

Acute effects of maternal skin-to-skin contact and massage on saliva cortisol in preterm babies

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Abstract *Saliva samples were obtained from clinically stable preterm babies in a low dependency unit, pre and 20 minutes post a 20 minute intervention of maternal skin-to-skin contact, or massage, or a control period. Eleven pre and post skin-to-skin contact, 13 pre and post massage and 16 pre and post a control period samples were obtained. There was no change in the control period. A 20 minute period of maternal skin-to-skin contact caused a consistent and significant reduction in infant saliva cortisol levels; the effects of massage were more variable.*

Introduction

We are currently evaluating stress in infants in neonatal intensive care, and how cortisol levels are affected by different types of intervention, such as massage and maternal skin-to-skin contact. It is important to establish the long term effects of such interventions, as different neonatal intensive care units have very varied practices. Whereas, for example, some encourage massage, others are concerned that such interventions may be harmful (Harrison *et al.*, 1996). There is increasing evidence from animal studies that perinatal stress can influence stress responses for life (Meaney *et al.*, 1985; Sapolsky, 1996).

We have previously shown that playing intrauterine sounds had no effect (Murthy *et al.*, 1993), and massage could reduce infant plasma cortisol levels (Acolet *et al.*, 1993). Maternal skin-to-skin contact reduced β -endorphin (Mooncey *et al.*, 1997), but the

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effect on cortisol was less clear-cut. This may have been because the samples were obtained by blood sampling and the effect of the initial venepuncture confounded the results.

Plasma cortisol can only be easily obtained from serial blood samples when the baby has an indwelling line. Venepuncture to obtain blood samples solely for research may be considered unethical. There is also evidence that insertion of a needle in itself changes cortisol (Lewis & Thomas, 1990) and so may confound the results. Saliva cortisol is increasingly used as a non-invasive index of adrenocortical activity (Kiess *et al.*, 1995). It has been used in several studies of older babies as an effective non-invasive method to assess the stress response to inoculation (Lewis & Ramsey, 1995), and other potentially stressful experiences (Larson *et al.*, 1991), as well as in preterm babies (Bettendorf *et al.*, 1998). It has been well established that blood and saliva cortisol levels correlate highly (Francis *et al.*, 1987).

In this small study we use a method for obtaining saliva from preterm babies giving a dilute citric acid solution orally, to increase salivation. The acid is then removed before assay. This has been used to compare the acute effects of maternal skin-to-skin contact and massage in a group of preterm babies.

Methods

The study was performed in the neonatal units at Hammersmith and Queen Charlotte's Hospitals, London, UK. The study was approved by the institutional research ethics committee and verbal parental consent was obtained.

Subjects

Preterm infants/parents were approached when their babies were considered medically fit to participate. All infants were clinically stable, no longer requiring intensive care support and within 4 weeks of birth. There was no significant difference between skin-to-skin ($n = 14$) and massage infants ($n = 15$) in birth weight (median/range), skin-to-skin (1.4 kg/0.9–2.7), massage (1.1 kg/0.7–1.9) or gestational age, skin-to-skin (29 weeks/26–37), massage (27 weeks/25–35). Each infant was studied during two periods, intervention (skin-to-skin or massage) and control over 2 consecutive days, to commence with either intervention or control on the first day. The values from the control period for the two groups were combined.

The procedures or control period lasted for 20 minutes between 11 am and 1 pm each day. Saliva samples were collected just before the procedure or control period and 20 minutes after its completion, i.e. 40 minutes after the baseline. Infants were not fed between the collection of the two saliva samples (Magnano *et al.*, 1989). If the volume obtained was 50 μ l or less (see below) the samples were not used.

Forty suitable paired pre and post intervention saliva samples were obtained, 11 pre and post skin-to-skin contact, 13 pre and post massage and 16 pre and post the control period, half from each group.

