DELIVERY AFTER A PREVIOUS CAESAREAN SECTION AT THE CHRIS HANI BARAGWANATH HOSPITAL

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Declaration

I, Muhammad Shafique Sayed, declare that this research report is my own work.

It is being submitted to the Faculty of Health Sciences for the degree of Master of Medicine in Obstetrics and Gynaecology, at the University of the Witwatersrand, Johannesburg.

It was concurrently submitted in March 2007, in partial fulfilment for the degree of FCOG(SA) at the College of Medicine of South Africa.

It has not been submitted before for any other degree or examination at this or any other University.

_____Day of _____ , 2007.

Dedication

I dedicate this research report to my loving and supportive wife,

Dr. Bibi Ayesha Seedat,

my wonderful parents Ahmed and Soogra Bibi ,

who always promoted education above all else,

and to my children,

Suhail and Nabila.

Presentations arising from this study

15/09/2006	**2006 Ethicon Registrars' Research Symposium.**	University of the Free State, Bloemfontein
21/10/2006	**University of the Witwatersrand, 22nd annual research Day. Department of Obstetrics and Gynaecology.**	Midrand, Gauteng
07/03/2007	**26th Perinatal Priorities Conference**. Day 2 ... Intra partum care.	ATKV Hartenbos, Mossel Bay, Western Cape

Abstract

Introduction

Chris Hani Baragwanath (CHB) hospital has 20 000 deliveries per annum, with 25% by caesarean section (CS). Therefore, vaginal birth after caesarean section (VBAC) is an important delivery option. We questioned the reasons for the low VBAC success following trial of labour (TOL). The primary objective was to determine the proportion of eligible patients attempting TOL and the VBAC success rate. Secondary objectives were to establish reasons for failed VBAC, predictive factors for VBAC, and maternal and neonatal morbidity and mortality.

Methodology

A retrospective descriptive study by record review, analysing demographic, obstetric and delivery outcome variables of women with one prior CS in a subsequent pregnancy.

Results

From the 340 patients eligible for VBAC, 287 (84.4%) attempted TOL and 53 (15.6%) had an elective repeat caesarean section (ERCS). VBAC success was 51.6% (148/287). Prelabour rupture of membranes and prolonged latent phase of labour resulted in 40% of failed VBAC. Successful VBAC was associated with a higher parity, lower birth weight and lower gestation ($p<0.001$). Positive predictors of successful VBAC were previous vaginal birth ($p=0.004$), previous VBAC ($p=0.038$), previous CS for malpresentation ($p=0.012$), birth weight <3500g ($p=0.003$), and gestation ≤ 39 weeks ($p<0.001$). Negative predictors were previous CS for cephalo-pelvic disproportion ($p=0.003$) and women with no prior vaginal deliveries ($p<0.001$). There was no maternal mortality. Complications however, included 2 uterine ruptures, 2 uterine dehiscences, 4 hysterectomies, and one intrapartum fetal death. Adverse maternal outcomes were increased with TOL compared to ERCS ($p=0.038$), and more so with failed compared to successful VBAC ($p=0.002$). Adverse neonatal outcomes were also increased with TOL compared to ERCS ($p=0.048$), however there was no difference in neonatal outcomes between failed and successful VBAC ($p=0.420$).

Conclusion

VBAC remains a viable option for patients with one prior CS in this setting, despite a lower VBAC success than developed countries. Failed VBAC due to prelabour rupture of membranes and prolonged latent phase of labour remains a problem.

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Abbreviations	
ACOG	American college of Obstetricians and Gynaecologists
BMI	Body mass index
CHB	Chris Hani Baragwanath (hospital)
CI	Confidence interval
CPD	Cephalo-pelvic disproportion
CS	Caesarean section
EmCS	Emergency repeat caesarean section
ERCS	Elective repeat caesarean section
HIV	Human immunodeficiency virus
ICU	Intensive care unit
NICE	National Institute for clinical Excellence
NIH	National Institutes of Health
OR	Odds ratio
PLPL	Prolonged latent phase of labour
PROM	Prelabour rupture of membranes
RR	Relative risk
SOGC	Society of Obstetricians and Gynaecologist - Canada
SD	Standard deviation
TLCS	Transverse lower uterine segment incision caesarean section
TOL	Trial of labour
VBAC	Vaginal birth after caesarean section

Definition of terms	
Augmentation of labour	The administration of oxytocin during the first stage of labour to women with poor progress, due to inadequate or inefficient uterine contractions.
CPD	Relative or absolute disproportion between the fetal head size and the maternal pelvis (due to fetal macrosomia, contracted maternal pelvis, or malposition of the fetal head during labour), resulting in failure of normal progress of labour.
EmCS	Repeat caesarean section, in patients with prior caesarean section following (1) an acute event that precludes conservative management or elective delivery at a later stage, (2) patients presenting in spontaneous labour, while having contra-indications to vaginal birth after caesarean section.
ERCS	Planned elective caesarean delivery in patients with prior caesarean section.
Failed VBAC	Patients that attempted a trial of labour, but eventually required caesarean delivery (due to prelabour rupture of membranes, prolonged latent phase of labour, poor progress in the active phase of labour, prolonged second stage of labour, fetal or maternal compromise).
PLPL	Latent phase of labour (0-3cm cervical dilatation) that lasts more than 8 hours.
Poor progress in active labour	Labour progresses slowly as determined by an increase in cervical dilatation of less than 1cm an hour (i.e. crossing the alert line of the Partogram).
PROM	Rupture of the amniotic membranes, with confirmed drainage of amniotic fluid, prior to the onset of labour contractions.
Poor progress in 2nd stage of labour	Delivery has not occurred after 30 minutes of active maternal pushing in a multiparous patient, or 45 minutes in a primparous patient, and the patient is not suitable for an assisted vaginal delivery by forceps or vacuum extraction.
Successful VBAC	Vaginal delivery of the fetus (spontaneous, and forceps or vacuum assisted delivery), following an attempted trial of labour.
TOL	An attempt at vaginal delivery by patients with a prior caesarean section, with careful maternal and fetal monitoring, for the signs of uterine rupture or other maternal and fetal complications of labour.
Uterine dehiscence	Disruption of the uterine muscle with intact uterine serosa. It is often asymptomatic and found at the time of operative delivery in patients with prior caesarean section.
Uterine rupture	Disruption of the uterine muscle extending to the uterine serosa, the bladder or the broad ligament. It is associated with a trial of labour and results in acute maternal and fetal compromise, necessitating an emergency laparotomy.

1. Introduction

1.1 Literature Review

The widespread use of caesarean section (CS), the operative abdominal delivery of a neonate for various indications, has forever changed current worldwide obstetric practice. However, ongoing controversy, around what is today one of the commonest operative procedures in modern medicine, has been raging for at least 500 years.

CS (often referred to as *caesarean* delivery or birth) is thought to have begun as a postmortem procedure during the Roman era. *Lex cesarea* was the law that mandated burial of the dead mother and fetus in separate graves. There is little evidence about the reported abdominal delivery of newborns from Greek Mythology, ancient Hindu, Egyptian and Chinese folklore (Drife 2002). The first documented survivor of CS was Elizabeth Nufer in 1500. Jacob Nufer, a Swiss pig gelder, performed a CS out of desperation (and with some anatomical knowledge and equipment he had gathered after years of slaughtering pigs), on his wife who had unsuccessfully laboured for several days. The child reportedly survived, and Elizabeth went on to deliver a further 4 singletons and one set of twins vaginally (Reiss 2003).

Sporadic reports of CS continued for the next 300 years. Following Nufer's success, Francois Roussett described 14 CS in 1581 (Sedhev 2005). Further operative deliveries were performed where the mother had survived by Mary Donally (1738) in Ireland, Dr James Barlow (1793) in England, James Miranda Barry (1821) in South Africa and Dr John Richmond (1827) in America. Although it was known that CS had been carried out by indigenous healers in Africa for many years, no documentation is available (Drife 2002). However, a British traveler to Africa in 1879, RW Felkin,

reportedly witnessed a CS performed by indigenous healers on a live women who subsequently survived, in Kahura, Uganda. There were apparently similar reports from Rwanda ("Cesarean section- A brief history" NIH).

All of these operations were carried out without anaesthesia and were often combined with hysterectomy. Death from haemorrhage or sepsis was the norm. In the 1846 diethyl ether was introduced at the Massachusetts General Hospital. Britain's Queen Victoria was the famous survivor of two CS deliveries, with children Leopold (1853) and Beatrice (1857). Even though the technique of asepsis was introduced in the 1870s by Lister, CS mortality remained high. Sedhev quotes Radford's description, in 1880, of a series of 131 CS with an 83% mortality rate. Max Sanger then described the benefit of suturing the uterine incision in 1882 (using silver wire and silk). He documented the survival of 8 out of 17 mothers in various American hospitals (Sedhev 2005).

While internal suturing decreased haemorrhagic morbidity and mortality, extraperitoneal CS described by Frank (1907) and adapted by Latzko (1909) helped to decrease peritoneal sepsis. Up to this point all CS were "classical" vertical incisions in the upper uterine fundus. Krönig realized, in 1912, that the extraperitoneal approach allowed a safer vertical incision in the thinner lower uterine segment. Beck (1919) and De Lee (1922) modified this incision. In 1926, Munro Kerr finally described the transverse lower uterine incision CS (TLCS) that is still used today. TLCS has the benefits of reduced haemorrhage and peritonitis when compared to a classical CS. With the discovery of penicillin by Alexander Fleming in 1928, and its availability by 1940, the extraperitoneal CS was no longer necessary (Sehdev 2005).

Up to this point the dictum of "once a caesarean, always a caesarean" established by Edwin Craigin in 1916, was generally accepted. The number of women delivered by CS continued to grow worldwide as surgical training, anaesthesia, antibiotics and facilities steadily improved. Craigin however, made his statement at a time when classical CS was the norm. In 1923, Schell described vaginal birth after caesarean delivery (VBAC), but the practice of elective repeat caesarean section (ERCS) persisted. ERCS in patients with a prior CS continued to contribute to the overall CS rate, which eventually peaked in the 1980s.

