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REVIEW

Instrumental vaginal delivery – back to basics

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Assisted vaginal delivery using forceps or a vacuum extractor is an essential part of obstetric practice. Operative vaginal delivery rates in the UK have remained stable between 10% and 15%, yielding safe and satisfactory outcomes for the majority of mothers and their babies. However, there has been an increase in medico-legal cases due to an increasing awareness of the potential morbidity for both the mother and the baby. There are many factors that can play a part in both the maternal and fetal complications resulting from instrumental deliveries. The aim of this educational review is to address these factors and identify measures to reduce them by adherence to the basics and relevant evidence.

Keywords: Forceps and vacuum extractor, instrumental delivery, maternal and fetal morbidity, obstetric litigation

Introduction

There has been a decline in the use of obstetric forceps in many countries in recent years. The cause might be multifactorial, although many of these factors are inter-related. Litigation has grown over recent years in all areas, but it is often related to care on the labour ward, departures from practice guidelines and inexperienced operators (Patel and Murphy 2004).

The goal of operative vaginal delivery is to simulate spontaneous vaginal birth, hence speeding up delivery with a minimum of maternal or neonatal morbidity. Most women still aim for spontaneous vaginal delivery. If complications do arise during labour, it should be possible to offer women suitable alternatives and not solely caesarean section. Women are more likely to achieve a spontaneous vaginal delivery in a subsequent pregnancy after forceps delivery than after caesarean section (Patel and Murphy 2004). However, obstetric forceps are potentially dangerous in the hands of untrained or inexperienced obstetricians.

There are several prerequisites for achieving the safe use of forceps or vacuum extractor, thus leading to a reduction in physical and psychological complications. These are: an understanding of the anatomy of the birth canal and the fetal head; an understanding of the dynamic of tractions which can alter the diameter by which the fetal head distends through the perineum and pelvic floor; the choice of instrument depending on thorough safety assessment; judicious preoperative and intraoperative precautions; being skilled in instrumental delivery and finally, adequate postoperative care. Together, these would reduce the need for second stage caesarean section, which in itself carries significant morbidity.

Some measures have been found to help achieve a vaginal delivery without the need of instrumental deliveries during labour. First and foremost is the continuous support of women throughout their labour (Hodnett et al. 2007), An upright position or tilting onto the left or right lateral position, depending on the direction of uterine tilt will also help the fetal head move towards the direction of the pelvis and hence engage in the pelvis (Gupta et al. 2012). Furthermore, a vaginal delivery without the need for instruments is more likely to be achieved with a reduction in the use of an epidural (Anim-Somuah et al. 2005), mobility during labour and delaying instrumental delivery itself after full dilatation for 2 h in primigravida before active pushing, for those who have had an epidural (Roberts et al. 2004).

The timing and the choice of which instrument and when to apply or not to apply it should involve balancing the risks and benefits of such an instrumental delivery with a second stage caesarean section. Caesarean section after failed instrumental delivery carries significant maternal and fetal morbidity. Hence, a trial of instrumental delivery, where a high rate of failure is anticipated should be performed in theatre by an experienced obstetrician, to avoid any delays that could increase both maternal and fetal morbidity. Obstetricians should be aware of the mechanism and reasons from which maternal and fetal complications could result from instrumental deliveries, to be able to take all reasonable precautions to reduce morbidity. Litigation results from failure to abandon the procedure at the appropriate time, particularly the failure to avoid prolonged, repeated or excessive traction efforts in the presence of poor progress.

The use of sequential instruments is associated with an increased risk of trauma to the infant. However, the operator must balance the risks of a caesarean section following failed vacuum extraction, with the risks of forceps delivery following failed vacuum extraction.

The aim of this review is to address the issues associated with the risks of instrumental delivery and identify any measures that would help to reduce them by adherence to the basics, based on evidence.

