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Clinical interventions that increase the uptake or success of vaginal birth after caesarean section: a quantitative systematic review

Abstract

Aim

To review clinical interventions that increase the uptake and/or the success rates of vaginal birth after caesarean section.

Background

Repeat caesarean section is the main reason for the increase in surgical births. The risk of uterine rupture in women who have prior caesarean sections prevents many clinicians from recommending vaginal birth after caesarean. Despite this, support for vaginal birth after caesarean continues.

Data Sources

A search of five databases and a number of relevant professional websites was undertaken up to December 2008.

Review methods

A systematic review of quantitative studies that involved a comparison group and examined a clinical intervention for increasing the uptake and/or the success of vaginal birth after caesarean section was undertaken. An assessment of quality was made using the Critical Skills Appraisal Programme.

Results

Induction of labour using artificial rupture of membranes, prostaglandins, oxytocin infusion or a combination, was associated with lower vaginal birth rates. Cervical ripening agents such as prostaglandins and transcervical catheters may result in lower vaginal birth rates compared with spontaneous labour. The impact of epidural anaesthesia in labour on vaginal birth after caesarean success is inconclusive. X-ray pelvimetry is associated with reduced uptake of vaginal birth after caesarean and higher caesarean section rates. Scoring systems to predict likelihood of vaginal birth are largely unhelpful. There is insufficient data in relation to vaginal birth after caesarean success between different closure methods for the primary caesarean section.

Conclusion

Clinical factors can affect vaginal birth after caesarean uptake and success.

Keywords: Vaginal birth after caesarean section, caesarean section, systematic review, literature review, Hospitals, maternity, intervention studies

Summary statement

What is already known about this topic?

- There is a high caesarean section rate around the world, and a high proportion of this is women electing to have an elective repeat caesarean.
- There is considerable variation in regard to acceptance, uptake, support and success of women undergoing VBAC.

What this paper adds

- Induction of labour using artificial rupture of membranes, prostaglandins, oxytocin infusion and various combinations of these methods, is often associated with a lower VBAC success rate.
- Cervical ripening agents such as prostaglandins and transcervical Foley catheters may result in a lower VBAC success rate compared with women who labour spontaneously.
- Women who have x-ray pelvimetry have a reduced uptake of VBAC, and higher caesarean section rates.
- Scoring systems devised to predict VBAC success are largely unhelpful.

Implications for practice and/or policy:

- Clinicians need to show caution when inducing or augmenting women who have had a previous caesarean section.
- X-ray pelvimetry and scoring systems to predict VBAC success should not be used exclusively to direct clinical practice.

Introduction

Many women opt for repeat caesarean after a primary caesarean section (CS) (Thomas and Paranjothy 2001; Guise, McDonagh et al. 2003). Rates of vaginal birth after caesarean section (VBAC) vary, for example 16.6% in Australia and 33% in the UK (Thomas and Paranjothy 2001; Laws, Grayson et al. 2006). In the United States of America (USA), a large study found women attempting a vaginal birth after a prior CS had at least a 73% likelihood of success (Landon, Hauth et al. 2004). The United Kingdom (UK) National Sentinel Caesarean Section Audit demonstrated variation between units of 6 to 64% (Thomas and Paranjothy 2001). Possible reasons behind the low uptake and success of VBAC include women's fear of uterine rupture in a subsequent labour and birth; health care provider fears of offering any choice other than a repeat caesarean; fear of litigation, and convenience, amongst others. Caesarean section has also been demonstrated in Australia as a preferred, safe and 'ordered' option in discourses with women (Bryant, Porter et al. 2007). Nonetheless, other studies have a found that a trial of labour is cost-effective (as opposed to an elective CS) and provides a higher quality of life (Traynor and Peaceman 1998; Guise, McDonagh et al. 2003).

Maternal preference is undoubtedly a factor in the rising rates of CS (Kerr-Wilson 2001). Women often fear the pain of a vaginal birth (Weaver, Statham et al. 2007), have concerns regarding the safety of their babies (Villar, Carroli et al.), postpartum sexual function (Lin and Xirasagar 2005) and may perceive an inadequacy of care (McCourt, Weaver et al. 2007). A UK study found only a few women request a caesarean in the absence of clinical indications, although maternal request was perceived by obstetricians to be a major factor in driving the CS rate (Weaver, Statham et al. 2007). The same study found women's psychological issues and perceptions of risk were significant factors in many maternal requests for repeat CS.

Caesarean section poses significant short and long term risks to both women and babies (Morrison, Rennie et al. 1995; MacDorman and Singh 1998; Smith, Pell et al. 2004; Villar, Valladres et al. 2006; Ritcher, Bergmann et al. 2007). Women have a greater risk of morbidity and mortality when having a caesarean section compared with a vaginal birth (Lydon-Rochelle, Holt et al. 2000; Lumbiganon, Laopaiboon et al. 2010). Lydon-Rochelle et al., (2000) found women who had CS were significantly more likely to be readmitted to

hospital for uterine infection, obstetrical surgical wound complications, and cardiopulmonary and thromboembolic conditions.

We have undertaken an extensive review of the literature (Catling-Paull, Johnstone et al. 2010) as there are no systematic reviews specifically addressing the promotion or success of VBAC. Studies reporting interventions designed to promote the uptake or success of VBAC were identified and evaluated. They broadly fell into two categories, that is, clinical and non-clinical interventions. This paper reports the clinical interventions.

Method of review

Aim

The aim of this review was to identify the clinical interventions that increase the success and/or uptake of VBAC. These interventions can occur before, and during, pregnancy and during labour.

Design

A systematic review of quantitative studies was performed using the Cochrane guidelines for a systematic review (Higgins and Green 2009) with particular variations. These involved the inclusion of a greater range of studies than solely randomised controlled trials (RCT).