VBAC was then encouraged on a large scale in an attempt to decrease the overall CS rate. This was supported by a study, involving 5733 patients with a prior CS opting for a trial of labour (TOL), carried out at 11 centres in California, USA (Flamm 1990). VBAC success in this study was 75%, with no maternal deaths in the TOL group. Perinatal mortality was similar to that of the general obstetric population.

Rosen (1991) reported a meta-analysis of 31 studies between 1982 and 1989, with 11 417 patients with prior CS having TOL, to evaluate maternal and neonatal morbidity and mortality associated with VBAC. It was concluded that oxytocin use, recurrent indication for previous CS, and an unknown previous uterine scar were not associated with uterine rupture or dehiscence. The meta-analysis also found that although the five-minute Apgar scores were lower in the TOL group of patients, the perinatal morbidity rate was not statistically different. Rosen therefore promoted VBAC.

However, the assumption that increasing VBAC deliveries would safely reduce overall CS rates was being increasingly challenged. Although there were no large randomised controlled trials comparing VBAC and ERCS, the data from large series

and meta-analyses indicated that the relative risk of uterine rupture, maternal morbidity, and severe perinatal morbidity or mortality, was increased in women undergoing TOL rather than ERCS. This risk appeared to be higher in patients who attempted TOL and failed, resulting in an emergency repeat CS (EmCS). Morbidity and mortality seemed to revolve around uterine rupture (McMahon 1996, Rageth 1999, Mozurkewich 2000, Kieser 2002, Smith 2002, Bujold 2002, Chauhan 2003, Landon 2004 and Shi Wu Wen 2004).

Uterine rupture is the rare but serious complication in subsequent pregnancies following a prior CS. The incidence is 0.2–1.5% after a TLCS, 1–1.6% after a vertical lower segment CS, and 4–9% after a classical or 'inverted-T' incision CS (NICE guideline 2004). The overall risk of uterine rupture or dehiscence in patients having TOL is 3.5 per 1000, compared to 1.2 per 1000 for those with ERCS. The risk of neonatal death with TOL is one per 1000, which is ten times higher than the rate for ERCS of 0.1 per 10 000 (NICE guideline 2004).

The first of the studies that identified a problem with the policy of VBAC to reduce overall CS rates, was a population-based study in Nova Scotia, Canada (McMahon 1996). Among 82 488 births from 1986 to 1992, of which 6 138 patients had a prior TLCS, 3249 patients underwent TOL compared to 2889 who had ERCS. The VBAC success rate was 60.4%, while the uterine rupture rate was 0.3%. Major maternal complications including hysterectomy, uterine rupture or operative injury were almost twice as likely in the TOL group (odds ratio (OR) 1.8; 95% confidence interval (CI) 1.1 to 3.0). Five-minute Apgar scores, neonatal intensive care unit (ICU) admissions, and perinatal mortality were similar in the TOL and ERCS groups. In this study age less than 35 years, a birth weight of less than 4000g, and delivery at a tertiary care

facility resulted in a greater likelihood of a successful VBAC. McMahon concluded that selection of women with a high probability of vaginal delivery after TOL was essential to decrease the overall risk of TOL.

The second study (cross sectional) looked at a pooled database of 457 825 deliveries in Switzerland, including 29 046 patients with prior CS (Rageth 1999). In 17 613 patients attempting TOL, there was a 73.7% VBAC success rate. The risk of uterine rupture in the TOL group was double that of the ERCS group (relative risk (RR) of 2.07; 95% CI 1.29-3.30). In this study uterine rupture was associated with induction of labour, epidural anaesthesia, failure to progress and an abnormal fetal heart rate pattern. In contrast to McMahon's study however, all other maternal risks were lower in the TOL group (including hysterectomy, RR 0.36; 95% CI 0.23-0.56).

The third study, a meta-analysis from 1989 to 1999 (Mozurkewich 2000), looked at indicators of both maternal and neonatal morbidity and mortality. Fifty-two studies from developed countries were identified. Only 15 studies were included because many of the subjects in the control group (ERCS patients) in the remaining 37 trials were not eligible for TOL. A total of 47 682 patients was included. Patients having TOL had a two-fold increase in the rate of uterine rupture (OR 2.10; 95% CI 1.45-3.05) compared to patients having ERCS, but were less likely to have febrile morbidity (OR 0.70; 95% CI 0.64-0.77), require a blood transfusion (OR 0.57; 95% CI 0.42-0.76) or have a hysterectomy (OR 0.39; 95% CI 0.27-0.57). The meta-analysis showed that there was no difference in maternal mortality between the ERCS and TOL patients. Fetal or neonatal death was more frequent in TOL (OR 1.71; 95% CI 1.28-2.28) and a low five-minute Apgar score was twice as likely in the TOL group (OR 2.24; 95% CI 1.29-3.88). This meta-analysis showed that the increased

likelihood of uterine rupture in TOL appeared to adversely affect neonatal outcomes rather than cause an increase in other adverse maternal events.

Some of the previous studies did not clearly distinguish between a uterine rupture and a uterine dehiscence. A population-based study by Kieser (2002) showed that uterine rupture and dehiscence occurred with the same frequency (2.4 per 1000), but only uterine rupture was associated with maternal morbidity (blood transfusion) and neonatal asphyxia.

The fourth study, demonstrating the dangers of TOL, was a Scottish population-based longitudinal study from 1992 to 1997 (Smith 2002). This study included 313 238 singleton, term, cephalic births and 15 515 TOL. This study showed that TOL had an eleven times higher risk of perinatal death (OR 11.6; 95% CI 1.6-86.7) compared to ERCS. Although the absolute risk was low (12.9 per 10,000 for TOL compared to 1.1 per 10,000 for ERCS), this was still double the risk of perinatal death in multiparous women without a prior CS (OR 2.2; 95% CI 1.3-3.5) and higher than that in primiparous women (OR 1.3; 95% CI 0.8-2.1). Prompt intervention, with emergency CS after uterine rupture, did not always prevent severe neonatal morbidity or death (Bujold 2002).

Chauhan (2003) subsequently carried out an extensive literature review of articles from 1989 to 2001. Seventy two out of 361 articles looked specifically at maternal and perinatal complications of uterine rupture in sufficient detail and numbers. The overall rate of uterine rupture associated with TOL was 6.2 per 1000 (880/142 075). This meta-analysis showed that uterine rupture related complications per 1000 attempted TOL was: 1.8 for blood transfusion, 1.5 for fetal asphyxia (cord pH<7.00),

0.9 for hysterectomy, 0.8 for genitourinary injury, 0.4 for perinatal death and 0.02 for maternal death. Chauhan concluded that although uncommon, adverse outcomes related to uterine rupture during TOL were dependant on the time of the publication, site of study, and size of the population studied.

All studies alluded to previously, were retrospective or population-based longitudinal cohort studies. Therefore, the large prospective cohort study by Landon (2004) was unique. This was carried out at 19 academic centres in the USA from 1999-2002, and reported on the primary outcomes of 33 699 patients from a total of about 46 000 patients with a prior CS. Those with a clear indication for ERCS were excluded. The study finally compared 17 898 TOL with 15 801 ERCS, with a reported 73.4% VBAC success rate. There was a 0.7% symptomatic uterine rupture rate for TLCS and a 2.0% rate for a previous vertical lower segment CS.

Landon found that uterine rupture was associated with the use of oxytocin augmentation of labour, and induction of labour by any means. Hysterectomy and maternal morbidity were not different between the two groups. However, endometritis and blood transfusion were more frequent with TOL patients. TOL had double the risk of an adverse maternal event when compared to ERCS (OR 1.96; 95% CI 1.73-2.22). Furthermore, a greater perinatal risk was associated with TOL (hypoxic ischaemic encephalopathy - 0.46 per 1000 TOL's compared to none for ERCS). The corrected perinatal death rate (stillbirths and neonatal deaths excluding congenital malformations) was 4.0 per 10,000 for the TOL group and 1.4 per 10,000 in the ERCS group.

The retrospective Canadian study of 308 755 patients with a previous CS (Shi Wu Wen 2004), showed that ERCS was associated with a higher rate of in-hospital deaths (5.6 maternal deaths per 100,000 ERCS versus one maternal death per 100,000 TOL). This study concluded that while TOL results in more uterine ruptures (0.65%), blood transfusions (0.19%) and hysterectomies (0.10%), ERCS patients might have an increased risk of maternal death.

With the danger of uterine rupture and the implications for maternal and neonatal morbidity and mortality well established, the number of patients attempting TOL began to fall by the mid 1990s, with resurgence in ERCS births in patients with a prior CS by 2002 (Greene 2004, ACOG bulletin no.54, 2004).

The key to the dilemma of mode of delivery for patients with a prior CS lies in identifying those patients who are most likely to succeed at TOL, with the lowest likelihood of uterine rupture. This brings us to the studies that attempt to identify factors that might be predictors of VBAC success, and factors that are less likely to be associated with uterine rupture.

A previous vaginal delivery, before or after the index CS, is one such factor. Zelop (2000) demonstrated a five fold decrease (OR 0.2; 95% CI 0.04-0.8) in uterine rupture for women with a prior CS delivering at term (0.2%), who also had one or more previous vaginal deliveries, when compared to those who did not have a previous vaginal delivery and attempted TOL (1.1%). Furthermore, Macones (2005) encouraged women with a previous vaginal delivery prior to the first CS, to attempt TOL in the subsequent pregnancy, after showing a reduced risk of uterine rupture (OR 0.40; 95% CI 0.20-0.81) in this subgroup.

A retrospective cohort study in Pennsylvania, USA, from 1994 to 1999, of 9 960 women with a singleton gestation and one prior CS, analysed the effect of previous vaginal delivery on VBAC success with TOL (Elkousy 2003). The overall VBAC success was 74%. This rate was studied independently for women with no prior vaginal deliveries, those with a previous VBAC after the first CS, those with a previous vaginal delivery before the first CS and lastly women who had both a previous vaginal delivery before and a previous VBAC after the initial CS. VBAC success was 65%, 94%, 83% and 93% respectively. In the first group (women with no prior vaginal deliveries) VBAC success was further decreased if the indications for previous CS were cephalo-pelvic disproportion (CPD) or failure to progress, or if induction or augmentation of labour was used during the TOL.

