wits.ac.za/. [Accessed: 15 January 2020].

14. Lamacraft G, Labuschagne C, Pretorius S, Prinsloo MC, Smit MD, Steyn JR. Preoperative fasting times: Prescribed and actual fasting times at Universitas Hospital Annex, Bloemfontein, South Africa. S Afr Med J. 2017;107(10):910-4. DOI:10.7196/SAMJ.2017.v107i10.10930.

15. Yurashevich M, Chow A, Kowalczyk JJ, Traynor AJ, Carvalho B. Preoperative Fasting Times for Patients Undergoing Caesarean Delivery: Before and After a Patient Educational Initiative. Turk J Anaesthesiol Reanim. 2019;47(4):282-6. DOI:10.5152/TJAR.2019.95770.

16. de Aguilar-Nascimento JE, Dock-Nascimento DB. Reducing preoperative fasting time: A trend based on evidence. World J Gastrointest Surg. 2010;2(3):57-60. DOI:10.4240/wjgs.v2.i3.57.

17. American Diabetes Association. Glycemic Targets: Standards of Medical Care in Diabetes-2019. Diabetes Care. 2019;42(Suppl 1):S61-S70. DOI:10.2337/dc19-S006.

18. Hamdy O. Hypoglycemia Clinical Presentation: WebMD LLC; 2019; Available from: https://emedicine.medscape.com/article/122122-clinical. [Accessed: 17 January 2020].

19. Vincent J, Abraham E, Kochanek P, Moore FA and Fink MP. Textbook of Critical Care E-Book: Elsevier Health Sciences; 2016.

20. Stomnaroska O, Petkovska E, Jancevska S, Danilovski D. Neonatal Hypoglycemia: Risk Factors and Outcomes. Pril (Makedon Akad Nauk Umet Odd Med Nauki). 2017;38(1):97-101. DOI:10.1515/prilozi-2017-0013.

21. Adamkin DH. Postnatal glucose homeostasis in late-preterm and term infants. Pediatrics. 2011;127(3):575-9. DOI:10.1542/peds.2010-3851.

22. Flores-le Roux JA, Sagarra E, Benaiges D, Hernandez-Rivas E, Chillaron JJ, Puig de Dou J, et al. A prospective evaluation of neonatal hypoglycaemia in infants of women with gestational diabetes mellitus. Diabetes Res Clin Pract. 2012;97(2):217-22. DOI:10.1016/j.diabres.2012.03.011.

23. Kamanga N, Maharaj S, Mayer M, Nakwa F, Nongena P, Potgieter H, et al. Neonatal Protocols. 4th ed. Saloojee H, Nakwa F, Velaphi S, editors. Chris Hani Baragwanath Hospital: Neonatal unit, Chris Hani Baragwanath Hospital; 2015.

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

25. Department of Health, 2006. Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa. Department of Health: Pretoria, South Africa. 2006. [Accessed: 7 November 2019]

26. Brink H. Fundamentals of Research Methodology for Health Care Professionals. Second ed. Cape Town: Juta & Co. (Pty) Ltd; 2006.

27. De Vos AS, Strydom H, Fouche CB, Poggenpoel M, Schurink EM & Schurink WJ. Research at grass roots. A primer for the caring professions. Pretoria: Van Schaik Publishers; 2000.

28. Botma Y, Greef M, Mulaudzi FM, Wright SCD. Research in Health Sciences. Forest Drive, Pinelands, Cape Town: Pearson Education South Africa (Pty) Ltd; 2010.

4.14 Appendices

4.14.1 Appendix 1: Letter to the Medical Advisory Committee

Dr Nathalie Prinsloo

Department of Anaesthesiology

University of Witwatersrand

Attention: Medical advisory committee

Medical advisory committee

Re: Preoperative fasting practices and incidence of hypoglycaemia in patients presenting for caesarean section at a central hospital

I will be conducting a Master of Medicine research study where I aim to describe the preoperative fasting practices of obstetric patients at Chris Hani Baragwanath Academic Hospital. The study is a prospective, descriptive, contextual study which will consist of obtaining demographic information about, as well as information regarding the fasting state of, parturients presenting for caesarean section. I will obtain measurements of blood glucose from the patient using one glucometer purchased by myself for the purpose of the study. I will then obtain a cord blood sample of the neonate in order to measure the blood glucose using the same glucometer. Any abnormal results will be acted upon in accordance with current clinical practice guidelines.

