Effects of valsalva manoeuvre on maternal and fetal wellbeing

By Caroline J Hollins Martin

Attention is now rightly focusing on the appropriateness of midwives ‘instructing women to push’ in the second stage of labour. ‘Purple pushing’ (otherwise known as closed-glottis pushing or valsalva manoeuvre) is a procedure which involves the midwife instructing a woman to hold her breath for ten seconds while forcefully pushing down during a contraction in the second stage of labour. This is followed by an increase in intrathoracic pressure and subsequent rise in maternal blood pressure. After a few seconds of forceful pushing, intrathoracic pressure exceeds that of the vessels which return blood to the heart and is followed by a decrease in maternal blood pressure, cardiac return and cardiac output (Barnett and Humenick, 1982). The purpose of valsalva manoeuvre is to shorten the length of second stage (Barnett and Humenick, 1982), reduce the incidence of fetal hypoxia (Katz et al, 1987) and reduce maternal fear and fatigue (Roberts et al, 2001). A number of research studies have examined the effects of purple pushing in second stage upon maternal and fetal wellbeing. The aim of this article is to relate the basic findings from research papers to assist midwives’ understanding of what underpins the Royal College of Midwives (RCM, 2007) second stage guidelines.

Search strategy
A review of literature was undertaken in December 2008. Several electronic databases were searched (Medline, CINAHL, MIDIRS, The Cochrane Database of Systematic Reviews (CDSR) and the Cochrane CENTRAL Register of Controlled Trials (CENTRAL). A general internet search using standard search engine (Google) was performed and reference lists were hand-searched for additional references. A combined free-text and thesaurus approach was adopted, using search terms such as labour, second stage of labour, management of labour, pushing, directed pushing, active pushing and valsalva manoeuvre. No inclusion or exclusion criteria were used since only 16 studies relate to the question, ‘what are the effects of valsalva manoeuvre upon maternal and fetal wellbeing?’ Analysis of the literature unearthed four main consequences from purple pushing in second stage. These include: an increase in fetal distress; maternal distress; and perineal trauma, when compared with spontaneous pushing. Valsalva manoeuvre also makes little difference to length of second stage. Key conclusions from this literature review are that women should be encouraged to push instinctively, which often embraces natural vocalization. Restrictions of time should not be imposed when mother and fetus are well. Awaiting instinctive behaviour reduces the incidence of urinary system, pelvic floor and perineal trauma. These findings should facilitate midwives to critically understand research that underpins the Royal College of Midwives (2007) second stage of labour guidelines.

Effects of valsalva manoeuvre on fetal wellbeing
Midwives measure fetal distress in several ways:
- Recording a fetal cardiotocograph (CTG)
- Extracting umbilical cord blood to ascertain levels of fetal hypoxia/acidosis
- Observing liquor amni for meconium staining
- Perinatal assessment using Apgar scores

Eight papers were unearthed that provide information about the effects of purple pushing on fetal condition.

Aldrich and colleagues (1995) conducted a prospective study in the UK that compared levels of fetal cerebral oxygenation and cerebral blood volume before and during maternal pushing in second stage (n=10 women with normal pregnancies). Participants were continuously monitored using CTG and a fetal optical probe to assess oxygen saturation levels. Immediately post-delivery, umbilical cord blood was collected for pH, base excess and haemoglobin. Results showed that coordinated and sustained maternal pushing is associated with a significant decrease in fetal cerebral oxygenation.

Barnett and Humenick (1982) found that long, hard valsalva pushing during second stage increased fetal acidosis. Women with normal pregnancies in first stage of labour (n=10) were randomly assigned to either: a long valsalva closed-glottis pushing group (breathholding for ten seconds while pushing); or a short open-glottis pushing group (allows exhalation while bearing down). Neonatal outcomes were...
assessed through measurement of umbilical blood gases. No significant difference between groups was established. Umbilical vein pH was found to be significantly higher among open-glottis pushers. Hence, long hard valsalva pushing, in comparison to open-glottis pushing, increases fetal acidosis (lowers pH) levels.

Hansen and colleagues (2002) in a randomized controlled trial (RCT) compared perinatal outcomes from two groups: women with epidurals who were actively encouraged to push at full dilatation (Group 1); and women who had a period of rest before active encouragement to push at full dilatation (Group 2). Five variables were measured: rate of fetal descent; length of time of pushing; number and type of fetal heart rate decelerations; Apgar scores; and arterial cord pH values. Group 2 were found to have a decrease in pushing time and fewer decelerations. Apgar scores and arterial cord pH values were found to be similar in both groups. Consequently, a delay in pushing is not associated with demonstrable adverse outcome, even when second-stage is as long as 4.9 hours. Therefore, delayed pushing in second stage of normal labourers appears to have benefits.