Cahill (2006) carried out a retrospective cohort study, at 17 centres in Washington, USA, from 1996 to 2000. The study included 6 619 patients with a prior CS and a previous vaginal delivery, with 5 041 attempting TOL and 1 578 having ERCS. TOL in this subgroup of patients resulted in no increase in uterine rupture or bladder injury, and lower rates of maternal pyrexia and blood transfusion.

When looking at other factors that possibly influence VBAC success and uterine rupture, induction and augmentation of labour appears to increase the risk of uterine rupture in TOL. This was reported in several studies (Lydon-Rochelle 2001, Blanchette 2001, Macones 2005, and Landon 2005).

A longitudinal, population-based study from 1987 to 1996 in Washington, USA, looked at 20,095 women with a prior CS who had a second singleton delivery within the same defined period (Lydon-Rochelle 2001). Those that delivered by ERCS had a

rate of uterine dehiscence of 1.6 per 1000 deliveries. Spontaneous TOL had a 3-fold increase in uterine ruptures (5.2 per 1000), induction of labour (IOL) had a 5-fold increase (7.7 per 1000), and IOL with prostaglandin a 15 fold increase in uterine rupture (24.5 per 1000). Similarly, a study at a community-based hospital in Massachusetts, USA, found that 11 out of 12 uterine ruptures from 754 TOL involved either induction, augmentation or both (Blanchette 2001).

More recently, Macones (2005) suggested that prostaglandins alone were not associated with uterine rupture, but the sequential use of prostaglandins and then oxytocin increased the chances of a uterine rupture (adjusted OR of 3.07; 95% CI 0.98-9.88). A guideline from the Society of Obstetricians and Gynaecologists of Canada (SOGC) (no.155, 2005) does not consider oxytocin augmentation to be a contraindication in TOL. However, in their Practice bulletin (no.54, 2004) the American college of Obstetricians and Gynaecologists (ACOG) discourages the use of prostaglandins for cervical ripening, but does not categorically state that oxytocin augmentation is contraindicated in VBAC. The ACOG concludes however, that the rate of uterine rupture is not greater in patients attempting VBAC who receive oxytocin, when compared to those who labour spontaneously.

The next factor that might be a predictor of VBAC success is birth weight. Zelop (2001) reported on a study from New York, USA, that included 2 749 patients at term with one previous CS and no prior vaginal deliveries, who attempted TOL. Women with a neonatal birth weight >4000g had an OR of 1.7 (95% CI 1.3-2.2) of having a failed VBAC and EmCS. The overall VBAC success however remained at least 60% provided the birth weight was <4250g. This study reported no increase in uterine rupture during TOL with these macrosomic babies compared to those <4000g.

Elkousy (2003) however, reported that while women with macrosomic infants still had a 60-90% chance of a successful VBAC, uterine rupture was increased in those without a previous vaginal delivery (RR of 2.3; $p<0.001$).

Factors affecting VBAC success were analysed in a large, multi-centred, prospective observational study conducted between 1999 and 2002, in the USA. (Landon 2005). This study looked at 14 529 patients with TOL, with a 73.6% VBAC success rate. Predictors of successful VBAC included a previous vaginal delivery before or after the prior CS (OR 3.9; 95% CI 3.6-4.3), indication for previous CS other than dystocia (OR 1.7; 95% CI 1.5-1.8), spontaneous labour (OR 1.6; 95% CI 1.5-1.8), and a birth weight of less than 4000g (OR 2.0; 95% CI 1.8-2.3). Negative predictors of VBAC success were a maternal body mass index (BMI) of more than 30, induction of labour, and the lack of a previous vaginal delivery.

A secondary analysis of a prospective observational study compared the outcomes of 14 142 women attempting TOL with 14 304 having ERCS (Hibbard 2006). This study reported that an increased maternal BMI was directly associated with failed VBAC (15.2% with BMI 18.5 to 24.9 compared to 39.3% for a BMI of 40.0 or more). Morbid obesity (BMI >40) was also a significant risk factor for uterine rupture or dehiscence (5 fold increase), composite maternal morbidity (2 fold increase) and neonatal injury (5 fold increase in fractures, brachial plexus injuries and lacerations).

A retrospective cohort study (1996 to 2000), of 25 005 patients, was carried out in Philadelphia, USA, to assess the impact of maternal age on VBAC success (Srinivas 2007). A total of 13 706 women (54.8%) attempted TOL. Women aged 15 to 20 were less likely to have a failed VBAC (OR 0.73; 95% CI 0.62-0.87). Women aged 35

years or older were more likely to have a failed VBAC attempt (OR 1.14; 95% CI 1.03-1.25), and more likely to have VBAC-related operative complications (OR 1.39; 95% CI 1.02-1.89).

A South African study, from Bloemfontein, with a similar setting to our own (i.e. a tertiary referral and teaching hospital in the public sector) looked at delivery outcomes in 189 patients with a previous CS (Van der Walt 1994). In this study, 79.4% of women attempted TOL and 56.7% had a successful VBAC. There was a 2% uterine rupture rate (4/189), one maternal and two perinatal deaths. Van der Walt concluded that TOL with a neonatal birth weight of >3200g, or a previous CS for CPD, were risk factors for failed VBAC. Emergency CS after a failed VBAC was the only significant risk factor associated with maternal morbidity.

In addition, Van der Walt (1994) discussed 10 publications addressing VBAC in developing countries, between 1987 and 1991. This meta-analysis of 5 458 patients showed a VBAC attempt rate of 54.2%, and a VBAC success rate of 64.5%. There was a 2% uterine rupture rate and 5.98 maternal deaths per 10,000 TOL attempts. The study concluded that VBAC success was relatively low in developing countries.

A recent publication (Tripathi 2006), also from a developing world setting in Ahmedabad, India, in a study of 81 patients, identified previous CS for malpresentation or fetal distress, and previous vaginal birth as factors associated with an increased VBAC success rate. They described a low likelihood of successful VBAC at a birth weight of more than 3000g and in patients receiving induction or augmentation of labour. The overall success rate however, was 73%.

Deutchman (2003) summarised factors that increased the chance of successful VBAC with TOL. These factors could help in the appropriate selection of patients for TOL. These included: absence of the prior indication for CS; absence of CPD; spontaneous onset of labour with an initial cervical dilatation of 3 to 4 cm; absence of induction (particularly with prostaglandins) or augmentation of labour; birth weight <4000g; the presence of one previous normal delivery or one previous VBAC; a previous transverse lower uterine segment CS; and a highly motivated patient who has been fully counselled about the risks of uterine rupture. This editorial concluded however, that there was a lack of reliable predictors of uterine rupture.

Macones (2006) recently developed a clinical predictive model for uterine rupture in TOL, using antenatal parameters, and then antenatal combined with early intrapartum factors. Unfortunately, both the combined clinical indices and individual predictive indices had poor sensitivity and specificity. This means that while we may be able to choose suitable patients for TOL who have a lower likelihood of uterine rupture, we cannot predict which patient is at risk of this rare but catastrophic event.

Evidence from prospective randomised controlled trials, to predict which patients are likely to have a successful VBAC (with the least potential for maternal and neonatal morbidity and mortality) remains elusive. At present, it seems unlikely that any patient population will consent to a large-scale randomised control trial, comparing ERCS and TOL, in order to clarify these concerns. A systematic review by Dodd and Crowther (2004) concluded that future controlled trials without randomisation, cohort or case controlled studies, could still offer better quality evidence by ensuring comparability of groups and reporting on precise and standard outcomes.

For the present time however, it remains the responsibility of health care providers to individualise delivery options for patients with prior CS, taking local resources and expertise into consideration. The mode of delivery must be decided upon after full informed consent from the patient, with regard to the potential risks and benefits of both TOL and ERCS.

1.2 Background

Since Chauhan (2003) concluded that adverse outcomes related to uterine rupture with TOL vary according to the time, place and size of that particular study, South African studies addressing VBAC would seem logical. This need for local research is strengthened by the paucity of recent local studies on this topic.

Chris Hani Baragwanath hospital is a tertiary referral centre in the South African public health sector. It is also a teaching hospital affiliated to the University of the Witwatersrand. It remains one of the largest single obstetric units worldwide, with more than 20 000 deliveries per annum. About 25% of these are by CS. Therefore, the choice of an elective repeat caesarean section (ERCS) or a trial of labour (TOL) is of particular importance in our setting.

VBAC has been shown to be reasonably safe and effective, with the provision of strict criteria for patient selection, intrapartum fetal and maternal monitoring, theatre facilities, blood transfusion services, and appropriately trained obstetric, neonatal, anaesthetic, and nursing personnel. Challenges in meeting these criteria at our facility include the high turnover of patients and limited personnel and equipment resources.

The patient load at the CHB hospital continues to rise with a growing population. The facilities for providing healthcare services to this community however, have not been upgraded accordingly. Therefore, clinical management within individual departments must adapt to best use the limited resources available. VBAC can be used as a measure to prevent increasing overall caesarean section rates. However, an appropriate selection of patients for TOL, to ensure a high VBAC success rate is of utmost importance. This would ultimately minimise maternal and neonatal morbidity and mortality, associated with failed VBAC and subsequent emergency repeat CS.

The most recent labour ward audit at the CHB hospital showed that 13% of the ANC population had one or more prior CS. However, the overall VBAC rate was only 33%. A study at the CHB hospital to establish the current VBAC success rate was therefore warranted.

This study would also need to identify factors associated with success or failure of TOL, in order to recommend changes to improve VBAC success. An analysis of current maternal and neonatal adverse outcomes related to TOL would also be necessary, for a complete assessment of safety and feasibility of a policy of VBAC, for suitable patients with a prior CS.

Doctors and patients must be aware of the expected chance of a successful VBAC and the potential adverse outcomes before attempting TOL. These issues must be included in the counselling and decision-making process when considering TOL compared to ERCS. A study of this nature could provide information on these aspects that are relevant to our particular clinical setting and patient profiles.