Confidentiality will be ensured as only my supervisors and I will have access to the raw data. Upon completion of my research, a copy of the final report will be made available to you should you so wish to have one. Furthermore, neither Chris Hani Baragwanath Academic Hospital nor the Department of Obstetrics and Gynaecology will incur any costs.

Yours sincerely,

Dr Nathalie Prinsloo (079 167 5075)

4.14.2 Appendix 2: Permission letter from the Head of Department of Anaesthesiology at Chris Hani Baragwanath Academic Hospital

08/01/2020

Dear Dr N Prinsloo

Permission is granted to conduct your research in the department of anaesthesiology at the CHBAH. This permission is subject to you obtaining clearance from the Wits ethics committee as well as permission from the HOD of obstetrics and gynaecology and the hospital management at CHBAH.

Good luck with your research

Dr D Lines

Acting HOD, anaesthesiology

CHBAH

4.14.3 Appendix 3: Permission letter from the Head of Department of Obstetrics and Gynaecology at Chris Hani Baragwanath Academic Hospital

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Department of Obstetrics and Gynaecology

OBSTETRICS AND GYNAECOLOGY
School of Clinical Medicine

Chris Hani Baragwanath Academic Hospital, PO Bertsham 2013, South Africa. Telephone: t 27 11 933 8156

Date: 7th January 2020

RE: Perioperative Fasting practices and Incidence of Hypoglycemia in Emergency Obsteric patients at CHBAH- Dr N Prinsoo

To whom it may concern,

This study is for an MMed. This is a prospective study where women undergoing caesarean section at CHBAH will be recruited. The women will be consented to be part of the study at the same time as they are consented for the anesthetic. Dr Prinsloo will only be doing data collection at this time – she will not be the treating anesthetist.

I have asked that the glucose result be written into the file. It will be corrected should there be a hypoglycemia and the surgeon will be informed of the result. In the event of a glucose >7.8 she should have hourly glucose testing with a sliding scale for insulin. In the case of a hyperglycemia of between 5.2 and 7.8 the patient should be given a note to have an OGTT in 12 weeks (the name of the clinic should be written on the note).

Permission for the neonatal tests will have to be obtained from Prof Velaphi/Dr Nakwa.

Permission is hereby granted to Dr Prinsloo to perform her study in the department of Obstetrics and Gynaecology Chris Hani Baragwanath Academic Hospital. This is provided that permission from CHBAH (CEO/MAC), HREC and Department of Paediatrics has been obtained.

Thank you

2020/01/07

X

Signed by: Wits University Staff User
Professor Y. Adam
Clinical Head and Adjunct Professor
Obstetrics & Gynaecology Department
Chris Hani Baragwanath Academic Hospital
The University of the Witwatersrand

Faculty of Health Sciences
Johannesburg Hospital I Private Bag X39, Johannesburg, South Africa I **T** +27 11 488 3179 I **F** +27 11 643 2522 I www.wits.ac.za

4.14.4 Appendix 4: Participant information letter

Preoperative fasting practices and incidence of hypoglycaemia in patients presenting for caesarean section at a central hospital

Dear Madam,

Good day, my name is Nathalie Prinsloo. I am a registrar in the Department of Anaesthesiology and am currently busy with my Master of Medicine research project. I would like to invite you to participate in my research. The aim of my research is to determine the average fasting times of women presenting to Chris Hani Baragwanath Academic Hospital for caesarean section as well as how often the blood sugar levels are low in these women. As part of the study, you will also be asked some questions about yourself and how you have been treated.

The study will require you to agree to a finger prick blood test to see what your blood sugar level is. If it is low, I will give you treatment to make it better. I will also need to take a blood sample from your baby to see what his/her blood sugar level is. The blood sample will be taken from the umbilical cord once your baby is born. This is the cord between the baby and the afterbirth. It does not involve pricking your baby and it will not harm your baby in any way. If your baby's blood sugar test is found to be low, I will treat this immediately. Your name and hospital number will only be available to me. I will give you a study number which will link you to the information I collect. I will be the only person who is able to see the names and study numbers of the people. No one else will know that you have been part of the study. Information about you will be locked away and will be password protected. Only my supervisor and I will have access to the information collected. When the study is over, you can ask to get your information if you want it.