Nordstrom and colleagues (2001) conducted an observational study of randomly selected labouring women. Fetal blood lactate concentrations were measured during second stage ($n=69$) (Normal blood lactate concentration in unstressed patients is 1–0.5 mmol/litre. Hyperlactatemia is defined as mild-to-moderate at 2–5 mmol/litre, and acidosis is diagnosed above 5 mmol/litre). Mean fetal scalp lactate levels at five observation points during second stage (15 minutes apart) were found to be 2.4, 3.1, 4.2, 4.9 and 5.8. Duration of active second stage was significantly associated with an increase in blood fetal lactate levels ($P=0.001$), and cord lactate post delivery ($P=0.001$). Findings show that fetal lactate concentrations significantly increase with duration of active second stage, with fetal anaerobic metabolism the cause (Nordstrom et al, 2001).

Paine and Tinker (1992) compared two types of maternal bearing-down technique and measured their effects upon fetal and maternal blood pH and length of second stage. Participants were assigned to: a valsalva group ($n=14$); or a spontaneous pushing group ($n=16$). No significant difference in fetal and maternal blood pH and length of second stage between the two groups was found.

Schneider and colleagues (1990) examined numbers of ‘bearing down efforts’ and the relationship with maternal/fetal lactate levels ($n=69$). Maternal blood concentrations and cord samples were measured post-delivery. Both maternal and fetal lactate concentration at delivery was found to significantly correlate (increase) with number of bearing down efforts.

Simpson and James (2005) in an RCT measured fetal

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<td><strong>Purple pushing increases fetal compromise</strong></td>
<td>Aldrich and colleagues (1995) found sustained maternal pushing to be associated with a significant decrease in fetal cerebral oxygenation. Barnett and Humenick (1982) found that long hard valsalva pushing during second stage of labour increases fetal acidosis (lowers pH). Nordstrom and colleagues (2001) found fetal lactate concentrations significantly increasing with duration of active second stage. Schneider and colleagues (1990) found a significant correlation between fetal lactate concentration at delivery and number of bearing down efforts. Thomson (1993) found that a lengthened period of directed pushing is more disadvantageous to the fetus than spontaneous pushing.</td>
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<td><strong>Purple pushing has no deleterious effects on fetus/neonate</strong></td>
<td>Paine and Tinker (1992) found no significant difference in fetal and maternal blood pH between valsalva and spontaneous pushing group. Yeates and Roberts (1984) found no difference in Apgar scores between a control group taught to bear down while holding their breath and an experimental group taught to bear down when an involuntary urge to push was felt.</td>
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<td><strong>Better to delay pushing at 10 cm dilatation until urge felt</strong></td>
<td>Hansen and colleagues (2002) found fewer decelerations when a period of rest is afforded at full dilatation before actively encouraging to push. Simpson and James (2005) found delayed pushing and encouragement of open-glottis pushing once the urge to push is felt to be more favourable for fetal wellbeing than coached closed-glottis pushing at full dilatation.</td>
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wellbeing in two groups (n=45): group 1 coached closed-glottis pushers at full dilatation; and group 2 delayed open-glottis pushers who spontaneously felt the urge to push.

Group 2 were found to produce better fetal outcomes. Group 1 had lower fetal oxygen desaturation during second stage (P=0.001) (less than normal amounts of oxygen carried by haemoglobin in the blood), and more fetal heart variable decelerations (P=0.02). No difference in Apgar scores and umbilical cord blood gases was found between groups 1 and 2. Hence, delayed pushing until the urge to push is, along with encouraged open-glottis pushing, more favourable for fetal wellbeing than coached closed-glottis pushing at immediate 10 cm dilatation.

Thompson (1993) in an RCT compared spontaneous pushers (n=15) and directed pushers (n=17), based on need for resuscitation and cord venous blood gas values at delivery. No adverse effects from awaiting spontaneous pushing were found. A negative correlation between length of second stage and venous cord blood pH levels at delivery in the directed pushing group was also found. Findings support that a lengthened period of directed pushing is more disadvantageous to the fetus than spontaneous pushing.

Yeates and Roberts (1984) studied the effects of bearing down in second stage upon the fetus/neonate. A control group were taught to bear-down while breath holding (n=5), and an experimental group (n=5) was encouraged to follow their natural instincts and bear down when they felt an involuntary urge to push. No difference in Apgar scores between the two groups was found.

For a brief summary of the effects of ‘purple pushing’ on fetal wellbeing see Table 1.