Maternal complications of instrumental delivery

Perineal and vaginal tears, pelvic floor damage leading to long-term urinary and faecal dysfunction and genital prolapse

Perineal and vaginal tears are an unfortunate outcome of an instrumental delivery. These can have a long-lasting effect on morbidity, including faecal and urinary incontinence, genital prolapse, dyspareunia and psychosexual problems. The rate can

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be reduced with experience but cannot be entirely eliminated, hence the importance of regular training for instrumental delivery and management of perineal trauma. The quoted rate of 3rd and 4th degree tears with forceps from different studies, is up to 7% (Buekens et al. 1985; Anthony et al. 1994; Poen et al. 1997; Donnelly et al. 1998; Poen et al. 1998; Gjessing et al. 1998; Wood et al. 1998; Sultan et al. 1999; Eason et al. 2000; Handa et al. 2001; Jander and Lyrenas 2001; de Leeuw et al. 2001; Fitzpatrick et al. 2001; Bodner-Adler et al. 2001; Richter et al. 2002; Fitzpatrick et al. 2002; Christiansen et al. 2003; McLeod et al. 2003).

Forceps are more likely to be associated with maternal perineal trauma than the vacuum extractor. Ten studies reported on 3rd and 4th degree tears and found them to be more likely to occur with forceps rather than in the vacuum group, irrespective of whether an episiotomy had been carried out or not (RR 1.89, 95% CI 1.51–2.37) (O'Mahony et al. 2010).

How can we reduce the risk of tears and pelvic floor damage in forceps delivery?

Mediolateral episiotomy. Selective episiotomies reduce the risk of 3rd and 4th degree tears with instrumental delivery. A large observational study from the Netherlands of 28,732 operative vaginal deliveries concluded that mediolateral episiotomy is protective against obstetric anal sphincter injury in both vacuum extraction (9.40% vs 1.36%, OR 0.11, 95% CI 0.09–0.13) and forceps delivery (22.73% vs 2.6%, OR 0.28, 95% CI 0.13–0.63) (de Leeuw et al. 2008). However, a smaller angle of episiotomy is more likely to lead to an anal sphincter tear. In a case–control study of the impact of mediolateral episiotomy angle on anal sphincter injury, rates showed that an episiotomy cut at a smaller angle from the midline was more likely to be associated with a 3rd degree perineal tear than an episiotomy cut at a larger angle (Eogan et al. 2006). This study found that there was an average relative increase of 10.4% in the risk of a 3rd degree tear for every degree smaller that a mediolateral episiotomy is cut. They concluded that if a right mediolateral episiotomy is indicated, then the angle of this should be as large as possible in order to reduce the incidence and thus the potential sequelae of obstetric anal sphincter injury.

Traction force in forceps delivery

The principle of traction in forceps delivery is to perform the traction while maintaining flexion of the head and in the direction of the pelvic floor. This will reduce the diameter which distends the pelvic floor and the perineum. The direction of traction in the occipito anterior is different from the occipito posterior position. Pajot's manoeuvre is recommended to achieve and maintain flexion and to perform traction in the direction of the pelvic floor (Figure 1) in cases of occipito anterior position. When the vertex appears distending the perineum, then traction is directed downward and forward, while in the direct occipito posterior, the traction should be in a horizontal forward direction when the delivery is intended to be face to pubis (Figure 2). Traction that does not maintain flexion and is not in the direction of the pelvic floor leads to head deflexion and an increase in the diameter, which distends the perineum. This leads to an increase in the risk of perineal tears, failure of instrumental delivery, difficult delivery and fetal injuries. In Kielland's forceps, the handle should not cross above the horizontal plane during traction after head rotation.

When the head is in direct occipito posterior, the decision has to be made whether to rotate the head to direct occipito anterior using manual rotation, rotation with vacuum extractor or deliver as face to pubis or by caesarean section, depending on the clinical circumstances and skills of the operator. A survey showed that most obstetricians in North America have abandoned rotational instrumental delivery in favour of caesarean section (Bofill et al. 1996). In Australia, obstetricians prefer using a vacuum extractor for rotational instrumental delivery (Kabiru et al. 2001). This has reinforced the opinion of some obstetricians that rotational deliveries of more than 45° are likely to be abandoned (Johanson and Menon 2000).