Search methods

The PICO principles (population, intervention, comparison and outcome) were used to formulate clinical questions that guided the search strategy. The questions were: What is the uptake and success rates of VBAC (O) for women who have had a previous caesarean section (P) comparing a range of interventions (I) compared with no intervention or different interventions (C). Essentially, we were interested in what makes a difference to the VBAC uptake and success rates.

An unrestricted search of CDSR (Cochrane Database of Systematic Reviews), CINAHL (Cumulative Index to Nursing & Allied Health), Ovid MEDLINE(R), MIDIRS (Maternity and Infant Care), and PsycINFO was undertaken to determine any studies that evaluated an intervention for VBAC. Government health websites and obstetric and midwifery

professional organisation websites were searched. Reference lists of relevant articles, including any guidelines and reviews, were also examined. The inclusion criteria was all studies written in English that evaluated an intervention for increasing either the uptake of and/or the success of VBAC; involved a comparison group (randomised controlled trials, cohort studies, case control studies and before and after studies); and, published up to December 2008. Studies that did not report VBAC uptake or success rates were excluded. Only primary sources were considered appropriate for this review. Systematic reviews were used to source further publications but were excluded as they were not primary sources.

Keywords used: "Intervention" and "Pregnancy Outcome" with "Vaginal Birth After C(a)esarean/Caesarian", "VBAC", "Trial of Labo(u)r ", "C(a)esarean/Caesarian Section", and "C(a)esarean/Caesarian Section, repeat".

Quality appraisal

Studies were rated using the Critical Appraisal Skills Programme (CASP) (Public Health Resource Unit, 2007). CASP is a specifically developed, internationally-used, critical appraisal tool, designed to encourage an evidence-based approach to health and social care. Quality scores for the cohort studies were: <5 – Poor, 6-9 – Fair, and 10-12 – Good. A similar grading out of 10 points was given for the randomised controlled trials. Studies deemed poor were evaluated by a second reviewer to confirm the rating and thus their exclusion. This resulted in two studies moving from poor to fair. Finally, 31 studies were deemed 'good', 30 'fair' and 17 'poor'. Hence, there were 61 included studies rated as 'good' or 'fair'. Of these, 27 addressed non-clinical interventions and 34 addressed clinical interventions (Figure 1). The 34 studies reporting clinical interventions are reviewed in this paper.

Data abstraction and synthesis

Data were extracted by three independent reviewers. After the search, studies reporting clinical interventions were grouped by study intervention which identified eight major categories to increase the uptake and/or success of VBAC. A narrative summary was then undertaken to report the findings. A meta-analysis was not undertaken due to the heterogeneity and insufficient number of studies.

Most studies provided limited statistical details. Many only reported p-values, rather than 95% confidence intervals. Despite this, these studies were included as excluding them would have severely limited the review.

Findings

Thirty-four papers were identified that met the inclusion criteria. This included six randomised controlled trials (RCT) testing clinical interventions for increasing VBAC uptake or success. There were 18 retrospective and 10 prospective cohort studies (Table 1).

The main categories were induction/augmentation of labour, the use of imaging (e.g. X-ray), evidence-based criteria (e.g. scoring systems), closure of primary CS, and epidural use in labour. After CASP rating, the studies in the categories of partograms and cervical dilation patterns, ultrasonography, and waterbirth were excluded as no studies met the inclusion and quality criteria. These are not discussed further.

Induction / augmentation of labour

The induction and augmentation of labour category had the largest number of studies. Six studies were excluded after a poor CASP rating (Horenstein, Eglinton et al. 1984; Lao and Leung 1987; Chua, Arulkumaran et al. 1989; Coltart, Davies et al. 1990; Sakala, Kaye et al. 1990; Ben-Aroya, Hallak et al. 2002) which left 18 studies. This category was sub-classified into *Prostaglandin use / cervical ripening, Induction of labour (various methods), Oxytocin use (IOL or augmentation),* and *Other methods.* Uptake rates of VBAC are not assessed in these studies as all studies compared either, methods of augmentation or induction to one another, or to women in spontaneous labour. VBAC success rate is the reported outcome of interest within this category.

Prostaglandin use / cervical ripening

The use of cervical ripening agents was tested in two RCTs (Taylor, Sellers et al. 1993; Rayburn, Gittens et al. 1999) and five cohort studies (Blanco, Collins et al. 1992; Flamm, Anton et al. 1997; Bujold, Blackwell et al. 2004; Hoffman, Sciscione et al. 2004; Yogev, Ben-Haroush et al. 2004).

Rayburn and others (1999) randomised 294 women to either receive a weekly dose of 0.5mg intracervical prostaglandin E2 gel from 39 to 41 weeks or be managed expectantly. Oxytocin was used in both groups for augmentation or induction as needed after 41 weeks. There was no difference in VBAC rates with a rate of 49 percent in both intervention and expectant groups. Taylor et al. (1993) randomised 42 women to receive either vaginal prostaglandin E2 (PGE2) followed by amniotomy three hours later or amniotomy and intravenous oxytocins. Women had been advised to have an induction of labour due to pre eclampsia or post dates pregnancy. This trial found no differences in the rate of VBAC. One woman from the prostaglandin group had a uterine rupture.

Most of the cohort studies compared different cervical ripening agents (Blanco, Collins et al. 1992; Flamm, Anton et al. 1997; Hoffman, Sciscione et al. 2004; Yogev, Ben-Haroush et al. 2004), or Foley catheter (Bujold, Blackwell et al. 2004; Hoffman, Sciscione et al. 2004) to spontaneous labour. Two of these showed no difference in VBAC rates between the groups (Blanco, Collins et al. 1992; Yogev, Ben-Haroush et al. 2004), but both had small numbers of women who received PGE2. Three cohort studies demonstrated that spontaneous labour was associated with a higher VBAC success rate than women who had undergone cervical ripening (Flamm, Anton et al. 1997; Bujold, Blackwell et al. 2004; Hoffman, Sciscione et al. 2004). Success rates for women who underwent cervical ripening ranged from 46% (Hoffman, Sciscione et al. 2004) to 56% (Bujold, Blackwell et al. 2004).