1.3 Statement of Problem

- The efficacy and safety of TOL and VBAC at CHB hospital have not been determined recently.
- The perception that there is low VBAC success at our facility needs to be researched.
- The VBAC attempt and success rate needs to be established.
- The assumption that offering TOL to all patients with one previous TLCS, would prevent increasing CS delivery rates, has not been justified in our setting.
- The option of TOL vs. ERCS or ERCS for all patients with one previous CS needs to be re-evaluated in light of current VBAC success rates and potential adverse effects.

1.4 Justification for the Study

- A study addressing VBAC in the South African public health sector is needed, since recent research on this topic is limited, and it will allow for meaningful comparison with existing studies from developed countries.
- These issues have significant financial and medico-legal implications, and have not been recently evaluated at our institution.
- The findings and recommendations of this study would justify current and future departmental policies on delivery after CS, at the CHB hospital.
- The outcomes and suggestions of this study could serve as a basis for future studies at this facility or others in South Africa.

1.5 Study Aim and Objectives

Aim

To assess the efficacy of TOL for patients with a prior CS and to identify predictive factors for VBAC success at CHB hospital.

Objectives

Primary objectives.

- Establish **mode of delivery**.
- Determine what proportion of eligible patients attempt TOL (by excluding patients with clear indications for ERCS, and those where an unplanned emergency event precluded TOL and resulted in an EmCS).
- Establish the **VBAC success rate** of those who attempt TOL.

Secondary objectives.

1. Establish reasons for EmCS, ERCS, and failed VBAC.
2. Determine the influence of the following variables on VBAC success rates:
    - Maternal age and parity
    - Birth weight and gestational age
    - HIV serostatus
    - Antenatal care-related factors (ultrasound, hospital booking)
    - Previous vaginal delivery (before or after previous CS)
    - Indication for previous CS
3. Compare **adverse outcomes** according to the mode of delivery :
    - **Maternal** (death, uterine rupture or dehiscence, hysterectomy, haemorrhage requiring blood transfusion, maternal sepsis)
    - **Neonatal** (Five-minute Apgar score < 7, neonatal ICU admission, intrapartum fetal death or early neonatal death)

2. Methodology

2.1 Study Design

This was a retrospective descriptive study, with analytic components of delivery outcomes in patients with one previous caesarean section.

2.2 Study population

This included all patients who delivered at the Chris Hani Baragwanath hospital for the period of January 2003 to December 2005. This represents a low-income urban population attending a public hospital in Soweto, Johannesburg, South Africa.

2.3 Sample size

This was calculated using Epi-Info statistical software. A minimum of 326 records were needed to provide an estimate of VBAC success rates, with a 5% precision using a 95% confidence interval. A study population of 60 000 patients was required, with an expected prevalence of previous CS of 13% and VBAC of 33% (based on labour ward statistics at CHB hospital).

2.4 Data Capture

All data relevant to patients' antenatal, intrapartum and postpartum care is handwritten. This is kept in individual hospital files, each of which is allocated a computer-generated random alphanumeric filing number on admission. The complete file is systematically stored on discharge, within the department, based on only the last 3 numeric digits.

A screening sample of 3600 records was collected from this record storage area. We sampled the first six records of the first six rows (from a total of ten rows), from each of the ten shelves in all ten filing cabinets. Randomisation was ensured by the original

computer generated number allocation and the existing filing system. This systematic screening yielded 383 records for analysis. (Figure 1)

Data from all patients with one or more previous CS was recorded and transferred onto a data capture sheet (Appendix 1). This was then placed on a computer database using Epi-Info statistical software (Appendix 3). Data capturing and transfer was carried out by the same researcher, in order to minimize any potential bias in interpretation of the written records.

2.5 Variables

Demographic Data

i. Age and parity
ii. Gestation
iii. Birth weight
iv. HIV serostatus

Obstetric History

i. Previous successful VBAC
ii. Previous vaginal delivery
iii. Indication for previous CS
iv. Booked antenatal care at CHB hospital
v. Antenatal ultrasound

Primary Outcomes

i. Final mode of delivery

Secondary Outcomes

i. Reasons for ERCS, EmCS and failed VBAC
ii. Adverse effects (maternal and neonatal)

2.6 Data Analysis

Epi-Info statistical analysis software (Version 3.3.2, 2005) was utilised for initial data capturing and analysis. Further statistical analysis of subgroups, stratified analysis, and graphic representation of data was carried out using SPSS statistical software package (version 11.0).

Presentation of descriptive statistics was done using proportions expressed as percentages. Continuous data were presented as means with ranges or standard deviations (±SD). Most variables were categorical in nature. Therefore the uncorrected Chi squared test (χ^2) for comparison of proportions was used to evaluate statistical differences between groups. The odds ratio (OR) was used to assess the strength of the associations of the variables analysed, with a 95% confidence interval (CI). The Fisher's exact test was used to evaluate statistical differences where numbers were inappropriately small for the χ^2 test. The strength of these associations was expressed by the relative risk (RR) with a 95% CI. The Student's T-test was used to compare continuous normally distributed variables (for example, age, gestation, birth weight, etc), while the Mann-Whitney test was used to compare differences in parity.

The primary outcome was final mode of delivery. This was expressed by using descriptive statistics such as frequencies and percentages, and included all 383 patients in the cohort.

Similar methodological steps needed to be followed in order for the results of this study to be comparable to others in the literature. This required the exclusion of all patients in whom there was a clear indication for ERCS, and all patients where an

unplanned emergency event precluded TOL and resulted in an EmCS, prior to a secondary analysis. After relevant exclusions, the sample size (n=340) was still large enough for statistically significant comparisons. The secondary analysis looked at differences between the subgroups of patients attempting TOL, i.e. successful and failed VBAC, in order to identify predictors of VBAC success.

Demographic factors analysed included maternal age and parity, birth weight, gestational age, HIV seropositivity, and specific antenatal certain care related factors. The latter included no antenatal booking, antenatal care at a primary or secondary-care facility other than CHB hospital, and having an antenatal ultrasound investigation. A stratified analysis of the effects of increasing gestation and neonatal birth weight on VBAC success was also carried out. Obstetric history analysed included previous vaginal delivery (before or after prior CS) and indications for previous CS.

Important outliers and confounders needed to be identified and removed when studying complications and adverse outcomes related to mode of delivery. This was important in standardising our results, thereby allowing comparison of this study with others, both from developing and developed countries. Therefore, when analysing adverse events, confounding factors (severe pre-eclampsia, lack of antenatal care, fetal congenital abnormalities) and outliers (prematurity and low birth weight) were first removed. A comparison of maternal and neonatal morbidity and mortality was then made between ERCS and TOL. This comparison was repeated between the successful and failed VBAC subgroups.

2.7 Pilot Study

A pilot study, using the first 100 records captured, was carried out to assess the feasibility of data capture and transfer. The data collection tools (Appendix 1,2 & 3) were modified according to the results of the pilot study, to include only variables that were consistently available for analysis.

2.8 Ethical Considerations

This was a retrospective record review, with no patient interaction. All data sampling and capture was carried out at CHB hospital in the Maternity department records room. No patient identifiable data, date or time of delivery, nor health-worker information was recorded.

Permission to access the data and use the department records room was granted by the CHB hospital department of Obstetrics and Gynaecology. Permission to conduct the study was obtained from the hospital superintendent.

Ethical clearance was obtained from the Human Research Ethics Committee (Medical) for the University of the Witwatersrand.

Protocol Number M060437, R14/49 Sayed/Buchmann. (Appendix 4)

3. Results

3.1 Overview

A random sample of 3600 patient records yielded 464 with one or more prior CS. Records of 10 patients with second-trimester medical termination of pregnancy, and one postnatal referral were excluded (Figure 1).

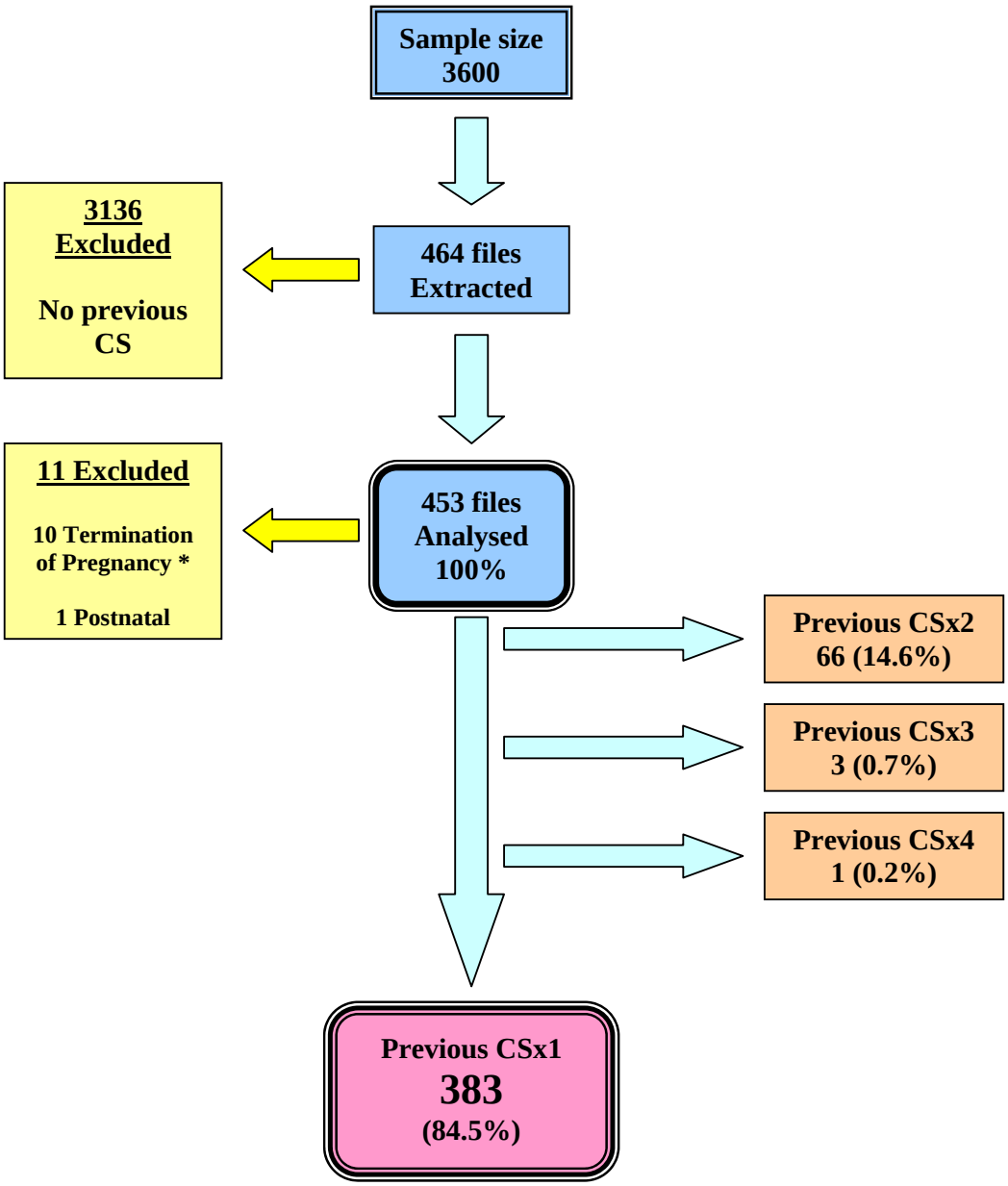

Figure 1. Data sampling and screening to identify records suitable for analysis.