Procedures

The neonatal nurseries for low dependency infants have a capacity of three to six infants in each room. Ambient temperature is 21 °C, the walls are painted in pastel colours with murals and noise levels are low. All study infants were in cribs. They were breathing

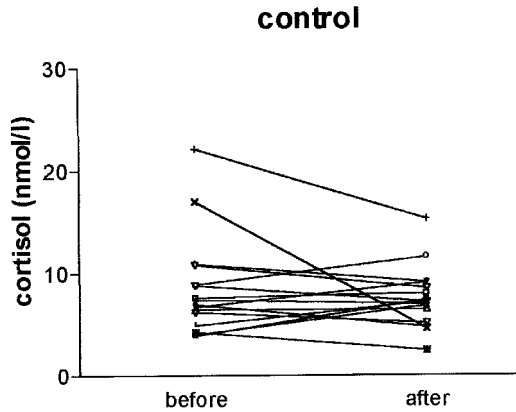


Figure 1. Saliva cortisol before and after a 40 minute control period.

spontaneously and receiving a combination of oral and nasogastric feeds. Infants at the Hammersmith site were recruited into the skin-to-skin study and infants at the Queen Charlotte's site, into the massage study. Massage was carried out by an experienced neonatal nurse using the technique previously described by Acolet *et al.* (1993). It consisted of gentle massage of the trunk and limbs using rachis oil. During skin-to-skin contact the infant, wearing only a nappy (diaper), was placed between the mother's uncovered breasts as described in Mooncey *et al.* (1997). The mother was seated on a standard rocking chair, tilted at an angle of approximately 60° .

Collection of saliva and assay of cortisol

A volume of 100 μ l of 0.25 M citric acid was applied to the infant's tongue with a plastic 1 ml syringe. A cotton dental roll was inserted into the mouth and the baby allowed to suck on it for a minimum of 2 minutes. The dental roll was removed into an empty 5 ml syringe and the liquid extracted using the plunger. This extract was stored at -20°C until assay. It was found that if the extract was used directly in the standard commercially available immunoassay (DPC Inc., California), the acid pH from the citric acid interfered and gave anomalous readings. The extract was therefore applied to a reverse phase SepPak cartridge that had been activated with 1 ml of acetonitrile and equilibrated with 2 ml of water. It was then washed with at least 2 ml of water to remove the acid. The cortisol was eluted with 1 ml acetonitrile, freeze dried, and reconstituted in 1 ml of radioimmunoassay buffer. This was then transferred to antibody-coated tubes and incubated for 24 hours at 4°C to increase sensitivity, using a control range 1.38 to 138 nmol. It was found with control pooled saliva that if values obtained were within this range, the results were independent of initial volume, and were constant for saliva volumes of $> 50 \mu$ l to 1 ml. The coefficient of variation was 16.1%.

Results

The baseline values in the two groups (skin-to-skin and massage) were similar both in the intervention and control periods. Baseline saliva cortisol levels ranged from 1.7 to 27.5 nmol/l. In the control period there was no significant change in saliva cortisol over the 40 minutes ($t = 0.99$; $df = 15$, ns) (Figure 1). Figure 2 shows the results for the

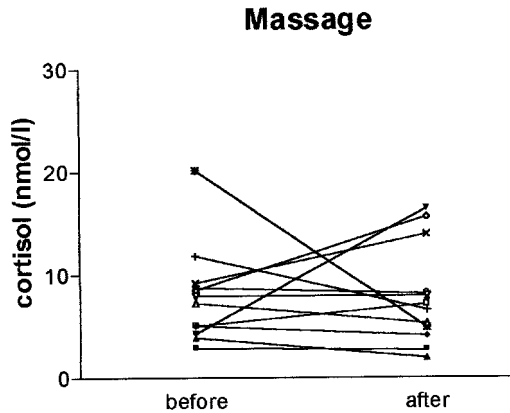


Figure 2. Saliva cortisol before and after massage.

massage group. In seven babies the levels were reduced, but in six they were increased or unchanged; there was no significant change overall ($t = 0.15$; $df = 12$, ns). Figure 3 shows the results of the skin-to-skin intervention. In 10 of the 11 babies studied there was a reduction in saliva cortisol, and the overall reduction for the whole group was highly significant ($t = 3.5$; $df = 10$; $p = 0.0058$; all two-tailed paired t -test).