Induction of labour (various methods)

Four cohort studies assessed whether or not induction of labour (IOL) affected VBAC rates. IOL methods included artificial rupture of membranes (ARM), prostaglandins, oxytocin infusions and combinations of these methods. The studies grouped women into ‘induction of labour’ and compared them with those who laboured spontaneously (Rageth, Juzi et al. 1999; Sims, Newman et al. 2001; Delaney and Young 2003), whilst one study compared three different methods of induction (Pathadey, Van Woerden et al. 2005).

Three of the four studies comparing IOL with spontaneous labour reported that induction was associated with a lower VBAC success rate (Rageth, Juzi et al. 1999; Sims, Newman et al. 2001; Delaney and Young 2003). The largest of these studies was by Rageth et al. (1999) and included 17,613 women, 2,459 of whom were induced. The VBAC success rate for women undergoing IOL was 66% compared with 75% in women who laboured spontaneously.

One study compared three different methods of inducing labour: ARM, oxytocin infusion and prostaglandins (Pathadey, Van Woerden et al. 2005). The study was small, only 81 women in total, with three receiving oxytocin. No findings reached statistical significance although there was a trend towards higher rates of successful VBAC in women who had undergone an ARM for IOL (with or without oxytocin) compared with those who received prostaglandins.

Oxytocin use

Five cohort studies addressed the use of oxytocin for either IOL or augmentation. One study (Flamm, Newman et al. 1990) grouped all women who received oxytocin regardless of the indication and compared them with women who did not receive oxytocin. Flamm et al. (1990) included 5733 women attempting VBAC, of whom 1686 received oxytocin for either IOL or augmentation. The proportion of IOL versus augmentation was not specified. VBAC success was lower in the oxytocin group (68%) compared with the no-oxytocin group (78%), although rates in both groups was high.

Of the remaining studies, an earlier study by Flamm et al. (1987) has the largest number of participants, with 405 women in the oxytocin group (149 for IOL) and 1291 women who did not receive oxytocin. Women who received oxytocin at 3-4cm cervical dilatation had a 72% VBAC success rate, and those who received oxytocin at 5-10cm had a 64% success rate. These two groups were not significantly different from one another, but both were different from the IOL group.

The remaining four studies have varying results. Horenstein et al. (1985) showed no difference in success rates for women who had oxytocin IOL (72% of 32 women) compared with augmentation (69% of 257 women). When all women receiving oxytocin were included, success rates were lower than women who did not receive oxytocin (89% of 443 women).

Stronge et al. (1996) included 13 women who were induced by oxytocin and 75 who were augmented. Due to the low IOL numbers, only augmentation rates were reported and compared with 120 women who did not receive oxytocin. Women receiving oxytocin augmentation were less likely to achieve VBAC (63% vs 86%).

In contrast to other studies in this category, Lai and Sidek (1993) reported higher rates of successful VBAC in the presence of oxytocin. There were small numbers in this study, but 58% of the 66 women who had spontaneous labour without augmentation had a VBAC rate. The VBAC rate was 77% in the 22 women who had a spontaneous labour augmented with oxytocin, The VBAC rate in the 11 women induced with oxytocin was 82%.

There were no differences in the maternal and neonatal morbidity or mortality outcomes in the studies that reported oxytocin use. The outcomes included uterine rupture, neonatal mortality, Apgar scores, maternal haemorrhage, hysterectomy, and perineal lacerations (Horenstein and Phelan 1985; Flamm, Goings et al. 1987; Flamm, Newman et al. 1990; Lai and Sidek 1993). These studies were underpowered to assess adverse outcomes such as uterine rupture.

Other methods

A number of other IOL methods have been studied. Lelaidier et al. (1994) randomised 32 women to either receive 200mg of mifepristone or placebo over a four day period. Mifepristone is a synthetic steroid used for the induction of labour. Induction of labour was planned for all women at the end of the four days as needed. The VBAC rates were 69% for the mifepristone group and 50% for controls which was not statistically significantly different given the small sample size.

In the USA, Grubb et al. (1996) tested the efficacy of early augmentation of labour in women with ineffective contractions. Women randomised to the intervention group were admitted to hospital and received the usual care for women undertaking trial of labour with unknown uterine scars. The control group ambulated and if no cervical change or spontaneous rupture of membranes had occurred after four hours, the woman was discharged with instructions to return for increasing contractions, rupture of membranes, vaginal bleeding, or decreased fetal movement. There were no statistically significant differences in VBAC rate (84% for the intervention group and 83% for the control group). There were five cases of uterine scar separation in the intervention group and none in the control group.

Use of Imaging (MRI, X-ray, CT)

Imaging such as MRI, X-ray or CT to evaluate the ‘adequacy’ of the maternal pelvis was evaluated. Most studies used imaging on all women and categorised them according to pelvic

dimensions. Twelve studies were initially identified. Following CASP rating, five were excluded (Wright 1985; Lao, Chin et al. 1987; Lau, Leung et al. 1998; Fox, Huerta-Enochian et al. 2004; Sibony, Alran et al. 2006) leaving seven studies.

All women undergo imaging

Five studies (Ngu and Quinn 1985; Mahmood and Grant 1987; Krishnamurthy, Fairlie et al. 1991; Thurnau, Scates et al. 1991; Wong, Wong et al. 2003) included women who all underwent imaging in pregnancy and compared groups of women (e.g. 'adequate' vs 'inadequate'). Definitions of pelvic adequacy differed between studies, but the authors' definitions have been used. Studies that assessed uptake of VBAC showed a reduction in the number of women attempting VBAC following classification of 'inadequate' pelvis (Mahmood and Grant 1987; Krishnamurthy, Fairlie et al. 1991). In one study (Krishnamurthy, Fairlie et al. 1991), VBAC uptake rates for women with an 'inadequate' or 'adequate' pelvis were 27% and 95%, respectively. Other authors advised women with an 'inadequate' pelvis to have an elective CS even if they fulfil the criteria for VBAC (Abu-Ghazzeh and Barqawi 2000). Three studies reported no difference in VBAC success rates related to pelvic adequacy (Ngu and Quinn 1985; Mahmood and Grant 1987; Krishnamurthy, Fairlie et al. 1991).