Effects of valsalva manoeuvre on maternal wellbeing

Directed pushing can unnecessarily distress women. When left to their own devices in second stage, instinct guides a spontaneous urge to push. Yet, many midwives feel compelled to impose strict instructions on how to breathe and bear down (Yeates and Roberts, 1984). The question is, does this drill sergeant approach expedite or impede delivery and what effects does it have upon maternal wellbeing?

Rossi and Lindell (1986) observed spontaneous positions adopted and breathing techniques used by women in second stage (n=50 low risk women 28–40 weeks gestation). In a non-prescriptive environment, women were found to spontaneously adopt open-glottis pushing. Behaviours exhibited differed considerably from when the closed glottis/valsalva regime was implemented. It was concluded that women instinctively know how to labour and do not require forceful direction in order to have successful outcomes.

Nordstrom and colleagues (2001) determined maternal blood lactate concentrations during second stage (n=69). Mean venous lactate levels at five observation points during second stage were found to be 2.6, increasing to 3.6, 4.2, 4.8, 5.4 for every 15 minutes of bearing down. Duration of active second stage was significantly associated with an increase in maternal lactate at crowning of the head (P=0.03).

Schneider and colleagues (1990) studied the relationship of bearing-down efforts to maternal and fetal lactate levels. Maternal blood lactate concentrations at delivery were found to significantly correlate with number of bearing-down efforts (n=69). It is therefore recommended that midwives avoid encouraging early pushing, since it increases stress and anxiety levels of labouring women. Provision of quality psychological support is recommended instead.

Williams and colleagues (1998) determined the effect of second-stage pushing on cerebral blood flow during labour and delivery (n=15). Maternal middle cerebral blood flow velocity was assessed continuously during labour using transcranial doppler ultrasonography. Assessment was performed during the peak of a contraction at the trough of a contraction and when pushing in second stage. Maternal cerebral blood flow speed fell, pulse was raised by 16 beats/minute and no change in blood pressure was found while pushing in second stage. Hence, valsalva manoeuvre does not expose childbearing women to risk of a middle cerebral vasospasm.

Thomson (1995) in a pilot RCT compared spontaneous (n=15), and directed (n=17) pushers. Observations found that women do not instinctively take a deep breath during spontaneous pushing, or commence expulsive effort at commencement of a contraction. In fact, instinctively they incorporate open and closed-glottis pushing. Thomson concluded that it is important that midwives understand what is considered normal second stage behaviour and that they provide support and permit women to instinctively labour.

Roberts and colleagues (2007) descriptively analyzed midwives’ care provision during second stage of labour. Communications of ten birth attendants and ten women were filmed during expulsive labour. Findings showed that midwives were more likely to provide directions on how to push when there is maternal distress, fatigue, fear and pain.

Yeates and Roberts (1984) studied the effects of women’s bearing-down efforts in second stage. Participants were allocated to a control group who were encouraged to push while holding their breath (n=5), and an experimental group who were taught to bear down when they experienced an involuntary urge to push (n=5). No difference between groups in relation to reports of maternal effort was found.

For a summary of the effects of purple pushing on maternal wellbeing see Table 2.
Effects of valsalva manoeuvre on length of second stage

The rationale for introducing valsalva manoeuvre was a belief in its ability to shorten second stage (Bosomworth and Bettany-Saltikov, 2006; Rossi and Lindell, 1986), reduce fetal hypoxia (Katz et al, 1987) and avoid maternal fear and fatigue (Roberts et al, 2007). Prescriptions for second stage length in a primigravida is one hour, after which medical assistance should be sought (Enkin et al, 2000). This limit is contradicted by research which indicates that when this time is doubled outcomes are usually good (Albers, 1999).

Barnett and Humenick (1982) examined the effects of long, hard valsalva pushing upon length of second stage. Ten women with normal pregnancies and first stage labours were randomly assigned to either a long valsalva (closed-glottis) pushing group and a short open-glottis (characterized by vocalization) pushing group. No significant difference in length of second stage between these two groups was found.

Sampselle and colleagues (2005) compared differences in duration or time spent pushing between an ‘active instruction to push’ group and a ‘natural pushing’ group (n=20 primigravidas). Maternal pushing behaviour (spontaneous or directed) was filmed. Results found no significant difference between groups in relation to duration of second stage (P=0.95) or time spent pushing (P=0.89).

Bloom and colleagues (2006) investigated the effects of ‘active coaching of maternal expulsive effort’ upon length of second stage. At second stage onset midwives instructed term nulliparous women (n=163) to push during contractions (glottis closed), while maintaining adequate ventilation between contractions. The control group (n=157) were told to ‘do what comes naturally’. The mean duration of second stage was significantly shorter (P=0.014) in the coached group (46 minutes), in comparison to the spontaneous pushers (59 minutes).

