Exposure to invasive procedures in neonatal intensive care unit admissions

D P Barker, N Rutter

Abstract

The nature and numbers of invasive procedures were studied in 54 consecutive infants admitted to a neonatal intensive care unit. Over 3000 procedures were recorded, 74% in infants below 31 weeks of gestation. One infant (23 weeks' gestation, birth weight 560 g) underwent 488 procedures. Heel prick blood sampling was the most common procedure (56%), followed by endotracheal suction (26%) and intravenous cannula insertion (8%).

Invasive procedures which would cause pain or distress to a child are frequently performed on infants admitted to the neonatal intensive care unit. A reduction in the number of procedures, modifying them, or providing adequate analgesia could relieve some of this pain and distress.

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Sick newborn infants are subjected to a variety of invasive procedures as part of their management, some for investigation, some for treatment. In children and adults pain produced by such procedures is recognised and treated on humanitarian grounds. In the sick infant invasive procedures can cause major physiological disturbance[1] which can be reduced by providing analgesia,[2] yet a recent survey confirmed that analgesia is used less frequently on neonatal compared with paediatric intensive care units.[3]

Before the provision of adequate analgesia can be addressed, a detailed examination of current practice is required. This study was designed to determine the nature and frequency of invasive procedures during neonatal intensive care.

Methods

Fifty four consecutive admissions to the neonatal intensive care unit over a three month period were enrolled into the study. Their gestational ages ranged from 23 to 41 weeks (median 33 weeks) and their birth weights from 0·56 to 4·42 kg (median 1·9 kg). Infants transferred postnatally from other hospitals, those transferred out to other hospitals following admission, and infants admitted to the unit for less than 24 hours were excluded.

Forty one (76%) infants were preterm, including 16 (30%) born at less than 31 weeks' gestation. Twenty six (48%) required treatment with supplemental oxygen. Thirteen (24%) were ventilated (for between one and 47 days), all but one of whom were below 31 weeks' gestation. Thirty three (80%) of the preterm babies received phototherapy, with two babies undergoing exchange transfusion. Of the 13 term babies, eight were admitted with hypoglycaemia associated with either intrauterine growth retardation or maternal diabetes. Three babies died. Two extremely premature infants of 23 and 24 weeks' gestation died aged 20 and 7 weeks, respectively, and a term baby with an abnormal karyotype died following withdrawal of intensive care at 9 days of age.

Procedures were documented by the person performing them ticking a designated chart. One tick only was recorded per procedure, even if more than one attempt was made. Charts were reviewed daily and checked against nursing and medical records to ensure accurate recording. Monitoring continued as the infants progressed from intensive care to low dependency and final discharge.

Most procedures surveyed involved direct tissue injury (table). Intubation and endotracheal suction were included because local trauma may occur during awake intubation, and because both cause substantial physiological disturbance.[4 5] Our list of painful or noxious procedures is not exhaustive; infants undergo others not included in this study, such as gastric tube placement and removal of adhesive tape and electrodes.

Results

The total number of invasive procedures recorded was 3283, of which the most common were heel prick blood sampling (56%), endotracheal suction (26%), and intravenous cannula insertion (8%) (table). The most immature infants underwent the highest numbers of procedures, with 74% performed on the 30% of infants born below 31 weeks' gestation (figure).

Numbers of procedures

Procedure	*Frequency*
Heel prick	1849
Endotracheal suction	854
Peripheral venous cannula	260
Venous blood sample	101
Intubation	66
Intramuscular injection	46
Venous long line	39
Peripheral arterial line	17
Umbilical catheter	16
Arterial stab	13
Lumbar puncture	9
Chest drain	8
Suprapubic aspiration	5
Total	3283

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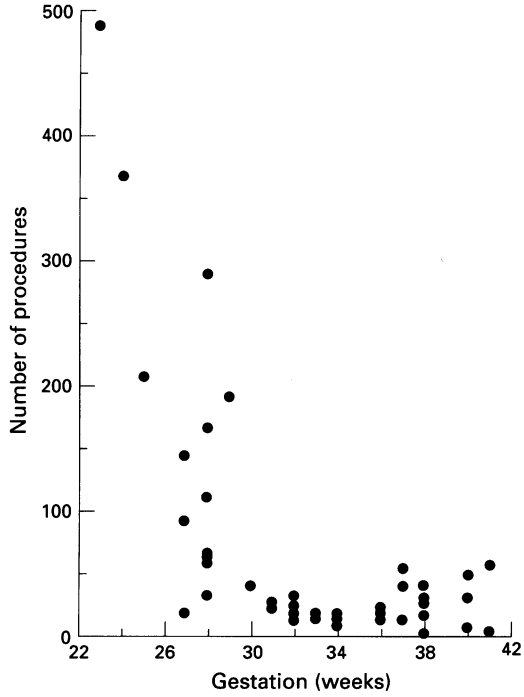

Number of invasive procedures v *gestational age.*

A girl of 23 weeks' gestation and birth weight of 560 g had the highest individual number of invasive procedures (n=488). Endotracheal suction (n=212), heel prick blood sampling (n=218), and intravenous cannula insertion (n=29) made up over 90% of this total.