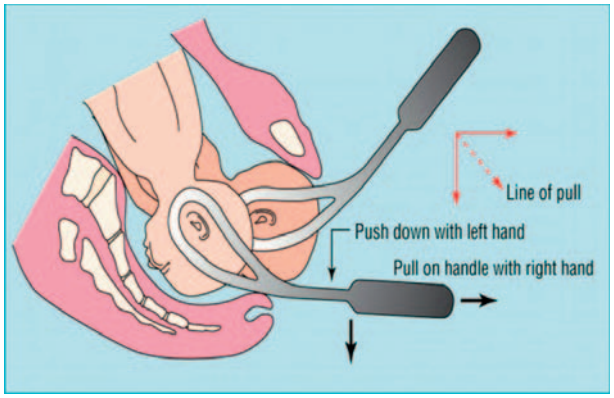

Figure 1. Traction in the occipito anterior position (Pajot's manoeuvre).

Arguments to deliver occipito posterior as face to pubis:

1. When the occiput lies directly posterior and low, one could accept this as an indication for proceeding with face to pubis delivery, since the pelvis in such cases must be wide enough to have allowed the head to have rotated into this position, so there is no indication for turning it.
2. In cases of prolonged labour, the uterus can be so closely applied to the body that it becomes difficult to rotate the head, especially if the head is low in the pelvis, which could be harmful to the baby.
3. The mechanics of moulding are better left undisturbed at this stage.
4. Delivery as face to pubis carries less risk of 3rd degree tears than rotational forceps, provided that traction is carried out in the direction that maintains flexion and in the direction of the pelvic floor (Figure 2). In this circumstance, the diameter which distends the perineum is the suboccipito frontal, which is 10 cm. If the head is deflexed due to downward traction,

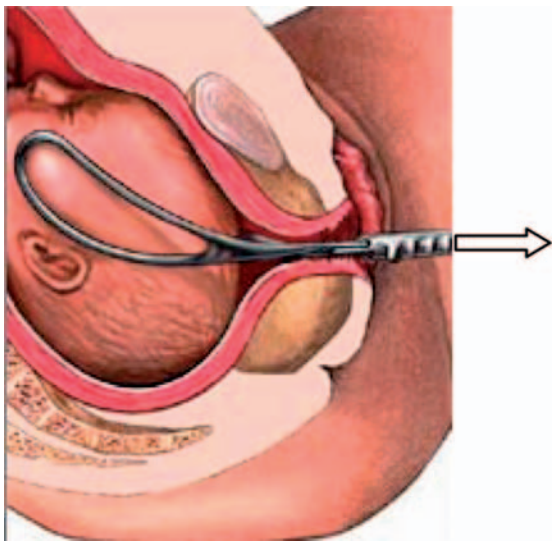

Figure 2. Direction of traction in the occipito posterior position.

then the diameter will be occipito frontal, which is 11.5 cm. This diameter is very large and will cause 3rd degree tears.

Traction force in vacuum delivery

In the UK there has been increasing use of a vacuum extractor rather than forceps (O'Connell et al. 2000; Patel and Murphy 2004). The experience and skills of obstetricians will vary depending on the setting in which they have been trained. A high rate of inappropriate placement and inappropriate choice of cup type and size leading to a high failure rate of vacuum has been cited as a reason for readdressing training needs (Sau et al. 2004).

The application of vacuum requires the understanding of the anatomy of the fetal head and the position of the flexion point. The flexion point is an imaginary spot over the sagittal suture of the fetal skull, located approximately 6 cm posterior to the centre of the anterior fontanelle or 1–2 cm anterior to the posterior fontanelle. When the cup is properly placed with its centre over the flexion point, the edge of a standard 60 mm cup lies approximately 3 cm or 2 fingerbreadths behind the centre of the anterior fontanelle in the midline over the sagittal suture. The cup has to be applied as much as possible near to the posterior fontanelle, with the edge of the cup 2 finger breadths from the anterior fontanelle. (See Figure 3 for occipito anterior and Figure 4 for occipito posterior.) The traction should always be directed perpendicular to the fetal head and neither twists obliquely nor extends the head as force is applied (Figure 5). The direction of pull on the traction handles changes as the fetal head transverses the pelvic curve. This will allow traction that maintains flexion and in the direction of the pelvic floor. In occipito posterior, the use of the posterior metal cup is preferable to the plastic cup, as the rate of detachment is less than with the plastic cup.