*Birth weight 300-870g, 6 hysterotomies (4 intra-uterine fetal death, 1 pre-eclampsia and 1 anencephaly), and 4 VBAC (misoprostol induction of labour for intra-uterine fetal death).

Delivery outcomes of the remaining 453 patients are listed in Table 1. One-third of patients with one or more prior CS had VBAC (152/453). Conversely, two-thirds (301/453) had a repeat CS. One-third of these were elective (97/301), with 45% of all patients with one or more prior CS having an emergency procedure (204/453).

Table 1. Delivery outcomes grouped according to number of previous CS.

	ERCS	EmCS	Failed VBAC	Successful VBAC	Total
Previous CSx1	**57 (14.9%)**	**39 (10.2%)**	**139 (36.3%)**	**148 (38.6%)**	**383**
Previous CSx2	37 (56%)	25 (37.9%)	0	4 (6.1%)	**66**
Previous CSx3	2	1	0	0	**3**
Previous CSx4	1	0	0	0	**1**
Total	97	65	139	152	**453**

3.2 Delivery outcomes

Three hundred and eighty three records were analysed in detail (Figure 2). There were 39 patients who had an emergency CS after an unplanned event precluding TOL (Table 3), and 4 patients having a clear indication for repeat CS (Table 4). From the remaining 340 patients who were eligible for VBAC, 287 **(84.4%) attempted TOL** (148 were successful and 139 had a failed VBAC). Fifty-three patients (15.6%) had ERCS. Therefore, **VBAC success was 51.6%** (148/287).

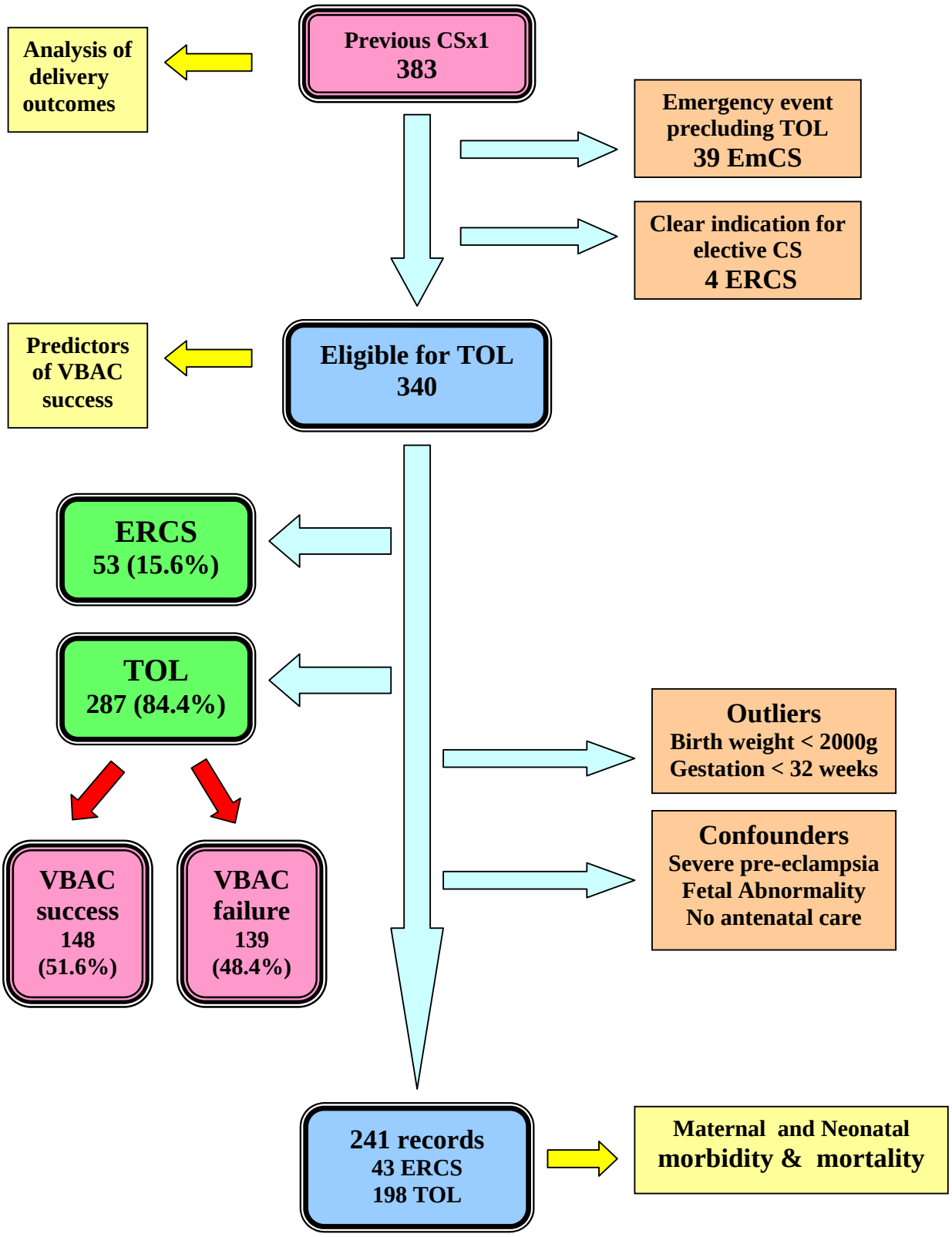

Figure 2. Methodological steps of data processing and analysis.

3.2.1 Indications for prior CS

Indications for the prior CS are listed in Table 2. The indications in order of decreasing frequency were : CPD (35%), fetal distress (14.4%), breech presentation (10.7%), hypertension (9.7%), twins (3.7%), failed induction of labour (IOL) (2.1%), other malpresentation (oblique or transverse lie 1.6%), placenta praevia (0.8%) and placental abruption (0.3%). The indication was unknown in 21.1% of cases.

Table 2. Indications for previous CS in patients with one prior CS.

Indication	EmCS n=39	ERCS N=57	Failed VBAC n=139	Successful VBAC n=148	Total n=383 (%)
Failed induction of labour	0	0	4	4	8 (2.1)
Breech	4	5	10	22	41 (10.7)
Malpresentation	1	2	0	3	6 (1.6)
Twins	3	0	6	5	14 (3.7)
Fetal distress	7	9	22	17	55 (14.4)
Hypertension	7	11	9	10	37 (9.7)
Placenta praevia	0	1	1	1	3 (0.8)
Cephalo-pelvic disproportion	12	13	65	44	134 (35.0)
Placental abruption	0	1	0	0	1 (0.3)
Unknown	8	12	20	41	81 (21.1)

3.2.2 Indications for EmCS

Indications for the 39 EmCS, in patients unsuitable for TOL, are listed in Table 3. Since the indications for EmCS were not mutually exclusive, 53 were recorded. It was difficult to determine from the records which of these patients had a failed TOL with a subsequent emergency repeat CS, or an ERCS, since patients either presented with spontaneous labour or required expeditious delivery. Some of this group of patients were further complicated by iatrogenic or spontaneous preterm delivery. Almost half of the patients in this subgroup (19/39) had a pregnancy complicated by hypertension. All of the remaining patients had other obstetric or medical contraindications to a vaginal delivery. We therefore excluded this subgroup from further analysis.

Table 3. Indications for emergency caesarean section (EmCS), n=39.

Indications	n*
Suspected classical / unknown scar	1
Breech	12
Transverse / oblique lie	2
Twins	2
Pre-eclampsia	16
Eclampsia	3
Maternal medical problem	1
IUGR	6
Fetal distress	6
Cord prolapse	3
Suspected abruptio placenta	1

* There were 53 indications recorded as 14 patients had more than 1 indication for EmCS.

3.2.3 Indications for ERCS

Indications for the 57 ERCS are listed in Table 4. Patients with clear indications for ERCS were excluded from further analysis (2 twin gestations and 2 breech presentations).

Table 4. Indications for elective caesarean section (ERCS), n=57.

Indications	n
Patient request	12
Post dates pregnancy	19
PIH	16
Twins *	2
Breech *	2
IUGR	2
Fetal macrosomia	4

* Excluded from final analysis

3.2.4 Reasons for failed VBAC

Indications for emergency repeat CS, following failed VBAC, are shown in table 5. Four patients from this subgroup of 139 had more than one indication. Prolonged latent phase of labour (PLPL) (33.8%), poor progress in active phase of labour (24.5%), suspected fetal distress (27.3%), and prelabour rupture of membranes (PROM) (6.5%) were the most common reasons for failed VBAC.

Augmentation of labour in patients with a prior CS is not practised at CHB hospital, therefore all TOL with PLPL and PROM were delivered by emergency CS.

Table 5. Indications for emergency repeat CS after failed VBAC (n=139).

