

Can topical lignocaine reduce behavioural response to heel prick?

J Alison Rushforth, Gillian Griffiths, Helen Thorpe, Malcolm I Levene

Abstract

In a randomised, double blind, controlled study the ability of 5% lignocaine ointment to reduce the behavioural response to heel lance in 30 healthy neonates was assessed. Five per cent lignocaine ointment applied to the heel under an occlusive dressing for one hour before heel prick did not reduce the infants' behavioural response to the heel prick procedure.

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Keywords: topical lignocaine, heel lance, behavioural response.

Local anaesthetics act by blockading the sodium channels in the cell membranes of sensory nerves, and so blocking nerve conduction. EMLA cream is a mixture of two local anaesthetic agents, lignocaine and prilocaine, suspended in an oil in water emulsion. The physical properties of EMLA cream make it an ideal drug for transdermal application. When applied to intact skin under an occlusive dressing the analgesic effect can last for several hours.¹ EMLA is widely used in infants and children and produces a reduction in pain response to procedures such as venepuncture and lumbar puncture.² Although it has been shown that lignocaine and prilocaine do not reach toxic concentrations following transdermal application of EMLA in children over 3 months of age,³ prilocaine has been implicated in the development of methaemoglobinaemia in infancy.⁴ A metabolite of prilocaine oxidises haemoglobin to methaemoglobin. The enzyme responsible for the reversal of this oxidation, cytochrome b5 reductase, is present in low concentrations in infancy, and this increases the risk of methaemoglobinaemia.⁵

Because EMLA is not suitable for use in neonates, if local anaesthesia is required the only method of giving this is by subcutaneous infiltration, which means an additional painful procedure. If an alternative local anaesthetic agent without prilocaine was available, which was effective when applied topically, this could be used in neonates and infants under 1 month of age.

We have already shown a consistent behavioural response to the painful stimulus of heel lance in healthy neonates,⁶ and were interested to see if this behavioural response could be reduced by the use of 5% lignocaine ointment before the procedure.

Methods

Using the results of our previous study of behavioural response to heel lance, we felt that if the local anaesthetic were to be judged successful in reducing the behavioural response to pain then the number of behaviour items induced following the heel lance stimulus should be reduced from a median of 5, to a median of 1.⁵ We calculated that 15 infants would be required in both the treatment and placebo groups to demonstrate this reduction (90% power, 5% significance).

Healthy infants who needed capillary blood samples for bilirubin estimation were recruited to the study following consent from the mother. The study was approved by the hospital ethics committee.

The study was of a double blind placebo design. Infants were allocated to receive 5% lignocaine ointment or control (emulsifying ointment) in a random manner. About 0.5 g ointment was applied to the heel of the infant and covered with a semipermeable polyurethane dressing (Tegaderm) one hour before heel lancing. All heel lances were performed manually by an experienced neonatal nurse (GG), using a standard medical lance, and the procedure was standardised for all infants. All observations of behavioural changes were performed by one experienced observer (JAR). Both nurse and observer were blind to the treatment group as ointments and other of randomisation were prepared in the pharmacy department.

The infants' arousal was assessed before preparation of the heel for lancing.⁷ The presence or absence of four facial actions (brow bulge, eye squeeze, nasolabial furrow and open mouth), and the presence or absence of cry were noted on three occasions: (1) in response to heel preparation (non-painful stimulus); (2) in response to heel lance (pain stimulus); and (3) in response to the first squeeze of the heel. Only the response to the first squeeze of the heel was noted as the duration of the heel squeeze period was expected to vary between patients. Each of the behavioural responses were given a score of 1 if seen, and 0 if absent.

Therefore, in response to heel preparation (control score), heel lance (pain score), and heel squeeze a minimum score of 0 and a maximum score of 5 was possible. The increase in behaviours seen following heel lance was calculated by subtracting the control score from the pain score. Because some local anaesthetics can produce vasoconstriction, a visual analogue score was used by the nurse

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Individual behaviour scores for 30 patients studied

Case No	Preparation score	Lance score	Squeeze score
1	0	5	5
2	0	2	5
3	0	3	5
4	1	5	5
5	0	5	5
6	1	5	5
7	0	1	5
8	0	5	5
9	0	4	5
10	0	4	5
11	2	5	5
12	0	4	0
13	0	5	1
14	0	5	5
15	0	3	5
16	0	5	0
17	0	5	5
18	0	4	5
19	0	5	5
20	0	5	5
21	0	4	5
22	0	5	5
23	0	2	5
24	0	5	5
25	0	5	5
26	0	5	5
27	1	4	5
28	0	3	5
29	0	5	5
30	0	5	5

1-15=5% lignocaine; 16-30=emulsifying ointment.

taking the blood to assess the difficulty in obtaining the blood samples.