You don't have to be in the study if you don't want to. If you are willing to be in the study you will be asked to sign a consent form to say that you are happy to be part of the study. You can ask to not be part of the study at any time. Not being in the study will not affect the way that you or your baby are treated. You will be treated the same as any person.

You will not be given anything to be part of the study but the findings of the study will help us to care for moms better in the future.

This study has been approved by the Human Research Ethics Committee (Medical) and the Graduate Studies Committee of the University of the Witwatersrand. Should you need any more information, or wish to speak to me about this study, my number is 079 167 5075. You may also speak to:

- Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone: 011 717 2301, e-mail: Clement.Penny@wits.ac.za
- Committee Secretariat: Ms Z Ndlovu or Mr Rhulani Mkansi, telephone: 011 717 2700/1234, or e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za.

Thank you for your time.

Yours sincerely,

Dr Nathalie Prinsloo

4.14.5 Appendix 5: Consent form

Preoperative fasting practices and incidence of hypoglycaemia in patients presenting for caesarean section at a central hospital

1. I ……. agree to participate in this research project. The research has been explained to me and I understand that my participation will involve a blood sample from myself and from my child being tested.

2. I have been given time to ask questions and have found the answers given to me to be reasonable and satisfactory.

3. I understand that there may be no immediate benefit to me, should I agree to participate, nor will I receive any payment.

4. Participation will not cost me anything but my time.

5. I understand that even if I initially consent to take part in the study, I may withdraw at any time and would not be required to give reasons. If that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained.

6. If I require further information, I have been given contact details, listed below.

…… (signature)

PARTICIPANT

…… (date)

I, Dr Nathalie Prinsloo (MP0782041) declare that I have explained the study to the patient and obtained her consent.

…… (signature)

DR N PRINSLOO

…… (date)

Contact details:

Dr N Prinsloo, cell phone: 079 167 5075 or via e-mail: 0701103R@students.wits.ac.za

Dr T Leonard, cell phone: 083 863 5855 or via e-mail: tristanleonard@hotmail.com

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone: (011) 717-2301, or via e-mail: Clement.Penny@wits.ac.za.

Ms. Z Ndlovu or Mr. Rhulani Mkansi, Committee Secretariat, telephone : (011) 717-2700/1234, or via e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

4.14.6 Appendix 6: Data collection sheet

Preoperative fasting practices and incidence of hypoglycaemia in patients presenting for caesarean section at a central hospital

1. Study Number: _____
2. Patient demographic information:

2.1. Age: _____

2.2. Parity: _____

2.3. Weight: _____

3. Caesarean section details:

3.1. Indication for caesarean section: _____

3.2. Fetal distress? _____

3.3. Caesarean section category:

Emergency		Elective	

4. Patient co-morbidities:

4.1. List of patient co-morbidities and treatment:

_____

_____

4.2. Diabetes? If so, details:

_____

_____

5. Duration of labour (if applicable): _____
6. Details of last meal:

6.1. Time of last meal ingested: _____

6.2. Duration: _____

6.3. Meal category:

Light Meal		Heavy meal	

7. Details of last drink:

7.1. Time of last drink: _____

7.2. Duration: _____

8. Aspiration prophylaxis received (if applicable): _____

9. IV fluid therapy:

9.1. Intravenous line present? _____

9.2. Type and quantity of fluid put up: _____

9.3. Estimated quantity of fluid patient received: _____

10. Maternal blood glucose:

10.1. Reading: _____

10.2. Intervention for maternal blood glucose reading (if needed):

_____

_____

11. Neonate cord blood glucose:

11.1. Reading: _____

11.2. Intervention for neonate blood glucose reading (if needed):

_____

_____

12. Neonate birth weight:

_____

Section 5: Annexures

5.1 Ethics approval

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R49 Dr N Prinsloo

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M2011115

NAME: (Principal Investigator)	Dr N Prinsloo
DEPARTMENT:	School of Clinical Medicine Department of Anaesthesiology Medical School University
PROJECT TITLE:	*Preoperative fasting practices and incidence of hypo-glycaemia in patients presenting for caesarean section at a central hospital*
DATE CONSIDERED:	2020/11/27
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr T Leonard
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2021/03/10

