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Factors associated with postpartum shivering: a cross-sectional study

The objective of this study was to investigate the postpartum shivering phenomenon. We carried out a cross-sectional study on a sample of 597 pregnant women. Logistic regression analyses were built. Independent variables were: parity, labour induction with prostaglandin agonist, oxytocin infusion during labour, amniotomy, epidural anaesthesia, premature rupture of membranes (PROM), postpartum fever, gestational age, mode of birth. Dependent variables were: mild shivering, severe shivering (severity of shivering) and shivering lasting: less than 30 minutes; between 30 minutes and one hour; more than one hour (duration of shivering). We found that both severity and duration of postpartum shivering phenomenon were associated with rupture of membranes (spontaneous or artificial), fever, caesarean section and oxytocin infusion. The conclusion reached was that those associations could be logically explained by already-known causes of chills. Further studies should assess those causes after birth.

INTRODUCTION

To date, shivers or rigors onset after birth have been considered normal in parturients. The pathophysiology of such a phenomenon has not been clearly established, although it was suspected that rigors were related to amniotic fluid transfusion from uterus to maternal vascular bed; but Benson et al (2006) tried and failed to prove this. Spread data suggest that shivering after birth could have the same causes as chills in other conditions.

When Benson et al investigated the postpartum shivering phenomenon in an observational study (2008), they built multivariable models assessing the duration and severity of shivering in relationship to 13 independent variables. Their results demonstrated a relationship between shivering and: mode of birth; epidural anaesthesia; gestational age; and parity. As stated by the authors, their models do not entirely explain the variability and may be biased as a result of inaccurate data collection. Moreover, the choice of independent variables in that study is not entirely logical. For example, the authors controlled for duration of the active phase of labour, but are unable to explain *why* a long-lasting active phase of labour should link to the shivering phenomenon.

Therefore, we judged that the postpartum shivering phenomenon had not been fully investigated. The aim of this study is to try to assess the issue anew, from what we considered a logical point of view.

METHODS**DATA COLLECTION**

We built a cross-sectional study at the Fatebenefratelli Hospital in Rome. Data were collected between December 2011 and September 2013 from labouring pregnant women and those scheduled for planned caesarean section. The presence and severity of chill was assessed in a subjective way by Silvia Scilimati, based on the amplitude of rigors: no chills; mild chills; or severe chills. Additionally, the duration of chills was assessed in minutes. Data on the presence of fever were collected twice – at the beginning and at the end of the postpartum period (from birth to two hours afterwards). The two measurements of cutaneous temperature were averaged.

DISCLOSURE OF DEPENDENT AND INDEPENDENT VARIABLES

The dependent variables were the severity of shivering (mild or not; severe or not) and the duration of shivering (less than 30 minutes; between 30 minutes and one hour; or more than an hour). Therefore, we built five logistic regression analyses by considering the following independent variables: parity (multiparity/nulliparity); labour induction with prostaglandin agonist dinoprostone (yes/no); oxytocin infusion during labour (yes/no); amniotomy (yes/no); epidural anaesthesia (yes/no); premature rupture of membranes (PROM) (yes/no); fever (yes/no, with fever considered when mean cutaneous temperature was equal to or greater than

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37.1°C); gestational age (pre-term, early term, full term or late term; reference category: full term); and mode of birth (vaginal birth, operative vaginal delivery, caesarean section; reference category: vaginal birth).

CHOICE OF INDEPENDENT VARIABLES

The decision to introduce the above-mentioned independent variables in multivariable logistic models was dictated by the literature and logical issues. Benson et al (2008) had demonstrated relationships between shivering and mode of birth, epidural anaesthesia, gestational age and parity. In the Benson et al article, temperature (during labour) fails to reach significance, despite the fact that it is relevant to the variability of a model. We introduced in our models all the significant above-mentioned variables found by Benson et al. Indeed, fever was introduced as an independent variable if it was found in the postpartum period.