Results were analysed using the statistical package Minitab, and differences between the groups were assessed using the Mann-Whitney U test.

Results

Thirty infants were studied. They had a median (range) gestational age of 37 (34-41) weeks and a postnatal age of 4 days (range 4-11). The median (range) birth weight was 3100 (1850-3970) g. Fifteen infants received 5% lignocaine and 15 a placebo. The two treatment groups did not vary with respect to gestational age, postnatal age, birth weight, Apgar score or state of arousal at the time of sampling.

There was no difference in the median behavioural scores to heel preparation between the lignocaine and placebo groups ($p=0.53$), nor was there a difference between the two groups with respect to their response to heel lance ($p=0.46$), or to the first squeeze of the heel following heel lance ($p=0.79$). Individual behaviour scores for the 30 patients studied are shown in the table.

In terms of change in the number of behavioural responses seen following heel lance in the placebo group the median (range) increase was 5 (2-5) and in the lignocaine group 4 (1-5); this difference was not significantly different ($p=0.14$).

A further four infants were each studied on two occasions, therefore acting as their own controls, receiving first one treatment then the other. There was no difference in the infants' responses on the occasion they received lignocaine and on the occasion they received placebo.

No local reactions were seen to either the lignocaine ointment or to the placebo. There

was no difference in the difficulty in sampling as judged by a visual analogue scale ($p=0.24$).

Discussion

For any analgesic agent to be effective it must be capable of reducing the level of pain perceived. In adults and older children the level of analgesia achieved can be assessed using several validated pain scales, or using a visual analogue scale. In young children and infants, however, the level of language development means self reporting of pain is an unsuitable method and alternatives for pain assessment must be used. We have shown that infants show consistent behavioural responses following the painful procedure of heel lance but not to a non-painful stimulus of heel preparation, and that these can be easily assessed at the bedside and are reproducible among independent observers.⁶ It would be expected, therefore, that if the behavioural responses to pain can be reduced, or even completely inhibited, following the application of a local anaesthetic agent to the heel before blood sampling, then the anaesthetic agent was responsible for diminishing the perception of pain.

Although we have shown no objective difference in the infants' behavioural response to pain in this double blind randomised controlled study, on several occasions we recognised that in some infants the response to heel lance was delayed. These infants were subsequently found to be in the treatment group. However, we could not quantify this subjective observation. On completion of this study both observer and nurse correctly identified the treatment and placebo groups based on their own subjective observations. The mothers of the four infants who received both lignocaine and placebo ointment were unable to discriminate between the two, and felt that the infants seemed equally upset by the two blood tests.

In another study comparing 5% lignocaine ointment with placebo an experienced nurse found that, using a visual analogue scale as a measure of observed pain in the infants, 5% lignocaine to some extent reduced the pain of heel lance, but that there was no difference in the changes in heart rate between the two groups.⁸

In our randomised controlled study application of 5% lignocaine ointment to the heel under an occlusive dressing for one hour before heel lance did not alter the infants' response to pain when compared to a second group of infants who received a placebo. This was also seen in those infants ($n=4$) acting as their own controls. The reasons for this are not clear. It may be that the lignocaine failed to penetrate the skin to an adequate depth to allow blocking of nerve endings, or that the nerve endings are insensitive to lignocaine. There is no reason to suspect that the skin of infants differs significantly from that of children or adults in its ability to allow transdermal passage of lignocaine, or that the nerve endings responsible for pain perception are different in their structure or function at different ages. It

may be that the time between the application of the lignocaine ointment and heel lance was insufficient to allow the full anaesthetic effect to occur in this study. This could be addressed by comparing the behavioural response of infants who had received topical lignocaine ointment for different lengths of time before heel lance. Another explanation is that the behavioural responses used in this study are insensitive when used to assess acute pain. This point emphasises the need for further evaluation of methods of assessing acute pain in infants.