Yeates and Roberts (1984) studied the effects of women’s efforts to bear down upon length of second stage. A control group were taught the traditional approach of bearing down while holding their breath (n=5), and an experimental group were taught to bear down when they experienced an involuntary urge to push. No significant difference between groups in mean duration of second stage was found.

Simpson and James (2005) conducted an RCT to evaluate the effects on fetal wellbeing of coached closed-glottis pushing at 10 cm dilation, and delayed open-glottis pushing once urge to push is felt (n=45). Results found no differen...
ences in length of labour or method of birth.
For a brief summary of the effects of purple pushing on length of second stage see Table 3.

**Effects of valsalva manoeuvre on trauma**
Trauma is an important factor to consider when assessing overall efficacy of directed pushing. Tears are a measurable outcome, since they can be categorized in terms of intact perineum, first-, second- or third-degree tears and episiotomy (Bosomworth and Betamy-Saltikov, 2006).
Sampselle and Hines (1999) retrospectively requested information about perineal damage in 39 primiparous women who had had spontaneous vaginal births. During the first postpartum week, women were asked to describe the type of pushing they used during second stage, about levels of pain experienced in the perineum and vaginal area, and partograms documented the magnitude of perineal trauma sustained (episiotomy/laceration). Eleven (28%) reported using spontaneous bearing-down efforts and 28 (72%) reported that the midwife had directed their pushing. Findings showed

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<td>Active pushing makes no difference to length of second stage</td>
<td>Barnett and Humenick (1982) found no significant difference in length of second stage between valsalva and open-glottis pushers.</td>
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<td>Sampsele and colleagues (2005) found that neither duration of second stage between a control group taught to bear down while holding their breath and an experimental group taught to bear-down when they experienced an involuntary urge to push.</td>
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<td>Simpson and James (2005) found that delayed open-glottis pushing once urge to push is felt, in comparison to coached closed-glottis pushing at 10 cm dilatation makes no differences to length of labour or method of birth.</td>
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<td>Active pushing shortens length of second stage</td>
<td>Bloom and colleagues (2006) found that mean duration of second stage was significantly shorter (P=0.014) in a coached pushing group (46 minutes), when compared to a control who did what comes naturally (59 minutes).</td>
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<td>Purple pushing increases the chances of sustaining bladder and perineal damage</td>
<td>Sampselle and Hines (1999) found that women who spontaneously push are more likely to have intact perineums and reduced episiotomies or second/third degree lacerations (P=0.043).</td>
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<td>Schaffer and colleagues (2005) found coached pushing in second stage to significantly affect urodynamic indices associated with increased detrusor overactivity.</td>
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<td>Simpson and James (2005) found that immediate pushers at full dilatation had more perineal lacerations than spontaneous pushers.</td>
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<td>Bloom and colleagues (2006) found active coaching compared with no coaching associated with impaired pelvic floor function, reduced bladder capacity and urinary urgency.</td>
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<td>Yeates and Roberts (1984) found that perineal integrity is more likely to be preserved in involuntary pushers compared to those who are actively encouraged to push.</td>
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that spontaneous pushers had less perineal damage. That is, they were less likely to have had episiotomies or second/third degree lacerations (P=0.043). Maternal age, infant birthweight, length of second stage, provider type and use of epidural affected no significant difference to perineal outcomes. A significant relationship between the extent of perineal disruption and pain was found (P=0.005).

Schaffer and colleagues (2005) determined whether refraining from coached pushing during second stage affected urogynecologic measures of pelvic floor structure and function postpartum. Term nulliparous women were randomized to a coached (n=67) pushing group and an uncoached (n=61) pushing group. Participants underwent urodynamic testing, pelvic organ prolapse examination (POPQ) and pelvic floor neuromuscular assessment at three months postpartum. Urodynamic testing revealed decreased bladder capacity (P=0.051) and decreased first urge to void (P=0.025) in the coached pushing group. Detrusor overactivity increased two-fold in the coached pushing group (16% vs 8%), although this difference was not statistically significant (P=0.17). Urodynamic stress incontinence was diagnosed at 16% in the coached pushing group, and 12% in the uncoached pushing group (P=0.42). Schaffer and colleagues (2005) conclude that coached pushing in second stage of labour significantly affects urodynamic indices and is associated with a trend towards increased detrusor overactivity.