Imaging vs no-imaging

Three studies compared women who underwent imaging in pregnancy compared with those who did not (Mahmood and Grant 1987; Thubisi, Ebrahim et al. 1993; Abu-Ghazzeh and Barqawi 2000). Thubisi et al. conducted the only RCT involving 288 women. Women in the control group had standard antenatal care which included a clinical pelvic assessment and a postpartum X-ray pelvimetry (XRP). Of the 144 women in the intervention group, 84 were considered to have an adequate pelvis on XRP and 23 of these gave birth vaginally (28%). Women considered on antepartum XRP to have an inadequate pelvis had a CS. Of the 144 women in the control group, 44% gave birth vaginally. In the control group, 33 of the 60 women (55%) who had a vaginal birth were assessed to have an 'inadequate pelvis' based on postpartum XRP and would have had a CS if this information had been known antenatally. This trial provides strong evidence that XRP is a poor predictor of VBAC success and might increase CS rates.

Other studies show a similar lack of benefit. Mahmood et al., (1987) in a retrospective cohort study of 239 women, found no differences in VBAC rates between those with imaging and those without. Within the imaging group, women with an 'adequate' pelvis were more likely to attempt VBAC than those with an 'inadequate' pelvis (as discussed above). A study of 219 women by Abu-Gazzeh et al. (2000) demonstrated that imaging in pregnancy had a negative effect on the uptake of VBAC. All women in the study initially had a preference for VBAC, however, 23% of women in the pelvimetry group were told they had an 'inadequate' pelvis and had a repeat CS. This led to an overall VBAC rate of 49% in the pelvimetry group compared with 78% in the group who did not have pelvimetry. The VBAC success rate in the pelvimetry group was also lower (64% vs 78%).

Using evidence-based criteria

This category examined five studies testing evidence-based criteria, such as tools, for predicting the success of VBAC. Three reported on the outcome of a scoring system for predicting VBAC success (Flamm and Geiger 1997; Vinueza, Chauhan et al. 2000; Hashima and Guise 2007). All these used different scoring tools and were retrospective assessing women who had attempted VBAC.

The first by Vinueza et al. (2000), assessed the ability of a scoring system designed by Troyer and Parisi (1992) to predict VBAC success. There was an inverse relationship between the score and successful VBAC. That is, women who scored 0 (a previous vaginal birth, CS was not for dysfunctional labour, no induction required and reassuring fetal heart rate) had a 98% chance of successful VBAC. Women with a score of 1 had a 69% success rate; a score of 2 had a 40% success rate; and a score of 3 had a 33% chance of achieving VBAC.

Hashima et al. (2007) and Flamm et al. (1997) employed similar techniques. Each tested a newly developed scoring system on a different cohort of women attempting VBAC. Hashima et al. found that non-recurrent prior caesarean indication, no history of a macrosomic infant, and no current maternal anaemia were associated with VBAC, and assigned women a score of 1 for each criteria they fulfilled. A linear relationship between score and VBAC success was seen, with success rates of 25%, 49%, 53% and 67% for scores 0, 1, 2 and 3 respectively. Flamm et al. determined five factors to be associated with successful VBAC in women who chose a trial of labour. These were less than 40 years, previous vaginal birth, CS for reasons other than failure to progress, cervical effacement at admission and cervical dilation of 4cm

or more at admission. Again, a linear relationship was noted between the score and the likelihood of successful VBAC. Women who scored 0-2 had a 49% chance of VBAC, compared with 95% in those who scored 8-10.

Another study (Bujold, Blackwell et al. 2004) examined the usefulness of a modified version of the commonly used Bishop's score to predict the success of IOL in women with a previous CS. Participants were categorised into four groups depending on their modified Bishop's score. The study demonstrated a linear relationship between the modified Bishop's score and successful VBAC. Women in the lowest category had a VBAC rate of 58% compared with 97% in the highest.

Finally, Pickhardt (1992) examined 19 variables to determine women's likelihood of a successful VBAC. He concluded that almost all women should attempt a VBAC, and that there were very few predictive factors of successful or unsuccessful VBAC that could be used to enhance the care of women.

Closure of primary CS

One RCT (Chapman, Owen et al. 1997) and two retrospective cohort studies (Durnwald and Mercer 2003; Gyamfi, Juhasz et al. 2006) examined the effect of the closure of the primary CS wound on future VBAC success. The RCT was a follow up study of an original trial conducted to examine the short term effectiveness of closure using one versus two layers of a locking suture in a CS (Hauth, Owen et al. 1992). Four years after the original study, 164 women from the original sample who had had a subsequent birth at the study institution were identified (Chapman, Owen et al. 1997). The 83 women who had had one layer closure were similar to the 81 women who had had two layer closure and there were no significant differences in the VBAC rate.

The two retrospective cohort studies included large numbers of women (948 and 768) but only a small proportion in each study had single layer uterine closure (35 and 267, respectively). Neither studies found a difference in VBAC uptake or success between single and double layer closure of the primary CS.

Epidural use in labour

Two studies were identified that used epidural analgesia in labour as an intervention. One was excluded after CASP rating (Sakala, Kaye et al. 1990). The remaining study assessed the use of epidural analgesia in labour on VBAC success (Stovall, Shaver et al. 1987). Stovall et al. (1987) conducted a prospective cohort study of 272 women and found that VBAC success was less in women who used an epidural in labour (74.5%) compared with those who did not (85.7%), however rates were high in both groups.