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in «**Missing mail merge field**» and therefore reports and re-certification will be due in the month of «**Missing mail merge field**» each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator

Date

5.2 Graduate studies approval

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

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

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

20 January 2021
Person No: 0701103R
PAG

Dr N Prinsloo
PO Box 1948
Bedfordview
2008
South Africa

Dear Dr Nathalie Prinsloo

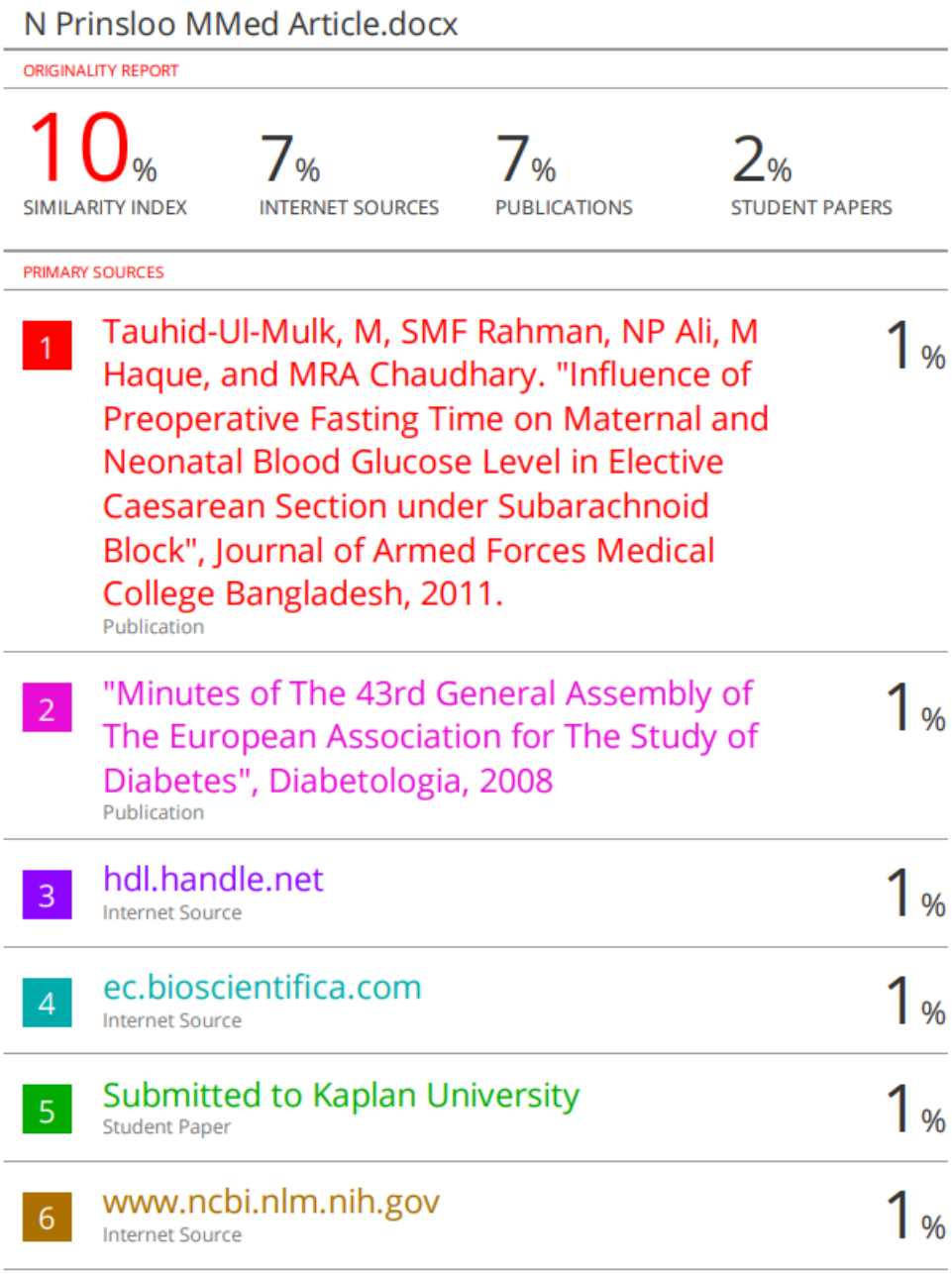
Master of Medicine in Anaesthesia: Approval of Title