Simpson and James (2005) in an RCT evaluated fetal well-being in coached closed-glottis pushers at 10 cm dilation and delayed open-glottis pushers once urge to push is felt (n=45). Women who pushed immediately had more perineal lacerations (P=0.01). Immediate (n=13) and delayed (n=5).

Bloom and colleagues (2006) assessed the effects of actively coaching maternal expulsive efforts on perineal damage. At second stage onset midwives instructed term nulliparous women to push during contractions with the glottis closed (n=163), while maintaining adequate ventilation between contractions. The control group (n=157) were told to ‘do what comes naturally’. Active coaching compared with no coaching was found to be associated with impaired pelvic floor function as well as reduced bladder capacity and increased urinary urgency. Consequently, active coaching can have long-term adverse effects on pelvic floor function, with damage possibly injurious for long-term reproductive health of women.

Yeates and Roberts (1984) studied the effects of women’s bearing-down efforts during second stage. A control group were taught the traditional approach of bearing down while holding their breath (n=5), and an experimental group (n=5) were coached to bear down when they experienced an involuntary urge to push. Differences between groups were found in relation to perineal damage, with integrity more likely to be preserved in the involuntary urge group. Put simply, instinctive bearing-down efforts are accompanied by reduced perineal trauma measures. This result supports that women should be encouraged to respond to involuntary urges, instead of being strenuously coached to push in second stage.

For a brief summary of the effects of purple pushing on perineal trauma see Table 4.

Discussion

The main rationale for why midwives direct pushing during second stage is to shorten length (Barnett and Humenick, 1982; Bosomworth and Bettany-Saltikov, 2006), reduce fetal hypoxia (Katz et al, 1987) and avoid maternal fear and fatigue (Roberts et al, 2001). Research reports that directed pushing actually increases maternal stress (Nordstrom et al, 2001), and that ordinarily women will do what midwives tell them (Sampselle et al, 2005). If left to their own devices during second stage, women will adopt spontaneous pushing that does not involve naturally holding their breath and subsequently bearing down (Rossi and Lindell, 1986).

It is imperative that midwives take heed of the evidence and incorporate research findings into the guidelines and protocols that direct their practice. Although some of the studies cited have notable flaws (e.g. small sample size, selection bias and failure to randomize participants), several conclusions can still be drawn. One key finding is that routine valsalva or holding breath style pushing (purple pushing) can have
detrimental effects for both woman and neonates. Sustained maternal pushing has shown to compromise the fetus (Barnett and Humenick, 1982; Schneider et al, 1990; Aldrich et al, 1995; Nordstrom et al, 2001) and increase maternal distress (Schneider et al, 1990; Nordstrom et al, 2001). In other words, the evidence supports that spontaneous pushing has benefits over directed valsalva type pushing in terms of fetal and maternal wellbeing (Roberts, 2002; RCM, 2007). Overall evidence supports that midwives should not prescriptively direct pushing, but instead provide support for unprompted natural pushing.

Women should be encouraged to push instinctively, which often embraces natural vocalization and restrictions of time should not be imposed when mother and fetus are well (Yeates and Roberts, 1984; Sampselle et al, 2005; Simpson and James, 2005). When second stage is progressing well and mother and fetus are in a satisfactory condition, there is no need to support an arbitrary imposition of time limits on duration (Enkin et al, 2000). Adverse outcomes attributed to prolonged second stage are consequent of underlying causative factors and not directly attributable to duration (Sleep, 1990; RCM, 2007). It is better to await the spontaneous urge to push, even when the women has had an epidural (RCM, 2007). Take heed, during a latent phase of second stage, it is normal for the women to feel no urge to push (RCM, 2007). Natural childbirth also reduces stress and anxiety levels of childbearing women (Scheider et al, 1990). Awaiting instinctive behaviour has been shown to reduce urinary system, pelvic floor and perineal trauma (Beynon, 1957; Yeates and Roberts, 1984; Sampselle and Hines, 1999; Bloom et al, 2006).

Conclusion

The findings in this article should help midwives to critically understand what underpins the RCM (2007) second stage guidelines (Box 1).


Key Points

- Attention is now rightly focusing on the appropriateness of midwives ‘instructing women to push’ in second stage of labour.

- ‘Purple pushing’ (otherwise known as closed-glottis pushing or valsalva manoeuvre) is a procedure which involves the midwife instructing a woman to hold her breath for ten seconds while forcefully pushing down during a contraction.

- ‘Purple pushing’ increases the incidence of fetal and maternal distress in comparison to spontaneous pushing.

- Valsalva manoeuvre makes little difference to length of second stage.

- Awaitting instinctive behaviour reduces the incidence of urinary system, pelvic floor and perineal trauma.

- The RCM guidelines reflect these findings.