1 Steward DJ. Eutretic mixture of local anaesthetics (EMLA): What is it? What does it do? *J Pediatr* 1993; 122: s21-3.

2 Koren G. Use of the eutretic mixture of local anaesthetics in young children for procedure related pain. *J Pediatr* 1993; 122: s30-5.
 3 Enberg G, Danielson K, Henneberg S, Nilsson A. Plasma concentrations of prilocaine and lidocaine and methaemoglobin formation in infants after epicutaneous application of a 5% lidocaine-prilocaine cream (EMLA). *Acta Anaesthesiol Scand* 1987; 31: 624-8.
 4 Jakobson B, Nilsson A. Methaemoglobinaemia associated with a prilocaine-lidocaine cream and trimethoprim-sulphamethoxazole: a case report. *Acta Anaesthesiol Scand* 1985; 29: 453-5.
 5 Nilsson A, Engberg G, Hennerberg S, Danielson K, de Verdier C-H. Inverse relationship between age dependent erythrocyte activity of methaemoglobin reductase and prilocaine-induced methaemoglobinaemia during infancy. *Br J Anaesthet* 1990; 64: 72-6.
 6 Rushforth JA, Levene MI. Behavioural response to pain in healthy neonates. *Arch Dis Child* 1994; 70: F174-6.
 7 Precht HFR. The behavioural states of the newborn infant (a review). *Brain Res* 1974; 76: 185-212.
 8 Wester U. Analgesic effect of lidocaine ointment on intact skin in neonates. *Acta Paediatr* 1993; 82: 791.

Atrioventricular block during fetal heart rate decelerations

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Abstract

Electrocardiograms (ECG) was examined in 15 fetuses during fetal heart rate decelerations in labour. Sinus bradycardia was demonstrated in six cases and in two cases inversion of the P wave was seen. In seven cases there was complete dissociation of the P wave from the QRS complex, indicating complete atrioventricular heart block.

Many decelerations are vagally mediated, but such cases associated with complete atrioventricular heart block may be due to the effect of hypoxia on the bundle of His.

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Keywords: atrioventricular block, fetal heart rate, deceleration.

Fetal heart rate decelerations have been the subject of obstetric concern for over a century.¹ Attempts have been made to classify heart rate patterns, and to understand the pathogenesis of fetal heart rate decelerations.² Changes in fetal heart rate are a function of many factors, and the pathophysiological mechanisms are not fully understood. In most cases the fall in heart rate is thought to be vagally mediated, either by head compression or by stimulation of the fetal umbilical cord, or by chemoreceptor response to hypoxia.² If these changes are attributable to vagal stimulation then direct examination of the fetal electrocardiogram (ECG) should reveal sinus bradycardia, or configurational changes in the P wave of the electrocardiogram could imply a wandering pacemaker.³ The aim of this study was therefore to make a direct examination of the fetal ECG during fetal heart rate decelerations in labour to clarify the underlying pathophysiology.

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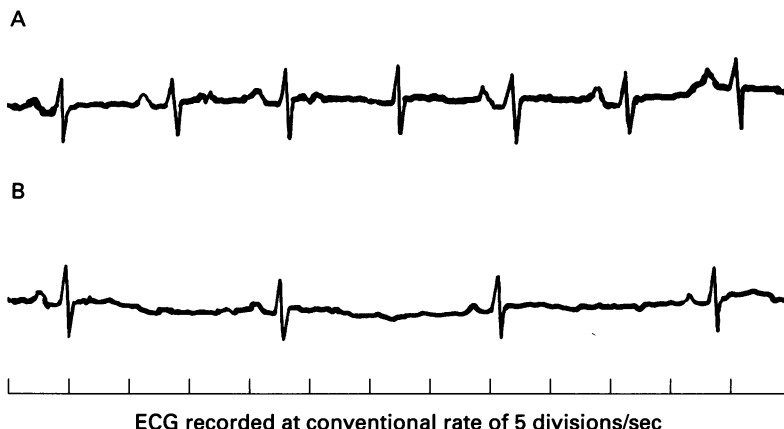


Figure 1 (A) Raw FEECG signal showing sinus rhythm during normal heart rate. (B) Raw FEECG signal showing sinus bradycardia during a deceleration.

Methods

Women in labour were selected for monitoring preferentially on the basis of a fetal risk factor (table). The fetal ECG signal was obtained

Risk factors in study population

Risk factor	No of patients
Pregnancy induced hypertension	14
Postmaturity	10
Antepartum haemorrhage	5
Diabetes	4
Intrauterine growth retardation	12
Intrapartum problems (abnormal CTG, meconium, delay in first stage)	21
Social factors (teenage mother, heavy smoking of >20/day, late booker)	16
Epilepsy	1
Thyroid disease	2