Failure of instrumental delivery and difficult second stage caesarean section leading to major postpartum haemorrhage, uterine and vaginal tears, hysterectomy and major maternal morbidity

Two retrospective studies comparing operative vaginal delivery in the labour room with deliveries in an operating theatre reported a doubling in the decision-to-delivery interval when deliveries were carried out in theatre (Olagundoye and MacKenzie 2007; Murphy and Koh 2007). However, trial of instrumental delivery in theatre reduces any delay that might follow an unsuccessful attempt at instrumental delivery requiring transfer of the patient

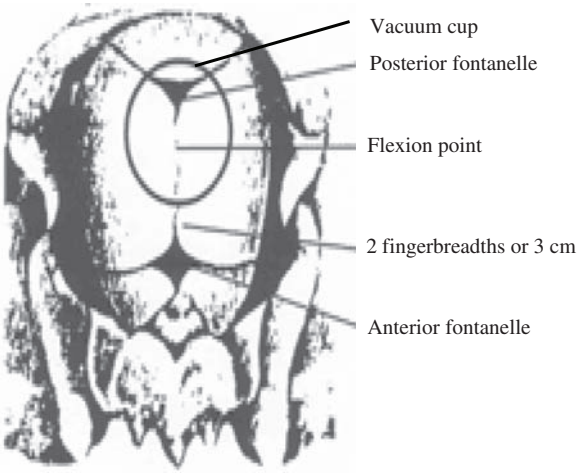

Figure 3. Position of the cup in the occipito anterior position.

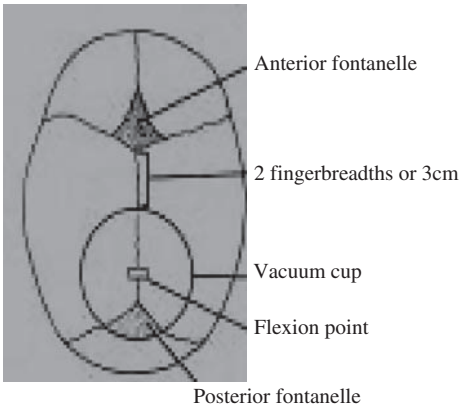

Figure 4. Position of the cup in the occipito posterior position.

to the operating theatre. A delay in delivery following failed instrumental delivery can result in hypoxic injury (Olagundoye and MacKenzie 2007). Therefore, the risks of failed operative vaginal delivery in the labour room should be balanced with the risks associated with the transfer time when the delivery is conducted in an operating theatre. The use of sequential instrumental delivery is sometimes indicated to avoid a difficult second stage caesarean section. This must be balanced with the increased risk of neonatal trauma associated with sequential use of instruments (Al-Kadri et al. 2003; Ezenagu et al. 1999; Gardella et al. 2001).

The recent RCOG guidelines (RCOG 2011) have summarised the preoperative precautions, which was adapted from the Society of Obstetricians and Gynaecologists of Canada and the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG 2009a,b). This should be the standard obstetricians follow. Failure of instrumental delivery could be as a result of an inexperienced operator, inadequate assessment, large caput and moulding and traction in the wrong direction. The sagittal suture should lie in the midline of the shanks and the operator cannot place more than a fingertip between the fenestration of the blade of the forceps and the fetal head. In vacuum, the cup should be placed on the flexion point. In the case of large caput, a trial to feel the fetal ear will be helpful to identify the occipital position. If there is no descent with one instrument, the procedure should be abandoned and a caesarean section performed instead.

Figure 5. Traction should be perpendicular to fetal head all the time during contraction.

Trial of instrumental delivery should be performed or supervised by a very experienced obstetrician to avoid the use of sequential instruments and to be able to deal with a difficult second stage caesarean section that may result from the failure of instrumental delivery. Anticipation of possible failure of instrumental delivery would reduce perseverance to achieve vaginal delivery and hence, difficult delivery. This could be anticipated in the presence of: maternal obesity; a clinically big baby; occipito posterior position; mid-cavity delivery; one-fifth of the head being palpable per abdomen; a prolonged late first stage of labour and a prolonged second stage of labour (Murphy et al. 2001).