Discussion

A number of clinical interventions evaluated appear to be effective in increasing either the uptake or success rates of VBAC. A large number of studies regarding clinical interventions for VBAC examined IOL or augmentation of labour, using various methods. The majority showed that women who require induction or augmentation were likely to have a lower chance of VBAC success than women who labour spontaneously. However, in most cases, the success rates in both groups were still high. Although this is a useful comparison to make, it does not provide detailed information on how induction or augmentation affects VBAC outcomes. There are many confounding variables that will impact these results. Women who require IOL or augmentation are probably less likely to proceed to a vaginal birth as there are other factors influencing their labour apart from the use of chemical agents to begin or improve labour. A more useful comparison to determine the effects of inducing or augmenting agents on women having a VBAC would be to compare women with labour dystocia who were given oxytocin to women with labour dystocia who were not given oxytocin. Changing the comparison group would give a more accurate indication of the effects of oxytocin in labour for women with labour dystocia rather than comparing them with women who did not experience labour dystocia. Whether or not it would be ethical to conduct this type of research is debatable.

It is not surprising that cervical ripening agents such as prostaglandins and transcervical Foley catheters may result in a lower VBAC success rate compared with women who labour spontaneously. For women without a previous CS, cervical ripening and induction of labour are associated with a reduction in the chance of vaginal birth (Alfirevic, Kelly et al. 2009). Although the chances of vaginal birth may be lower for women who undergo cervical ripening, the success rate is still around 50% or greater. Cervical ripening may provide a

means of avoiding a number of unnecessary caesarean sections for women with a previous CS however, this study did not aim to address the safety concerns around the use of prostaglandins in these women. Certainly, there are other factors involved in the decision to attempt cervical ripening techniques for women with a previous CS.

Given that all included studies in the induction/augmentation category compared women undergoing IOL or augmentation with those who laboured spontaneously, it is no surprise that rates of VBAC success appear lower. However, if the clinical decision making involves the trial of an inducing or augmenting agent or having a repeat CS then it seems reasonable that induction or augmentation may increase VBAC. Considering that success rates across studies of IOL or augmentation are 50% or greater, it seems reasonable that women attempting a VBAC be assessed for the appropriateness of these agents, if needed. What this study does not address is the safety of induction or augmentation for women attempting VBAC. Issues such as a potential increase in uterine rupture rates with induction agents such as prostaglandins have not been included. Other studies have addressed this, for example a systematic review by Guise et al. (2003) reports a 10 percent reduction in normal birth after oxytocin use and a similar reduction after the use of prostaglandins and McDonagh et al (2005) reports a non-significant increase in uterine rupture in women with previous caesarean sections whose labours were induced.

The same is true of epidural use in labour. Although it is important to ensure that women are aware that the use of epidural may reduce their likelihood of having a successful VBAC, there are likely a number of confounding variables involved and perhaps differences between the labours of women who choose an epidural and those who do not. These factors may impact the outcome more significantly than the use of epidural alone. In women without a previous CS, epidural use is associated with a higher likelihood of instrumental delivery, so it is not surprising that epidural use during VBAC may be associated with a lower success rate.

The available evidence does not indicate which clinical factors may increase VBAC uptake or success rates. The use of imaging in pregnancy to assess pelvic adequacy appears to increase clinician and maternal anxiety, reducing VBAC uptake and preventing a proportion of women who may have achieved a vaginal birth from even attempting. The correlation between pelvic adequacy and VBAC success is not strong, and recommendation of its use appears unethical given the significant proportion of women with a pelvis deemed to be ‘inadequate’ who

achieve a VBAC. Furthermore, other predictive tools such as scoring systems with respect to risk factors or the study of the cervicogram from the previous labour may facilitate decision making (particularly for women who have a very high probability of successful VBAC using these tools) but may also increase anxiety for women in the group with the poorest outcome. The clinical value of such scoring systems is limited.

It was not possible to undertake a meta-analysis on these data and this is a limitation of this review. There is significant heterogeneity of management techniques and inclusion criteria for women in the studies that assess hospital factors such as local policies for reducing CS rates. In spite of these differences, the literature demonstrates that the attitudes of the institution and its clinicians and the desire to reduce CS rates and promote VBAC for women with a previous CS can make a significant impact on the uptake and success rates of VBAC. This has significant implications for hospital administrators and management staff. A local drive and commitment to VBAC from the top down can significantly increase VBAC rates, thus lowering the overall CS rate of an institution. High rates of VBAC have been shown to be sustainable (Myers and Gleicher 1993). An investment in initiatives to increase the VBAC rate may therefore have ongoing returns.

This review provides an important view of the literature in this area however there are additional limitations which need to be considered. The findings highlighted a number of changes that have occurred in the past two decades. Practices surrounding VBAC have changed significantly during the 20 year time span the studies in this review covers. There have also been inaccuracies related to ICD-9 codes and data quality during this time period (American Medical Association 1995; Reker, Hamilton et al. 2001), and as such, studies using these codes in their methods may be flawed. Our review included all studies with a comparison group and as such bias could have been introduced. Typically, systematic reviews only select RCTs if the aim is to determine effectiveness. As the number of RCTS is small and some aspects of this do not lend themselves to random allocation, we felt the review would be limited if we chose this path. Therefore, to incorporate a greater range of studies we chose any study with a comparison group that met the other inclusion criteria.

Conclusion

Induction of labour using ARM, prostaglandins, oxytocin infusion and various combinations of these methods, is often associated with a lower VBAC success rate. The use of oxytocin appears to be safe but may decrease the number of women achieving VBAC. Cervical ripening agents such as prostaglandins and transcervical Foley catheters may result in a lower VBAC success rate compared with women who labour spontaneously. Evidence on whether epidural use in labour contributes to VBAC success is insufficient.