Indication	n	% of VBAC Failure
Prelabour rupture of membranes	9	6.5
Prolonged latent phase of labour	47	33.8
Poor progress in active phase	34	24.5
Poor progress in 2nd stage	8	5.6
Fetal distress	38	27.3
Antepartum haemorrhage	3	2.2
Suspected uterine rupture	4	2.9

3.3 Predictors of VBAC success

3.3.1 Demographic Factors

Table 6 demonstrates that there was no difference in maternal age between the successful and failed VBAC groups. There was however, a significantly higher parity, lower gestation, and lower birth weight for successful compared to failed VBAC.

Table 6. Demographic variables affecting VBAC success.

	Successful VBAC n=148	Failed VBAC n=139	P value
Age mean±SD	29.5 (±5.9)	28.3 (±5.5)	0.06
Parity Mean (range)	1.80 (1-5)	1.43 (1-4)	**<0.001**
Gestational age mean±SD	37.2 (±3.0)	38.7 (±2.0)	**<0.001**
Birth weight (g) mean±SD	2909 (±654)	3207 (± 507)	**<0.001**

At a gestation <34 weeks the VBAC success rate is 89%, and this decreases to 56% at ≤39 weeks. At >40 weeks gestation the ratio of VBAC success to failure reverses (33%). This difference was significant (p<0.001) on stratified analysis (Figure 3).

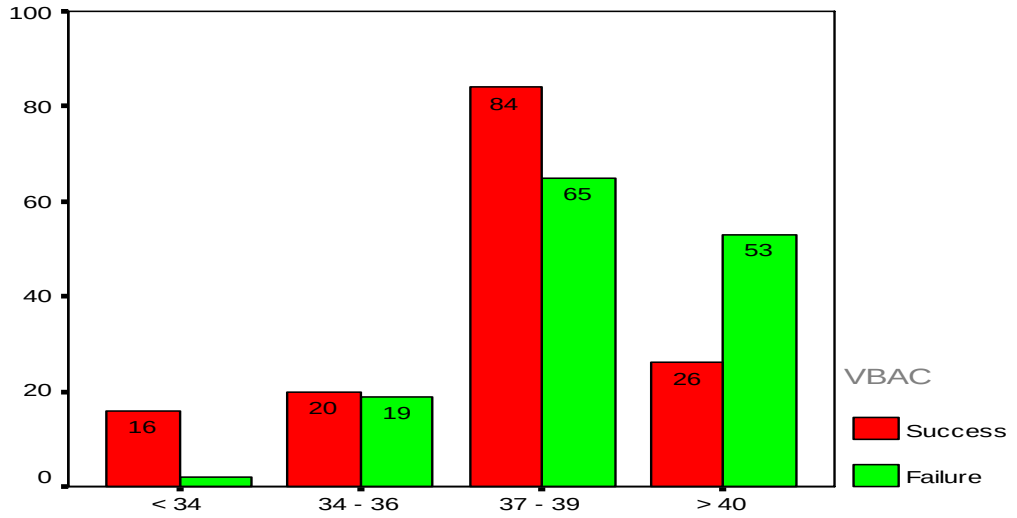

Figure 3. VBAC success according to gestation intervals (p<0.001).

The VBAC success to failure pattern is similar for birth weight (Figure 4). VBAC success at a birth weight <2000g is 93% and declines to 52% at ≤3499g. The ratio is reversed at a birth weight >3500g (38%), and is low at >4000g (22%). This difference was also significant (p<0.001) on stratified analysis.

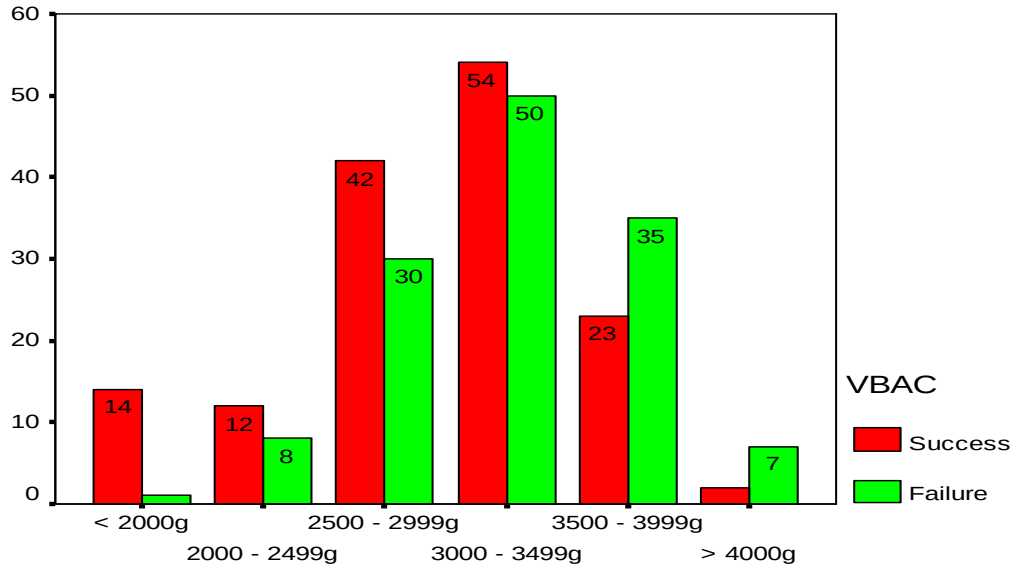

Figure 4. VBAC success according to birth weight intervals (p<0.001).

Table 7 demonstrates that in this study, HIV seropositivity, and certain care related factors did not differ significantly between the VBAC success and VBAC failure groups. (All p>0.05 in this analysis.)

Table 7. The effect of HIV seropositivity and antenatal care-related variables on VBAC Success.

	Failed n=139 (%)	Successful n=148 (%)	OR (95% CI)	p value
HIV seropositive	44 (31.7)	39 (26.4)	0.77 (0.45–1.33)	0.322
No antenatal booking	5 (3.6)	11 (7.4)	2.15 (0.67-7.32)	0.157
Primary or secondary level care only	25 (18.0)	23 (15.5)	0.84 (0.43-1.63)	0.579
Presence of antenatal sonar	72 (51.8)	70 (47.3)	0.84 (0.51-1.36)	0.446

3.3.2 Obstetric history

The presence of a previous vaginal delivery before the first CS, or a previous vaginal birth after the first CS (VBAC) proved to be independently predictive for successful VBAC (OR 2.32 and 1.93 respectively). The relationship was explored further by combining the two individual variables in a statistical analysis. This identified the patient with no prior vaginal deliveries as having the lowest likelihood of successful VBAC (OR 0.34; 95% CI 0.20-0.58) (Table 8).

Table 8. The effect of previous vaginal delivery on VBAC success.

	Failed VBAC n=139 (%)	Success VBAC n=148 (%)	OR (95% CI)	p value
Previous vaginal delivery	22(15.8)	45(30.4)	2.32 (1.31-4.13)	**0.004**
Previous VBAC	18(12.9)	33(22.3)	1.93 (1.03-3.62)	**0.038**
No previous vaginal delivery	103(69.6)	73(49.3)	0.34 (0.20-0.58)	**<0.001**

The indications for previous CS in patients who attempted TOL are summarised in Table 9. Previous CPD was a negative predictor of VBAC success (OR 0.48; 95% CI 0.30-0.78), while a previous CS for malpresentation was a positive predictor (OR 2.62; 95% CI 1.15-6.12). The effect of previous CS for fetal distress or hypertension was not statistically significant.

Table 9. The effect of indications for previous CS on VBAC success.

Indications for prior CS	Failed n=139 (%)	Successful n=148 (%)	OR (95% CI)	p value
Cephalo-pelvic disproportion	65 (46.8)	44 (29.7)	**0.48 (0.30 – 0.78)**	**0.003**
Fetal distress	22 (15.8)	17 (11.5)	0.69 (0.35 – 1.36)	0.283
Malpresentation	10 (7.2)	25 (16.9)	**2.62 (1.15 – 6.12)**	**0.012**
Hypertension	9 (6.5)	10 (6.8)	1.05 (0.38 – 2.91)	0.924

3.4 Maternal and neonatal adverse outcomes

Although this study was not designed to show differences in adverse maternal or neonatal outcomes, no study of this nature is complete without some mention of morbidity and mortality.

The sample included no maternal deaths. There were two symptomatic uterine ruptures in patients attempting TOL and therefore, a 0.7% uterine rupture rate (2/287). Similarly, there were two asymptomatic uterine dehiscences in patients with failed VBAC. There were four hysterectomies, 2 associated with uterine rupture following failed TOL, one with haemorrhage after failed TOL and a subsequent emergency repeat CS, and one with haemorrhage following an EmCS in a patient not suitable for TOL. This represents a 1% hysterectomy rate (4/383).

Before analysing neonatal morbidity or mortality however, it was necessary to remove the confounding effects of prematurity, in order to isolate the effects of TOL and ERCS on these outcomes. Gestational age distribution in this study was skewed towards the right (Figure 5), with a mean (±SD) of 37.8 (±2.9) weeks. Therefore, patients with a gestational age of more than 2 standard deviations below the mean, i.e. <32 weeks, were excluded from the final analysis of adverse events.

Since gestational age and birth weight correlated in only 74.3% of cases in this study (Pearson correlation $r = 0.743$, $p<0.01$), we analysed these two variables separately. In order to avoid the confounding effects of low birth weight on adverse neonatal events, the final analysis was confined to women with a gestational age of 32 weeks or more, as well as a birth weight of 2000g or more.