Prostaglandin agonist dinoprostone, used to induce labour, has the same pharmacological behaviour as the prostaglandin agonist misoprostol used for preventing postpartum haemorrhage (Tunçalp et al 2012). So some cases of rigors could relate to pharmacological labour induction. Therefore, pharmacological labour induction was introduced in the multivariable models. Amniotomy and PROM were introduced in multivariable models because they could associate with intrauterine infections (Cohain 2013; Blanchon et al 2013). Finally, Benson et al (2008) had found that the length of the second stage of labour seemed to be associated with multiple rigors. In the Benson et al (2008) setting, a long-lasting second stage of labour should have been managed with oxytocin infusion. Therefore, we chose to introduce oxytocin administration as an independent variable in logistic regression models, hypothesising that oxytocin infusion may provoke rigors.

A software package was used for statistical analysis, with $p < 0.05$ as significant.

RESULTS

During the study period, 597 cases were collected (mean age 33.2, ± 5.53 ; 47.2 per cent multiparas, 50.3 per cent full term, 6.7 per cent preterm, 34 per cent early term, 9 per cent late term, 8.2 per cent labour induction with prostaglandin agonist, 38.7 per cent oxytocin infusion, 32.7 per cent amniotomy, 46.6 per cent epidural analgesia, 13.7 per cent PROM, 4.9 per cent fever in the post-partum, 3.7 per cent operative vaginal birth, 39.4 per cent caesarean section).

Mild shivering was found in 28 per cent of cases and severe shivering was found in 22.6 per cent of cases. Shivering lasting less than 30 minutes was observed in 18.8 per cent of cases; between 30

minutes and one hour was observed in 12.6 per cent of cases; shivering lasting one hour or more was observed in 19.3 per cent of cases.

After multivariable logistic regressions, the odds ratios for having shivering were increased by: oxytocin infusion, amniotomy, PROM, fever in the post-partum, caesarean section.

Mild shivering was more likely in case of oxytocin infusion (odds ratios (OR) 1.800; 95 per cent CI 1.231-2.632; $p=0.002$) and PROM (OR 1.744; 95 per cent CI 1.054-2.886; $p=0.030$).

Severe shivering was more likely in case of oxytocin infusion (OR 1.692; 95 per cent CI 1.057-2.710; $p=0.029$), amniotomy (OR 2.510; 95 per cent CI 1.472-4.280; $p=0.001$), fever in the post partum (OR 3.525; 95 per cent CI 1.595-7.793; $p=0.002$) and caesarean section (OR 1.863; 95 per cent CI 1.088-3.189; $p=0.023$).

Shivering lasting one hour or more is more likely in case of caesarean section (OR 1.920; 95 per cent CI 1.119-3.295; $p=0.018$), amniotomy (OR 2.515; 95 per cent CI 1.427-4.432; $p=0.001$) and PROM (OR 2.728; 95 per cent CI 1.453-5.122; $p=0.002$).

Oxytocin infusion increases the odds ratios to have shivering lasting less than 30 minutes (OR 1.941; 95 per cent CI 1.278-2.948; $p=0.002$).

If you would like to see all of the results in detail, please go to the website where you will find the addition of *Table 1*, showing Descriptive, univariate and multivariate results.

DISCUSSION CAUSES

This paper assesses the shivering phenomenon in the postpartum period in greater depth than Benson et al (2008). We assume that a common cause of shivering could also cause postpartum rigors. Remarkably, some of these causes are linked to the medicalisation of labour. Amniotomy, PROM and postpartum fever could link to an infective or inflammatory cause of shivering, all of these three variables apparently being associated with the severity and duration of shivering (more than an hour).

FEVER

Fever shows the stronger association. Interestingly, we found 4.9 per cent of cases with postpartum fever in our series. This rate is similar to the 3-5 per cent rate of histological signs of inflammation in term placentas reported by Kim et al (2015) as markers of chorioamnionitis. Therefore, it would be interesting to investigate if pathological findings of chorioamnionitis would associate with the presence and severity of postpartum rigors and with postpartum fever.

CAESAREAN SECTION

Severe shivering and long-lasting shivering (over an hour) were also found in the case of caesarean section. A warming procedure during caesareans has been found to reduce shivering (Munday et al 2014). Therefore, hypothermia during surgery could be the main cause of chills after caesareans, because warming procedures were not always used in our setting. However, collinearity was found between caesarean section and amniotomy in the case of long-lasting shivering. Such collinearity suggests that women undergoing amniotomy are also the ones more at risk of caesarean section in cases of long-lasting shivering. Therefore, the causes of shivering related to amniotomy and caesarean section could act together in cases of long-lasting shivering.