Women who have X-ray pelvimetry have a reduced uptake of VBAC, and higher caesarean section rates, and as such, X-ray pelvimetry is a poor predictor of the outcome of a trial of labour. Similarly, scoring systems devised to predict VBAC success are mostly unhelpful, although some large-study systems have some clinical value. There is insufficient data to comment on differences in rates of VBAC success between different methods of closure of the primary caesarean section.

Future research needs to address the implementation and testing of effective interventions to increase the uptake and success of VBAC. This review provides valuable information that will assist clinicians, researchers and policy makers in their future endeavours to address this important issue.

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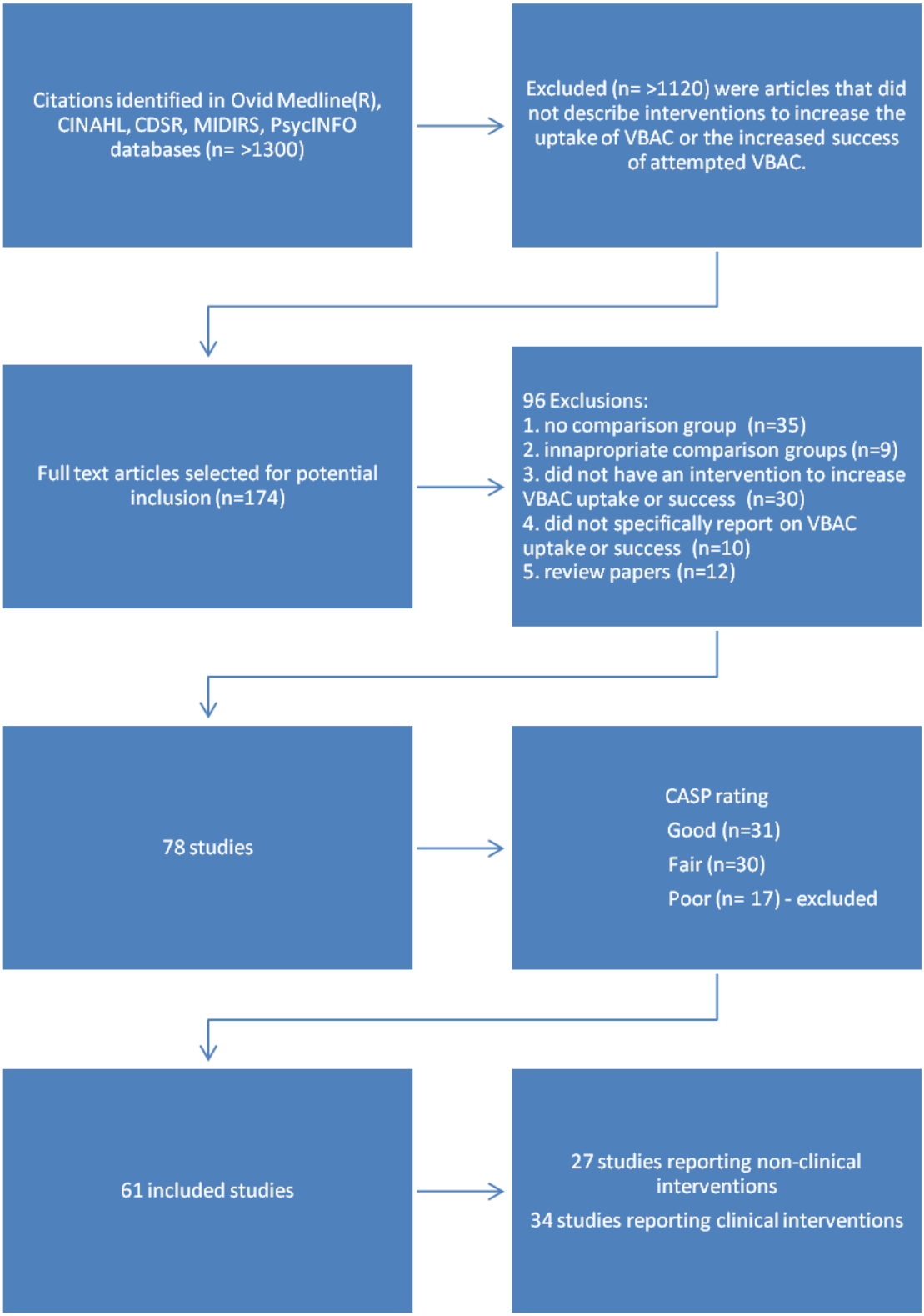
Figure 1: A flowchart of excluded and included studies



Non-Clinical interventions*= practices indirectly affecting women's VBAC uptake/success (e.g. hospital guidelines)*
Clinical interventions*= practices directly affecting women's VBAC uptake/success (e.g. induction of labour methods)*