Discussion

Intensive care of sick newborns has improved outcome, but pain and potentially adverse physiological effects caused through procedures and recurrent handling warrant consideration, both on humanitarian grounds and because of the potential for further improving outcome.

This study forms a carefully documented record of invasive procedures in an unselected group of infants admitted to our neonatal intensive care unit. The pattern and frequency of invasive procedures will vary between units, but is likely to be broadly similar across the United Kingdom. It has been suggested that audit of invasive procedures should form an essential component of intensive care, though the difficulty of complete data collection has been demonstrated.[6]

The procedures in this study resulted from standard medical and nursing practices on our unit. We were surprised by the number of invasive procedures performed, as we do not consider our practice to be particularly interventional. However, our data underestimate the trauma inflicted on our patients. Heightened awareness among staff during the study probably led to fewer procedures – for example, by improved co-ordination of blood sampling – and the number of attempts per procedure was not recorded. The actual number of skin punctures experienced by babies depends on the difficulty of the procedure and the experience and skill of the operator. Even for heel prick sampling repeats are often required.[7]

The most frequently performed procedures were heel prick sampling, endotracheal suction, and intravenous cannula insertion. Previous research has shown that the distress caused by heel prick sampling can be reduced by improving the method of specimen collection.[8] The use of local anaesthetic cream before skin puncture has been widely adopted in paediatric practice, yet little attention has been paid to topical anaesthesia in the newborn. EMLA cream is not licensed for use in infants due to potential toxicity of the prilocaine component.[9] However, this should not prevent a search for suitable alternatives, particularly as the preterm infant becomes hypersensitive after repeated injury.[10]

The number of procedures performed increased dramatically in infants below 30 weeks' gestation. Although this reflects both the severity and duration of illness, in the extreme case of the two most immature infants (23 and 24 weeks' gestation), who died having undergone a combined total of over 850 invasive procedures, this raises important ethical issues of whether intervention on this scale is really justified.

Our study confirms the scope for more widespread use of analgesia on neonatal units. Most procedures were performed without analgesia. Most ventilated babies received diamorphine by infusion, but this was usually limited to the first few days of life. Invasive procedures are necessary and unavoidable when caring for sick infants, but should be kept to a minimum. Further research is needed into methods of reducing procedure related pain on the neonatal unit. Efforts should be concentrated on those procedures performed most frequently, and on infants of very low birth weight, on whom most procedures are carried out.

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1 Speidel BD. Adverse effects of routine procedures on preterm infants. *Lancet* 1978; i: 864–5.
2 Pokela M-L. Pain relief can reduce hypoxaemia in distressed neonates during routine treatment procedures. *Pediatrics* 1994; **93:** 379–83.
3 Bauchner H, May A, Coates E. Use of analgesic agents for invasive medical procedures in pediatric and neonatal intensive care units. *J Pediatr* 1992; **121:** 647–9.
4 Kelly MA, Finer NN. Nasotracheal intubation in the neonate: physiologic responses and effects of atropine and pancuronium. *J Pediatr* 1984; **105:** 303–9.
5 Perlman JM, Volpe JJ. Suctioning in the preterm infant: effects on cerebral blood flow velocity, intracranial pressure, and arterial blood pressure. *Pediatrics* 1983; **72:** 329–34.
6 Southall DP, Cronin BC, Hartmann H, Harrison-Sewell C, Samuels MP. Invasive procedures in children receiving intensive care. *BMJ* 1993; **306:** 1512–3.
7 Barker DP, Latty BW, Rutter N. Heel blood sampling in preterm infants – which technique? *Arch Dis Child* 1994; **71:** F206–8.
8 Harpin VA, Rutter N. Making heel pricks less painful. *Arch Dis Child* 1983; **58:** 226–8.
9 Jakobson B, Nilsson A. Methemoglobinemia associated with a prilocaine-lidocaine cream and trimetoprim-sulphamethoxazole. A case report. *Acta Anaesthesiol Scand* 1985; **29:** 453–5.
10 Fitzgerald M, Millard C, McIntosh N. Hyperalgesia in premature infants. *Lancet* 1988; i: 292.