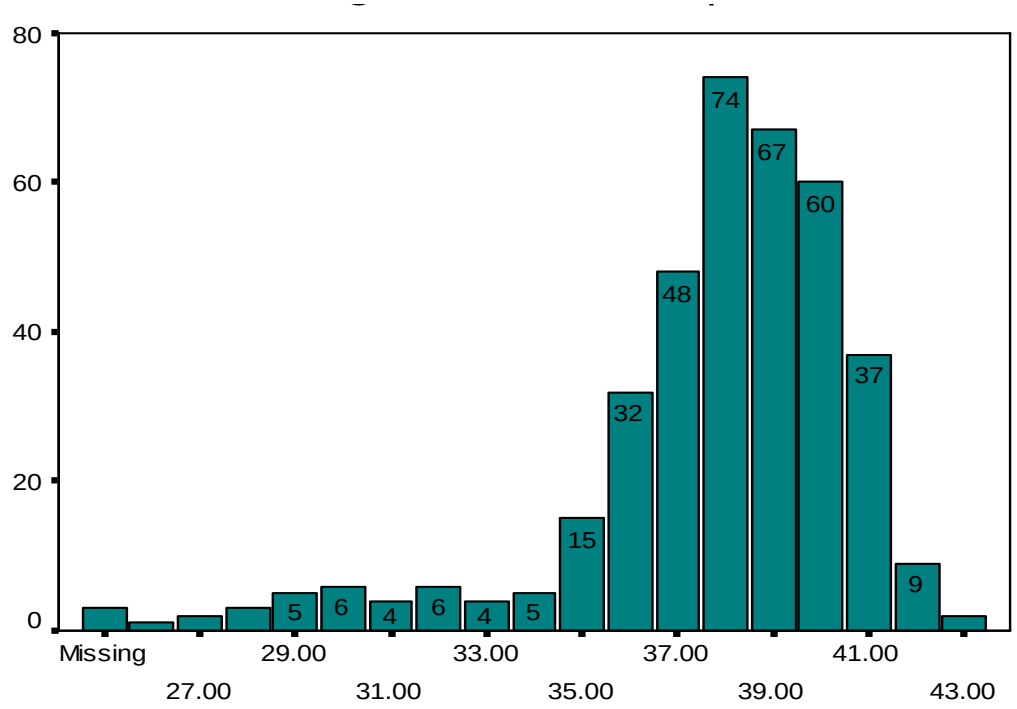

Figure 5. Gestational age distribution in patients with one previous CS.

Birth weight also deviated from the normal distribution curve, and was skewed to the right (Figure 6). The mean (±SD) for birth weight was 2993g (±658). Therefore patients with birth weights <2000g (less than 1.5 SD from the mean) were excluded.

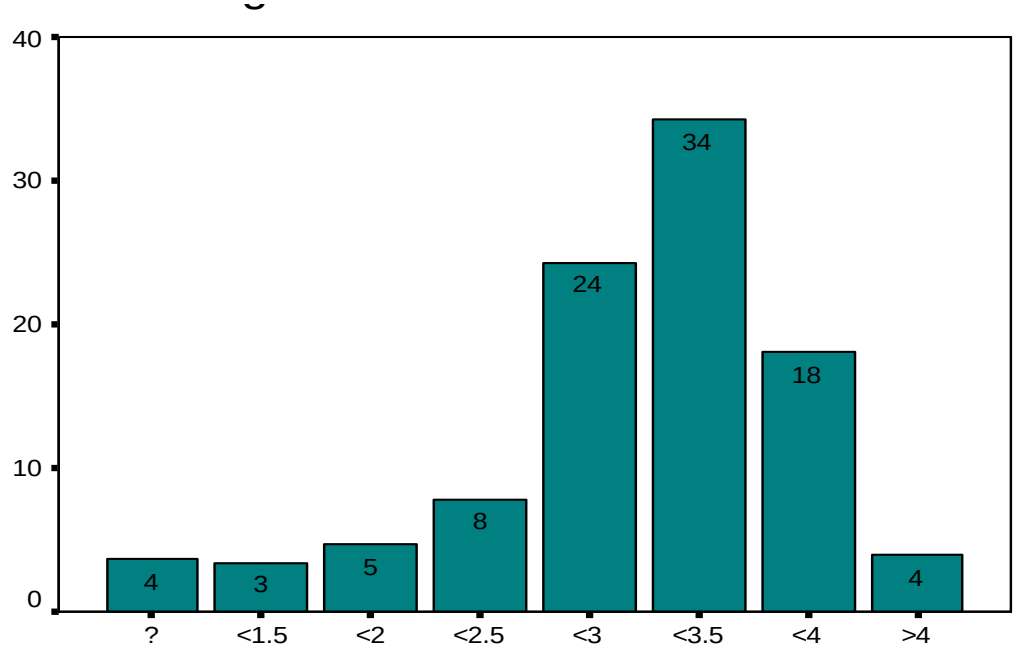

Figure 6. Birth weight distribution in patients with one previous CS.

Demographic factors such as patients not booking for antenatal care, and antenatal care at lower-level facilities than CHB hospital, were identified as possible confounders. Three neonates with hydrocephalus were also identified post partum. These patients were therefore excluded from the final analysis.

After removing all identified outliers and possible confounding factors, we were left with 241 patients (from an initial 383) comprising ERCS (n=43) and TOL (n= 198). The TOL group was further divided into two subgroups, successful and failed VBAC (n=99 and n=99 respectively), for further analysis of adverse outcomes.

Adverse events were analysed looking in turn at maternal (Table 10) and then neonatal (Table 11) indicators of morbidity and mortality. Outcomes are listed both before and after removing confounders, outliers, and patients that were not eligible for TOL, in order to allow for comparison. Statistical analysis however, was only carried out on the corrected variables. These included differences between the ERCS (n=43) and the TOL (n=198) groups, and differences between the successful (n=99) and failed (n=99) VBAC groups.

The analysis showed no maternal morbidity or mortality (0/43) in the ERCS group when compared to the TOL group (16/198). This suggest that patients who elected to have TOL at more than 32 weeks gestation or with a neonatal birth weight of more than 2000g, had an increased chance of having one or more indicators of morbidity. Therefore, the relative risk of overall maternal morbidity for TOL in this study, was RR of 1.24 (95% CI of 1.16-1.32, Fisher exact p=0.038).

Table 10. Adverse Maternal outcomes according to mode of delivery.

Indicators of maternal morbidity	Observed				Corrected *		
	EmCS n=39	ERCS n=57	VBAC failure n=139	VBAC Success n=148	ERCS n=43	VBAC failure n=99	VBAC Success n=99
Uterine rupture	0	0	2	0	0	2	0
Uterine dehiscence	0	0	2	0	0	2	0
Hysterectomy	1	0	3	0	0	2	0
Blood transfusion	2	0	6	1	0	4	0
Sepsis	0	0	5	3	0	4	2

*** After correcting for confounding factors including severe pre-eclampsia, eclampsia, congenital abnormalities, gestation <32 weeks, birth weight <2000g and other obstetric contraindications to TOL.**

This effect was more marked (RR 1.87) when comparing maternal morbidity indicators between the failed and successful VBAC groups, (14/99 compared to 2/99). (95% CI 1.47 -2.39, χ^2 =9.79, p=0.002). This suggests that the patient who attempts TOL and fails has an increased risk for maternal morbidity.

Indicators of serious maternal morbidity included two uterine ruptures and two hysterectomies (failed VBAC). These numbers were too small for meaningful individual statistical analysis. The analysis of other individual indicators of maternal morbidity (ERCS vs. TOL and failed vs. successful VBAC) were also not significant (Fisher exact test, p>0.05).

Table 11. Adverse Neonatal outcomes according to mode of delivery.

Indicators of neonatal morbidity	Observed				Corrected *		
	EmCS n=39	ERCS n=57	VBAC failure n=139	VBAC success n=148	ERCS n=43	VBAC failure n=99	VBAC success n=99
Five-minute Apgar 0-3	0	0	1	1	0	1	0
Five-minute Apgar 4-6	4	1	3	7	0	2	4
Neonatal ICU admission	14	3	4	19	0	3	4
Intrapartum fetal death	0	0	2	1	0	0	1
Early neonatal death	0	0	0	2	0	0	0

***After correcting for confounding factors including severe pre-eclampsia, eclampsia, congenital abnormalities, gestation <32 weeks, birth weight <2000g and other obstetric contraindications to TOL.**

TOL patients had a RR of 1.23 of having an adverse neonatal outcome when compared with ERCS patients (15/198 compared to 0/43), 95% CI of 1.16-1.32, Fisher exact p=0.048. While there was an apparently lower adverse neonatal outcome in the failed compared to the successful VBAC group (6/99 compared to 9/99), this was not significant (p=0.420).

Analysis of individual indicators of neonatal morbidity between both the ERCS and TOL groups, and between the failed and successful VBAC groups, were not significant (Fisher exact test, p>0.05).

4. Discussion

Research with regard to the elective CS versus trial of labour debate, for suitable patients with prior CS, is very relevant in the South African setting since there are only a few small studies in the literature from developing countries on this topic (Van der Walt 1994, Tripathi 2006).

Chris Hani Baragwanath hospital has a massive patient load with over 20 000 deliveries per annum at present. It serves a low-income urban population. This retrospective cohort study represents a 6% random sample over a three year period (January 2003 to December 2005), from a single tertiary referral centre in the South African public health sector. With a current CS rate of 25% of all deliveries at our hospital, VBAC remains an important means of attempting to stabilise the increasing CS rate.

While the private health sector in South Africa mirrors developed countries in terms of resources available, the public health sector remains under resourced both in terms of personnel and in terms of equipment. It is therefore inappropriate for developing countries to rely on evidence from developed countries, in order to plan healthcare services for our patients with previous CS. Furthermore, adverse outcomes related to uterine rupture after TOL, are dependant on time, place and size of the population studied (Chauhan 2003). This would imply that it is imperative to repeatedly analyse the outcomes of VBAC in South Africa.

This study provides information that is relevant to our unique patient profiles and the various constraints under which we work in the South African public health sector.

We have shown that, contrary to the pattern seen in the developed world, a larger percentage of our patients with one prior CS (74.9%) opted for TOL in the next pregnancy. By comparison, the VBAC attempt rate was 60.6% in Rageth's study from Switzerland (1999), 52.9% in McMahon's study from Canada (1996) and 53.1% from Landon's study in the USA (2004).

This might be one of the reasons why VBAC success is lower than expected in this study (52% compared to 60-80% from other studies). This also meant that just under half (46.5%) of all patients with a prior CS had an emergency CS.

In the literature review, it was found that emergency repeat CS in patients with a prior CS is associated with complications, resulting in increased maternal and neonatal morbidity. Consequences like emergency after-hours anaesthetic and theatre requirements, maternal high-care or ICU admissions, long neonatal admissions to ICU and the incalculable costs of long-term neonatal morbidity secondary to neurological disabilities, translate into significantly increased costs to the health-care system. Therefore, a high emergency CS rate is of particular concern in our setting.