Table 1: Details and CASP rating of included studies by category area

Trial (author and date)	Country	Design	CASP rating
Induction / augmentation of labour (n=18)			
Prostaglandin use / cervical ripening			
Taylor et al 1993	UK	RCT	FAIR
Rayburn et al 1999	USA	RCT	GOOD
Flamm et al. 1997	USA	Prospective cohort	GOOD
Blanco et al. 1992	USA	Prospective cohort	FAIR
Yogev et al 2004	Israel	Retrospective cohort	FAIR
Hoffman et al 2004	USA	Retrospective cohort	GOOD
Bujold et al. 2004a	Canada	Retrospective cohort	GOOD
Induction of labour (various methods)			
Sims et al. 2001	USA	Prospective cohort	FAIR
Delaney & Young, 2003	Canada	Retrospective cohort	GOOD
Rageth et al. 1999	Switzerland	Retrospective cohort	GOOD
Pathadey et al. 2005	UK	Retrospective cohort	FAIR
Oxytocin use			
Flamm et al. 1987	USA	Retrospective cohort	GOOD
Flamm et al. 1990	USA	Prospective cohort	FAIR
Lai and Sidek 1993	Singapore	Retrospective cohort	FAIR
Stronge et al. 1996	Ireland	Prospective cohort study	FAIR
Horenstein et al. 1985	USA	Prospective cohort	FAIR
Other methods			
Grubb and Kjos 1996	USA	RCT	FAIR
Lelaidier et al 1994	France	RCT	GOOD
Imaging (MRI, X-ray, CT) (n=7)			
Thubisi et al 1993	South Africa	RCT	GOOD
Krishnamurthy et al. 1991	Scotland	Retrospective cohort	FAIR
Mahmood et al. 1987	UK	Retrospective cohort	FAIR
Ngu et al 1985	Australia	Retrospective cohort	FAIR
Thurnau et al. 1991	USA	Prospective cohort	GOOD
Wong et al. 2003	China	Prospective cohort	GOOD
Abu-Ghazzeh et al. 2000	Jordan	Prospective cohort	FAIR
Evidence-based criteria (n=5)			
Hashima et al. 2007	USA	Retrospective cohort	GOOD
Pickhardt et al. 1992	USA	Retrospective cohort	FAIR
Vinueza et al 2000	USA	Retrospective cohort	FAIR
Flamm and Geiger 1997	USA	Retrospective cohort	GOOD
Bujold et al. 2004b	Canada	Retrospective cohort	GOOD
Closure of primary CS (n=3)			
Chapman et al 1997	USA	RCT	FAIR
Gyamfi et al. 2006	USA	Retrospective cohort	GOOD
Durnwald and Mercer 2003	USA	Retrospective cohort	GOOD
Epidural analgesia / anaesthesia (n=1)			
Stovall et al. 1987	USA	Prospective cohort	FAIR

Table 2: Detailed information on induction/augmentation of labour studies

Trial (author and date)	Intervention	Sample size and comparison group	Uptake of VBAC	Impact on VBAC success rates	Statistical values
Prostaglandin use / cervical ripening					
Taylor et al 1993	PGE2 and amniotomy vs oxytocin and amniotomy	42 women • 21 PGE2 • 21 Oxytocin	NA	No difference	p=NS
Rayburn et al 1999	Weekly intracervical PGE2	294 women • 143 PGE2 • 151 Expectant	NA	No difference	p=NS
Flamm et al. 1997	PGE2 IOL	5022 women • 453 PGE2	NA	77% - no PGE2 51% - PGE2	p=0.0001
Blanco et al. 1992	PGE2 IOL	81 women • 25 PGE2	NA	No difference	p=NS
Yogev et al 2004	PGE2 IOL	1028 women • 931 spontaneous labour • 97 PGE2	NA	No difference	NR
Hoffman et al 2004	Preinduction cervical ripening – misoprostol, PGE2 Foley catheter	934 women • 398 with cervical ripening	NA	77% VBAC without intervention 47% VBAC with intervention	p=0.001
Bujold et al. 2004a	Amniotomy Foley catheter spontaneous labour	2479 women • 417 amniotomy • 255 Foley catheter • 1807 spontaneous labour	NA	78% VBAC with amniotomy 56% VBAC with Foley Catheter 78% VBAC with spont. labour	p <0.01 Foley v control

Induction of labour (various methods)					
Sims et al. 2001	IOL – oxytocin, misoprostol, dinoprostone	236 women • 179 spontaneous labour • 57 IOL	NA	77% - VBAC with spontaneous labour 58% - VBAC with IOL	p=0.008
Delaney & Young, 2003	IOL	3746 women • 2943 spontaneous labour • 803 IOL	NA	75.8% - VBAC with spontaneous labour 62.5% - VBAC with IOL	p<0.001
Rageth et al. 1999	IOL	17,613 women • 15,154 spontaneous labour • 2459 IOL	NA	75% VBAC with no IOL 66% VBAC with IOL	NR
Pathadey et al. 2005	IOL – amniotomy oxytocin PGE2	81 women • 36 amniotomy • 5 amniotomy and oxytocic • 34 PGE2 • 3 oxytocic only	NA	79% - VBAC No difference	p=NS
Oxytocin use					
Flamm et al. 1987	Oxytocin for IOL or augmentation	1776 women • 485 oxytocin • 1291 no oxytocin	NA	78% VBAC without oxytocin 64% VBAC with oxytocin	p<0.001
Flamm et al. 1990	Oxytocin	5733 women • 1686 oxytocin • 4047 no oxytocin	NA	78% VBAC without oxytocin 68% VBAC with oxytocin	p<0.001
Lai and Sidek 1993	Oxytocin for IOL or augmentation	99 women • 66 spontaneous labour, without oxytocin • 22 oxytocin • 11 IOL plus oxytocin	NA	58% VBAC with spontaneous labour 77% VBAC with oxytocin 82% VBAC with IOL	p<0.05

Stronge et al. 1996	Oxytocin	195 women • 123 oxytocin not used • 75 oxytocin augmentation	NA	86% VBAC no oxytocin 63% VBAC with oxytocin	p=0.001 Association lost on multivariate analysis
Horenstein et al. 1985	Oxytocins for IOL or augmentation	732 women • 443 oxytocin not used • 32 IOL • 257 augment	NA	72% - VBAC with IOL 69% - VBAC with oxytocin 89% - VBAC with no oxytocin	p=0.05
Other methods					
Grubb and Kjos 1996	Early augmentation of labour	197 women • 51 no oxytocin • 78 oxytocin	NA	77% VBAC with no oxytocin 80% VBAC with oxytocin	p=NS
Lelaidier et al 1994	200mg mifepristone	32 women • 13 spontaneous labour • 11 mifepristone • 2 placebo	NA	69% VBAC with spontaneous labour 37% VBAC with mifepristone 24% VBAC with placebo	p=NS

Note: The statistics are presented as they were reported in the original publications. ***Abbreviations***: PGE2=Prostaglandin gel, CI=Confidence Interval, IOL= Induction of Labour, NS=not significant, NR=Not Reported.