Postpartum haemorrhage (PPH)

Instrumental delivery is a known risk factor for PPH, which can lead to serious maternal morbidity and mortality. Two cases of maternal mortality were reported in two separate reports in the Confidential Inquiry into Maternal Deaths of 1988–1990 and 1994–1996 (DoH et al. 1994, 1998). One death was due to cervical laceration from vacuum delivery and the other death resulted from a ruptured uterus related to instrumental delivery. However, maternal mortality from instrumental delivery is extremely rare. The commonest cause of PPH is uterine atony due to prolonged labour, either first or second stage, induction of labour, obesity, shoulder dystocia and second stage caesarean section after failure of instrumental delivery. All necessary precautions should be taken to avoid major PPH in these circumstances and in any other condition which is known to carry risk of PPH.

Bladder dysfunction

Instrumental delivery in the cases of prolonged labour, epidural or spinal analgesia, sequential instrumental delivery and failed instrumental delivery, is a risk factor for postpartum urinary retention, which can be associated with long-term bladder dysfunction (Carley et al. 2002; Yip et al. 2004; Groutz et al. 2001). Every unit should have clear guidelines for bladder care following an instrumental delivery, taking into consideration the above risk factors.

Psychological and psychosexual problems

Operative vaginal delivery can be associated with a fear of subsequent childbirth and in severe form, may manifest as a post-traumatic stress-type syndrome (RCOG 2011). Several studies have looked at debriefing approaches to reducing the psychological morbidity following childbirth (Small et al. 2000; Lavender and Walkinshaw 1998). There is no evidence to support the use of formal debriefing alone in reducing the risk of subsequent postnatal depression for women who have experienced operative vaginal delivery. This is possibly due to multiple factors leading to these conditions. Factors which could lead to psychological trauma or psychosexual problems are: a lack of support in labour; inadequate pain relief in labour and during instrumental delivery; poor communication and debriefing during and after instrumental delivery; urine retention and bladder dysfunction; inadequate immediate postnatal care, especially in the presence of painful perineal or vaginal tears; lack of physiotherapy support and denying women a postnatal follow-up appointment for support; debriefing; vaginal and perineal assessment and support regarding the plan for future delivery.

Fetal complications of instrumental delivery

Shoulder dystocia

There can be significant perinatal morbidity and mortality associated with shoulder dystocia, even when it is managed appropriately (Gherman et al. 1998). Brachial plexus injury is one of the most important fetal complications of shoulder dystocia. Previous shoulder dystocia; prolonged first stage of labour; a clinically large baby; diabetes mellitus; maternal obesity and prolonged second stage of labour, are risk factors for shoulder dystocia during instrumental delivery. Hence, the obstetrician should be vigilant in identifying early signs of shoulder dystocia and seek support in advance.

Other neonatal complications

These include: scalp laceration; facial nerve palsy; cephalohaematoma (subperiosteum haematoma); subdural haematoma; subgaleal haematoma; corneal injury; retinal haemorrhage (no adverse long-term effect); skull fracture; cervical spine injury and hyperbilirubinaemia; intrauterine hypoxia leading to cerebral palsy.

Neonatal subgaleal and intracranial haemorrhage are life-threatening complications. The incidence of subgaleal haematoma is 16/10,000 deliveries. It develops within 1–24 h following delivery. This is caused by the rupture of the emissary vein in the loose sub-aponeurotic tissue. The haematoma spreads in a large space, which extends from the orbit to the nape of the neck, causing a large collection of blood that can lead to hypovolaemic shock. It is more common with vacuum rather than forceps delivery. Hence, it has been suggested that vacuum extractors should not be used at gestations of less than 36 weeks because of the risk of subgaleal and intracranial haemorrhage (Vacca 1999; Rosemann 1969).