Figure 4 shows the individual changes in pre-post (Δ) values for each group (one-way ANOVA between groups: $F = 3.2$, $p = 0.05$).

Discussion

The saliva cortisol values found here were in the range 1.7–27.5 nmol/l. This is about 10% of their total plasma level (Mooncey *et al.*, 1997), and similar to values found in older babies. Whereas the level of cortisol in adult saliva is in the same range, this represents about 2% of the plasma value. The citric acid solution applied to the tongue had no significant effect on the cortisol level 40 minutes later, as shown on the control day (Figure 1). There was thus no evidence that the collection of the baseline saliva, or the application of citric acid solution, was stressful in itself with these babies.

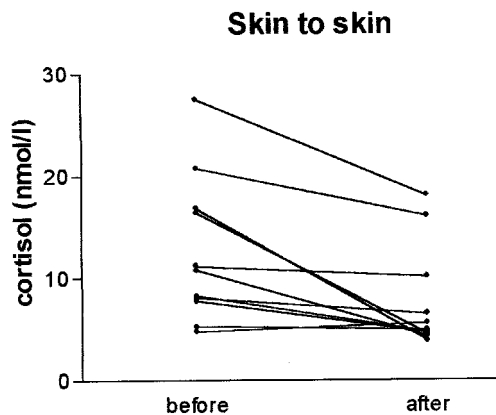


Figure 3. Saliva cortisol before and after skin-to-skin contact.

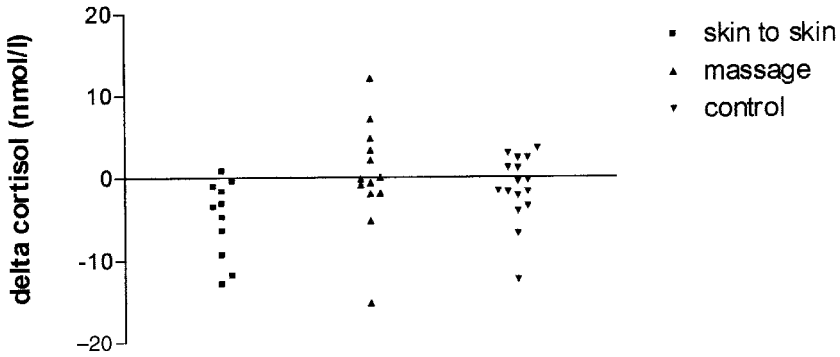


Figure 4. Pre-post (delta) saliva cortisol values in the skin-to-skin, massage and control groups.

The period of skin-to-skin contact consistently reduced saliva cortisol. This confirms and extends our previous study, in which plasma hormone levels were measured (Mooncey *et al.*, 1997). The results of the massage intervention were more varied, and different from our previous study which showed a consistent reduction in plasma cortisol (Acolet *et al.*, 1993). There were differences in design of the massage intervention from that used previously. In the first study, the massage was carried out by an experienced nurse when she thought it appropriate for the baby. In the current study, the procedure was carried out at a particular time of day, independent of the state of the baby. Whereas the skin-to-skin group of babies usually went to sleep, the massage, in some, caused an increase in alert/awake state. Also, in the original study the second saliva sample was taken 60 minutes after the completion of the massage, instead of 20 minutes in this study. This also may be a cause of the different results.

It is not axiomatic that a reduction of saliva cortisol is beneficial and an increase harmful, and these results should not be taken to imply that massage does not have long term benefits. There may well be an optimal cortisol level, and some babies may benefit from stimulation, but little is known about this. Field *et al.* (1996) have shown convincingly the wide range of benefits of massage in both full term babies (Cigales *et al.*, 1997) and preterm infants (Field *et al.*, 1987).

However, there may be some babies in whom it is desirable to be able to reduce cortisol levels. This study does suggest that skin-to-skin contact with the mother does have a consistent effect in achieving this, at least in the short term. Future studies are needed to evaluate long term effects.

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