Furthermore, at least 40% of patients having an emergency CS (PROM or PLPL) may have been amenable to induction or augmentation of labour with oxytocin (SOGC guidelines 2004). A further 24.5% of failed TOL patients (those with poor progress in active phase) may also have been considered for oxytocin augmentation. A small case control study previously carried out at the CHB hospital (Van Gelderen 1986) recommended augmentation of labour in selected patients having TOL.

However, inadequate staffing for one to one intrapartum care and insufficient cardio-tocograph machines for continuous electronic fetal monitoring meant that this is not feasible at present at CHB hospital. Had this option been available, VBAC success may have been improved in this subgroup of patients.

There were no differences between successful and failed VBAC in terms of maternal age, HIV seropositivity, hospital–based antenatal care and the presence of an antenatal ultrasound examination. However, as expected, those with successful VBAC had a higher parity, lower birth weight, and lower gestation at delivery when compared to those with failed VBAC. Our finding of increased VBAC failure with increasing birth weight or gestation matches the findings of existing studies. (Zelop 2001 and Elkousy 2003)

Positive predictors of VBAC success that match findings in the literature review included a previous vaginal birth both before and after the initial CS, a previous CS for malpresentation, and a gestation ≤ 39 weeks at delivery. (Zelop 2000, Macones 2005, Landon 2005 and Cahill 2006) Conversely, negative predictors of VBAC success in this study were patients with no prior vaginal delivery, and a previous CS for CPD, which also reflect existing findings.

We found that VBAC had a lower success rate at a birth weight >3500g. This may be true for the South African setting when considering Van der Walt's study (1994) that showed similar findings for birth weight >3200g. Similarly, Tripathi (2006) reported low VBAC success at a birth weight >3000g in their study from India. Studies in the literature that were conducted in developed countries only reported low VBAC

success at birth weights over 4000g (Landon 2005) and some of up to 4250g (Zelop 2001, Elkousy 2003).

There was no maternal mortality in this study. There was a 0.7% uterine rupture rate (identified separately from asymptomatic uterine dehiscence, which also had a frequency of 0,7%). These adverse outcomes occurred in patients who attempted TOL and had a failed VBAC. There was a 1% hysterectomy rate for all patients with one prior CS. This uterine rupture and hysterectomy rate is comparable however, to all large studies cited in the literature review.

In this study TOL compared to ERCS had an increased risk of having a maternal adverse outcome, including uterine rupture, uterine dehiscence, hysterectomy, haemorrhage requiring blood transfusion or maternal sepsis.

Similarly, TOL had an increased risk of a neonatal adverse outcome, including a five-minute Apgar score<7, neonatal ICU admission, intrapartum fetal death or early neonatal death. Failed VBAC however, had almost double the risk of maternal morbidity when compared to successful VBAC. This was statistically a very significant finding. The results of morbidity and mortality in this study do not differ from evidence in the current literature.

4.1 Implications for research

The world literature still lacks evidence from large, prospective, randomised controlled trials with respect to VBAC. The current evidence determining outcomes, risk factors and current practice trends comes from the analysis of relatively large

databases. It remains important however, that we strive towards prospective randomised trials, to eliminate bias from the results.

Unfortunately, even this may not give us all the answers to the dilemma of elective caesarean delivery versus attempted vaginal birth after caesarean section. It is not always possible to extrapolate findings from studies in well-staffed and well-resourced centres to smaller hospital or less privileged institutions in the developing world.

Ideally however, South Africa requires a collaborative, multi-centred, prospective randomised controlled trial, which can assess the effects of demographic data and obstetric history on VBAC success rates and associated maternal or neonatal adverse outcomes in our setting. Until then, further prospective studies looking at VBAC in South Africa, at this and other centres, will continue to add to evidence on how best to manage this issue of growing importance.

4.2 Implications for practice

This study is reassuring that a policy of VBAC for suitable patients with one prior low transverse CS, is relatively safe at our institution. However, the failed VBAC rate remains high. An improvement in the VBAC success rate would be the key to minimising maternal and neonatal morbidity and mortality.

Firstly, a more stringent selection of patients for TOL is necessary. This means a change in policy for local primary and secondary level facilities to refer patients with a prior CS well before 40 weeks of gestation to CHB hospital for an elective CS. It also implies that the patient with an estimated birth weight in excess of 3500g should

be cautioned about the increased chances of a failed VBAC, with its associated complications. Patients with no previous vaginal delivery must be informed about the low likelihood of VBAC success, particularly in those with a prior CS for CPD.

Secondly, improved staff and equipment quotas might allow for a change in policy towards selective oxytocin induction or augmentation of labour, in patients who clinically do not have cephalo-pelvic disproportion, and present with prelabour rupture of membranes or prolonged latent phase of labour. The small increase in uterine rupture (Landon 2004) will need to be balanced against reducing the current high emergency CS rate.

4.3 Limitations

The retrospective nature of this study introduces a number of limitations. Only information clearly and consistently recorded in the patients' hospital file and antenatal card was available for analysis. This resulted in a number of important variables been left out of the study, including maternal body mass indices, pre-delivery birth weight estimates, cervical dilatation on admission, labour duration and long term neonatal data

It is inappropriate to comment on the influence of HIV on VBAC without assessing patients' immune status independent of seropositivity. This meant that we required CD4 counts and information on anti-retroviral therapy, which was unfortunately not available in a large proportion of the patients studied. With the introduction of a full-scale anti-retroviral therapy roll-out program, this can be rectified in future studies.

Our data on maternal and neonatal adverse outcomes must be interpreted with caution, since very large sample sizes are necessary to adequately assess the infrequent but serious events that lead to death and disability, in particular uterine rupture following TOL. This study was designed to show differences in mode of delivery and subsequently predictive factors for VBAC success. It remains underpowered to show differences in morbidity and mortality.

The findings of this study should only be extrapolated to other facilities in South Africa with similar resources and personnel, in the context of the availability of emergency CS facilities.

4.4 Conclusion

The VBAC success rate at the CHB hospital is lower than those reported from large cohorts in developed countries. A large proportion of our patients attempt TOL, with only a small percentage having ERCS.

This implies that a large proportion of patients are having an emergency CS after a failed VBAC. Patients having TOL in this study had an increased likelihood of maternal and neonatal morbidity, with a significantly higher maternal morbidity in the failed compared to the successful VBAC group. It is therefore possible that an increased number of patients should be having ERCS.

Antenatal counselling of patients needs to highlight the increased risk of maternal and neonatal morbidity with TOL compared to ERCS. The relative safety of VBAC after one prior caesarean section therefore, can only be justified if ongoing attempts are made to reduce the chances of a failed VBAC.

This implies that a more stringent selection of patients for TOL is warranted. This study suggests that VBAC success was higher in patients with birth weights <3500g, gestational age ≤ 39 weeks, prior vaginal delivery (before or after previous CS) and in those patients with a previous CS for malpresentation.

A possible change in policy toward selective induction of labour in patients with prelabour rupture of membranes, or augmentation of labour in those with prolonged latent phase of labour, can only be considered if staffing and equipment shortages are corrected.

Overall the research is reassuring of the feasibility of an ongoing policy, at Chris Hani Baragwanath hospital, of trial of labour for suitable patients with one previous caesarean section.

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Appendix 1 : Data capture sheet.

Record No.								
Delivery plan TOL / ERCS								
Reason for ERCS								
Age								
Gestation								
HIV								
Fetal Weight								
Previous Vaginal delivery								
Previous VBAC								
Indication previous CS								
Adverse effects								
Reasons for Failed VBAC								
Final mode of delivery								

Appendix 2 : Key to data capture sheet.

Key to Data Capture Sheet

Final mode of delivery

A- VBAC
B- ERCS
C- Failed VBAC
D - Emergency CS
E- Ventouse Assisted VBAC
F- Forceps Assisted VBAC

Reasons for ERCS

A- Maternal request
B- Post dates
C- Maternal medical condition
D- Fetal condition (medical/malpresentation/ multiple gestation)

Indications for previous CS

A- Dystocia (specify : Cephalo-Pelvic Disproportion (CPD), fetal macrosomia, slow progress, failed IOL, failed assisted delivery)
B- Malpresentation (specify : Breech, Transverse)
C- Suspected fetal Distress
D- Other fetal or maternal indication (specify : antepartum haemorrhage (APH), Pre-eclampsia, Intra-uterine Growth Restriction (IUGR), Twins)

Adverse effects

A- Maternal death
B- 5 min Apgar score 0-3
C- 5 min Apgar score 4-7
D- Neonatal ICU admission
E- Fetal intrapartum death
F- Neonatal death
G- Uterine rupture
H- Uterine dehiscence
I- Hysterectomy
J- Haemorrhage
K- Blood transfusion
L- Maternal sepsis

Reasons for failed VBAC

A- PROM
B- PLPL
C- Poor progress in labour
D- Failed assisted delivery
E- Suspected fetal distress
F- Suspected uterine rupture

Appendix 3 : Epi-Info computer data capture sheet.

Appendix 4 : Ethics clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Sayed/Buchmann

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M060437**
PROJECT	Delivery after a Previous Caesarean Section at the Chris Hani Baragwanath Hospital
INVESTIGATORS	Dr/Prof MS/EJ Sayed/Buchmann
DEPARTMENT	Obstetrics & Gynaecology
DATE CONSIDERED	06.05.05
DECISION OF THE COMMITTEE*	Approved subject to using the Tara consent form and Hospital Superintendents' writtne permission (submit a copy)

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 06.05.08 **CHAIRPERSON** .....

pp (Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof MJ Buchmann

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Sayed/Buchmann

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M060437**
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INVESTIGATORS	Dr/Prof MS/EJ Sayed/Buchmann
DEPARTMENT	Obstetrics & Gynaecology
DATE CONSIDERED	06.05.05
DECISION OF THE COMMITTEE*	APPROVED UNCONDITIONALLY

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 07.06.25 **CHAIRPERSON** .....
(Professors PE Cleaton-Jones, A Dhai, M Vorster, C Feldman, A Woodiwiss)

*Guideli ...ched where applicable

cc: Sup

.....

.....

DECLA

To be cc ...rned to the Secretary at Room 10005, 10th Floor, Senate H