OXYTOCIN

Finally, oxytocin infusion during labour is associated with mild or severe shivering lasting less than 30 minutes. It is unclear why oxytocin does this. A possible explanation could be water intoxication provoked by oxytocin, under the special condition of labouring. Pregnancy, labour pain, stress, high-fluid intake can cause water intoxication and hyponatraemia, a sign of which is seizure (Ophir et al 2007). Cases of severe water intoxication due to high doses of oxytocin infusion have been reported (Borg et al 1983; Lafay-Pillet et al 1987). Therefore, pharmacological doses of oxytocin used for enhancing labour may worsen a mild water intoxication, causing mild seizures (like shaking rigors) in relationship with hyponatraemia (Badjatia et al 2007). Therefore, it would be interesting to assess the blood sodium values in case of shivering, as well as sodium behaviour in relationship to oxytocin doses and duration of oxytocin administration.

CONCLUSION

This study demonstrates that the shivering phenomenon after birth would be independently associated with rupture of membranes (spontaneous or artificial), postpartum fever, caesarean section and oxytocin infusion. Those associations could be explained logically by already-known causes of chills: infections/inflammation, intra-operative cooling, hyponatraemia. They need further investigation.

IMPLICATIONS FOR MIDWIVES

The take-home message for practising midwives is that the postpartum chill could sometimes be iatrogenic. Avoiding high fluid intake, unnecessary oxytocin infusion, unnecessary amniotomy, checking for fever in the postpartum, and warming women after caesarean section seems to be

appropriate in those with severe and long-lasting shivering. **tpm**

REFERENCES

- Badjatia N, Kowalski RG, Schmidt JM et al (2007). 'Predictors and clinical implications of shivering during therapeutic normothermia'. *Neurocritical Care*, 6(3): 186-191.
- Benson MD, Kobayashi H, Sehgal LR et al (2006). 'Complement, fetal antigen, and shaking rigors in parturients'. *The Journal of Maternal-Fetal and Neonatal Medicine*, 19(1): 31-34.
- Benson MD, Haney E, Dinsmoor M et al (2008). 'Shaking rigors in parturients'. *The Journal of Reproductive Medicine*, 53(9): 685-690.
- Blanchon L, Accoceberry M, Belville C et al (2013). 'Rupture of membranes: pathophysiology, diagnosis, consequences and management'. *Journal de Gynécologie, Obstétrique et Biologie de la Reproduction*, 42(2): 105-116.
- Borg G, Seligmann G, Sournies G et al (1983). 'Water intoxication following oxytocin perfusion'. *Journal de Gynécologie, Obstétrique et Biologie de la Reproduction*, 12(1): 51-53.
- Cohain JS (2013). 'The less studied effects of amniotomy'. *The Journal of Maternal-Fetal and Neonatal Medicine*, 26(17): 1687-1690.
- Kim CJ, Romero R, Chaemsathong P et al (2015). 'Acute chorioamnionitis and funisitis: definition, pathologic features, and clinical significance'. *American Journal of Obstetrics and Gynecology*, 213(4Suppl): S29-S52.
- Lafay-Pillet MC, Taurelle R, Massard JD et al (1987). 'Acute water intoxication after prolonged infusion of oxytocin'. *Journal de Gynécologie, Obstétrique et Biologie de la Reproduction*, 16(4): 489-494.
- Munday J, Hines S, Wallace K et al (2014). 'A systematic review of the effectiveness of warming interventions for women undergoing cesarean section'. *Worldviews on Evidence-Based Nursing*, 11(6): 383-393.
- Ophir E, Solt I, Odeh M et al (2007). 'Water intoxication – a dangerous condition in labor and delivery rooms'. *Obstetrical and Gynecological Survey*, 62(11): 731-738.
- Tunçalp Ö, Hofmeyr GJ, Gülmezoglu AM et al (2012). 'Prostaglandins for preventing postpartum haemorrhage'. *The Cochrane Database of Systematic Reviews*, 8: CD000494.

For an expanded version of this article, showing details of the results in table format, please visit the website at www.practisingmidwife.co.uk and click on Factors associated with postpartum shivering: a cross-sectional study