The incidence of subdural or cerebral haemorrhage does differ significantly between vacuum, forceps and caesarean section delivery. However, the risk is significantly higher among babies exposed to sequential instrumental delivery (Towner et al. 1999).

Neonatal injuries due to instrumental delivery are usually multifactorial. The factors include: a large caput, making it difficult to localise the position and type of the fontanelles; excessive traction with forceps; sequential use of instruments; traction in the wrong direction; continuous tractions in absence of uterine contractions; the vacuum cup not being on the flexion point leading to head deflexion; recurrent detachment of the vacuum cup due to excessive traction; traction not being kept perpendicular to the vertex all the time; prolonged traction time of more than 20 min; the forceps blades being kept locked at all times; failure to abandon the procedure on time and failure to ask for help.

Ventouse has become the first-line instrument for vaginal operative delivery, in-keeping with published recommendations, but this has led to inappropriate use in some cases, particularly by less experienced obstetricians. In cases of arrested progress in the second stage of labour with borderline disproportion, it may prove safer to perform a trial of vaginal delivery in theatre by forceps, with a maximum of three pulls rather than an initial attempt by ventouse followed by a further attempt with forceps (Murphy et al. 2003).

Medico-legal issues

The total value of claims between 1 April 2000 and 31 March 2010 for operative vaginal delivery was £93,659,223, according to the UK National Health Service Litigation Authority report (NHS 2012), which is approximately £10,000,000 annually.

Generally, human error is routinely blamed for when things go wrong in healthcare. However, quick judgements and routine assignment of blame obscure a more complex truth. The identification of an obvious departure from good practice is usually only the first step of an investigation. Although a particular action or omission may be the immediate cause of an incident, closer

analysis usually reveals a series of events and departures from safe practice, each influenced by the working environment and the wider organisational context (Vincent et al. 2002).

Medico-legal issues arise from:

- Failure to exercise adequate medical judgements when assessing which cases are appropriate for an instrumental operation and when and where that intervention should take place
- Failure to anticipate risk factors and understand or accept the limitations of the procedure itself and plan in advance for possible failure
- Failure to abandon timely a trial of instrumental delivery
- Failure to recognise CPD
- Failure to seek help from a senior colleague when needed
- Failure to take paired cord blood samples following all attempts at operative vaginal delivery
- Failure to follow an agreed protocol (without clinical justification)
- Inadequate documentation
- Failure to supervise a junior member of staff adequately.

How to reduce the risks of litigation

To reduce litigation, trainees should be supervised until they become competent in performing instrumental delivery. Practical training using simulators and mannequins can be useful to enhance training and enables trainees to learn how to achieve the appropriate force with the help of computer-assisted visual feedback (Sinha et al. 2010).

Regular labour ward skills and drills in instrumental delivery are needed to maintain these skills. A trial of instrumental delivery in theatre should be performed or supervised by the most senior obstetrician. Instrumental delivery proforma is useful to improve documentation. The patient should be briefed of labour circumstances and of any morbidity and its implication on the short and long term. Postnatal follow-up should also be organised. Regular review of cases of failed instrumental delivery and medico-legal cases is very useful to increase the awareness of all staff.

The following are some key points which are useful to implement when morbidity arises from instrumental delivery (adapted from Vincent et al. 2002):

1. Ensure that failed instrumental delivery is reported.
2. Trigger the investigation procedure when morbidity arises. Notify senior members of staff who have been trained to carry out investigations.
3. Establish the circumstances as they initially appear and chronology of events, and identify any obvious care management problems.
4. Interview juniors if necessary.
5. Identify both specific and, where appropriate, general contributory factors.
6. Compile a report of events, listing causes of care management problems and recommendations to prevent recurrence.
7. Anonymously present cases in informal meetings to learn from mistakes.
8. Implement actions arising from the report and monitor progress.

Conclusion

The right equipment in the right hands can achieve a good and safe maternal and fetal outcome. This requires a high level of training and supervision of the trainees until they achieve the necessary competence level. Operative vaginal delivery should be abandoned where there is no evidence of progressive descent with moderate traction during each contraction or where delivery is not imminent following three contractions of a correctly applied instrument by an experienced operator.

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