We have pleasure in advising that your proposal entitled *Preoperative fasting practices and incidence of hypoglycaemia in patients presenting for caesarean section at a central hospital.* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

5.3 Turnitin report



N Prinsloo MMed Article.docx

ORIGINALITY REPORT

10%	7%	7%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Tauhid-Ul-Mulk, M, SMF Rahman, NP Ali, M Haque, and MRA Chaudhary. "Influence of Preoperative Fasting Time on Maternal and Neonatal Blood Glucose Level in Elective Caesarean Section under Subarachnoid Block", Journal of Armed Forces Medical College Bangladesh, 2011. Publication	1%
2	"Minutes of The 43rd General Assembly of The European Association for The Study of Diabetes", Diabetologia, 2008 Publication	1%
3	hdl.handle.net Internet Source	1%
4	ec.bioscientifica.com Internet Source	1%
5	Submitted to Kaplan University Student Paper	1%
6	www.ncbi.nlm.nih.gov Internet Source	1%

7	unsworks.unsw.edu.au Internet Source	1 %
8	www.samj.org.za Internet Source	<1 %
9	www.frontiersin.org Internet Source	<1 %
10	P L P Brand. "Neurodevelopmental outcome of hypoglycaemia in healthy, large for gestational age, term newborns", Archives of Disease in Childhood, 2005 Publication	<1 %
11	bmcanesthesiol.biomedcentral.com Internet Source	<1 %
12	www.researchgate.net Internet Source	<1 %
13	Makanza, Enireta. "Risk Factors for Chronic Obstructive Pulmonary Disease among Patients Visiting Chris Hani Baragwanath Academic Hospital, Medical Outpatient Department: 2015 -2020", University of Johannesburg (South Africa), 2022 Publication	<1 %
14	academic.oup.com Internet Source	<1 %
15	pubmed.ncbi.nlm.nih.gov Internet Source	<1 %

16	www.omicsonline.org Internet Source	<1 %
17	Leshata Abigail Mapatha, Firdose Lambey Nakwa, Mantoa Mokhachane. "A comparison of weight gain between HIV exposed uninfected and HIV unexposed uninfected infants who received KMC at Chris Hani Baragwanath Academic Hospital", Frontiers in Pediatrics, 2022 Publication	<1 %
18	www.nature.com Internet Source	<1 %
19	Ahmad E. Mostafa, Nehal Badr Elnahhas, Khaled El-Menyawi, Mostafa El Nozahi. "The Relationship between Elevated Pre-procedural Random Blood Glucose Level and Periprocedural Myocardial Injury in Patients Undergoing Elective Percutaneous Coronary Intervention", The Egyptian Journal of Hospital Medicine, 2022 Publication	<1 %
20	Caroline Crawford, Pauline Black, Vidar Melby, Ben Fitzpatrick. "The academic journey of students with specific learning difficulties undertaking pre-registration nursing programmes in the UK: A retrospective cohort study", Nurse Education Today, 2022 Publication	<1 %

21	Ray O. Bahado-Singh, Utku Oz, Char-Dong Hsu, Ozgur Deren, Joshua A. Copel, Maurice J. Mahoney. "Ratio of nuchal thickness to humerus length for Down syndrome detection", American Journal of Obstetrics and Gynecology, 2001 Publication	<1 %
22	Submitted to University of Glamorgan Student Paper	<1 %
23	boardofed.idaho.gov Internet Source	<1 %
24	malariajournal.biomedcentral.com Internet Source	<1 %
25	Annalivia Loizzo, Valerio Zaccaria, Barbara Caravale, Carlo Di Brina. "Validation of the Concise Assessment Scale for Children's Handwriting (BHK) in an Italian Population", Children, 2023 Publication	<1 %
26	hyper.ahajournals.org Internet Source	<1 %
27	spotidoc.com Internet Source	<1 %
28	www.wjgnet.com Internet Source	<1 %