Table 3: Detailed information on imaging (MRI, X-ray, CT) studies

Trial (author and date)	Intervention	Sample size and comparison group	Uptake of VBAC	Impact on VBAC success rates	Statistical values
Thubisi et al 1993	Antenatal X-ray pelvimetry	228 women • 84 X-ray pelvimetry • 144 control group	NA	16% - VBAC with x-ray pelvimetry 42% - VBAC control group Pelvimetry is poor predictor of the outcome of labour	OR 3.8, 955 CI 2.1-6.8
Krishnamurthy et al. 1991	X-ray pelvimetry 'adequate' vs 'inadequate' pelvis	331 women • 248 'inadequate' pelvis • 83 'adequate' pelvis	76 women with 'inadequate' pelvis and 79 women with 'adequate' pelvis attempted VBAC	No difference	P=0.11
Mahmood et al. 1987	X-ray pelvimetry	239 women • 89 X-ray pelvimetry • 150 control group	within pelvimetry group, those with 'adequate' more likely to try VBAC than those with 'inadequate'	No difference	P<0.01
Ngu et al 1985	X-ray pelvimetry	155 women with normal X-ray pelvimetry • 93 VBAC • 62 CS	NA	The larger the pelvic diameters, the more likely a successful VBAC	True conjugate – p<0.002
Thurnau et al. 1991	Fetal pelvic index vs two other methods of identifying fetal-pelvic disproportion	74 women • Fetal pelvic index • Colcher-Sussman x-ray pelvimetry	NA	72% - VBAC all with negative fetal pelvic index 28% - CS with majority having positive fetal pelvic index The fetal pelvic index was	p=<0.00001

		• Ultrasonography of fetal weight over 4gm using Shepard tables		highly predictive of fetal pelvic disproportion	
Wong et al. 2003	CT-pelvimetry positive vs negative fetal pelvic index (positive index= fetus larger than maternal pelvis)	170 women • 57 Repeat CS • 113 VBAC	NA	20% - VBAC with positive fetal pelvic index Fetal pelvic index not predictive of outcome of attempt for VBAC	P=0.012
Abu-Ghazzeh et al. 2000	CT-pelvimetry (use vs no use)	219 women • 100 antenatal low-dose CT pelvimetry • 119 control group	All women had preference for VBAC, but 23% in pelvimetry group told they had 'inadequate' pelvis and had elective CS.	49% - VBAC with CT pelvimetry 78% - VBAC without	P=0.02

Note: The statistics are presented as they were reported in the original publications. OR=Odds Ratio, CI= Confidence interval.

Table 4: Detailed information on Evidence-based criteria studies

Trial (author and date)	Intervention	Sample size and comparison group	Uptake of VBAC	Impact on VBAC success rates	Statistical values
Hashima et al. 2007	Scoring systems	10828 women • Score development group • Score validation group	NA	17% - VBAC success if scored 0 68% - VBAC success if scored 3	NR
Pickhardt et al. 1992	Factors determined that were possibly prognostic of CS	495 women • Previous VBAC • Previous unsuccessful VBAC	NA	10 predictive factors identified significantly related to birth outcome	P=0.05
Vinueza et al 2000	Scoring system (0-4) as designed by Troyer and Parisi	263 women • Previous dysfunctional labour-1 • No prior vaginal birth-2 • Non-reassuring FH tracing on admission-3 • Labour induction-4	NA	98% - VBAC with score of 0 69% - VBAC with score of 1 40% - VBAC with score of 2 33% - VBAC with score 3-4 Also, increasing CS for CPD with increasing scores	P=<.0001
Flamm and Geiger 1997	Scoring system (0-10) for predicting VBAC success	5003 women • Score development group • Score testing group	NA	Linear relationship between scores and success. From 49% for score 0-2 to 95% for scores 8-10	NR
Bujold et al. 2004b	Modified Bishop's score for predicting IOL success for women having VBAC	685 women • 187 (BS of 0-2) • 276 (BS of 3-5) • 189 (BS of 6-8) • 33 (BS of 9-11)	NA	Linear relationship between score and VBAC. From 57.8% for scores 0-2 to 97% for scores 9-11.	P=<0.05 for all groups

Note: The statistics are presented as they were reported in the original publications

Abbreviations: BS=Bishops Score, IOL=Induction of Labour, CS=Caesarean Section, CPD=Cephalo-pelvic disproportion, FH=Fetal Heart, NR=Not Reported

Table 5: Detailed information on Closure of primary CS studies

Trial (author and date)	Intervention	Sample size and comparison group	Uptake of VBAC	Impact on VBAC success rates	Statistical values
Chapman et al 1997	Double vs single layer closure	145 women • 70 single layer • 75 double layer	NA	No difference – 56% - VBAC with single layer 64% - VBAC with double layer	NR
Gyamfi et al. 2006	Double vs single layer closure	948 women attempting VBAC with previous: • 35 single layer • 913 double layer	NA	No difference – 74% - VBAC with single layer 77% - VBAC with double layer	P=0.685
Durnwald and Mercer 2003	Double vs single layer closure	768 women attempting VBAC with previous: • 267 single layer • 501 double layer	NA	No difference – 68% - VBAC with single layer 65% - VBAC with double layer	NR

Note: The statistics are presented as they were reported in the original publications. NR=Not Reported

Table 6: Detailed information on Epidural analgesia / anaesthesia study

Trial (author and date)	Intervention	Sample size and comparison group	Uptake of VBAC	Impact on VBAC success rates	Statistical values
Stovall et al. 1987	EDB in labour	272 women • 153 had an Epidural • 119 did not	NA	85.7% - VBAC without EDB 74.5% - VBAC with EDB	NR

Note: The statistics are presented as they were reported in the original publications. NR=Not Reported