Ventilatory arrest after a fluid challenge in a neonate receiving s.c. morphine

A. R. WOLF, R. A. LAWSON AND S. FISHER

Summary
S.c. infusions of morphine have been advocated for postoperative analgesia in children, but experience with this technique is limited. We report a case in which an s.c. infusion of morphine given after operation to a neonate failed to provide acceptable analgesia until the child had been adequately rehydrated. However, restoration of peripheral perfusion with a fluid challenge was followed by sudden ventilatory arrest which required resuscitation and naloxone infusion. This report emphasizes the dangers of giving morphine by a peripheral route in the dehydrated or hypovolaemic infant. (Br. J. Anaesth. 1995; 75: 787–789)

Key words

There is no longer doubt that infants require adequate analgesia in the postoperative period, and in recent years considerable progress has been made in the development of effective and safe methods to provide such analgesia. The use of s.c. morphine via an indwelling cannula has been advocated in children [1–3]. An appropriate dose of morphine given intermittently through the cannula can provide satisfactory analgesia while avoiding the pain of i.m. injection. Continuous s.c. morphine infusions have been described in adults [4] and older children [5], and McNicol has recently described its use after surgery in infants as young as 7 months [6]. His report suggests that there are inherent safety advantages with the continuous i.v. route, in that drug absorption is “slower” and that “in the event of equipment failure or overdosage for other reasons, any effect upon the child would be less rapid”.

We report a case of sudden ventilatory arrest in a neonate receiving continuous s.c. morphine which suggests that this route may be relatively contraindicated in this age group.

Case report
An 8-day-old term neonate, weighing 3.5 kg, was transferred to our hospital with a 2-day history of bile-stained vomiting and mild abdominal distension. Abdominal obstruction was confirmed by x-ray examination. There were no other apparent abnormalities and the infant was scheduled for surgery after appropriate fluid resuscitation. Anaesthesia consisted of a modified rapid sequence induction using thiopentone 4 mg kg⁻¹ and vecuronium 0.1 mg kg⁻¹ followed by ventilation to normocapnia with 0.2–0.4 % isoflurane and air and oxygen, and fentanyl 5 µg (1.4 µg kg⁻¹) i.v. This anaesthetic technique is commonly used in our hospital; it avoids the use of suxamethonium, and the low dose of fentanyl used is sufficient to provide haemodynamic stability during surgery and adequate analgesia in the immediate postoperative period. During surgery the patient received 0.45 % saline 22 ml h⁻¹ in 5 % glucose (6.3 ml kg⁻¹ h⁻¹) and in addition 25 ml (7 ml kg⁻¹) of an albumin-containing solution. During surgery systolic arterial pressure remained between 90 and 100 mm Hg and heart rate was 140–160 beat min⁻¹.

At laparotomy, malrotation of the bowel with a midgut volvulus was confirmed and the infant underwent de-rotation of the gut, Ladd’s procedure and elective appendicectomy. Operative time was 45 min. Neostigmine 140 µg (40 µg kg⁻¹) and atropine 70 µg (20 µg kg⁻¹) were given at the end of the procedure to antagonize residual neuromuscular block. The trachea was extubated uneventfully at the end of surgery and the patient was returned to the neonatal unit awake with a rectal temperature of 36.2 °C and satisfactory vital signs.

An s.c. morphine infusion was commenced at an initial rate of 20 µg kg⁻¹ h⁻¹ via a 24-gauge cannula sited in the deltoid region and i.v. fluids were given at a rate of 20 ml h⁻¹ (0.45 % saline in 5 % glucose with potassium supplementation). Oxygen was administered via nasal cannulae at 2 litre min⁻¹ and a bolus dose of plasma protein solution 10 ml kg⁻¹ was given as initial treatment for poor peripheral perfusion and a sinus tachycardia. In accordance with a previously validated regimen [7], patients receiving opioid infusions are assessed hourly for sedation and analgesia by the nursing staff and data recorded on a pain assessment chart. A summary of pain scores, analgesia and management taken from this chart is shown in table 1.

The records demonstrated that despite the relatively large hourly dose of morphine, the infant remained unsettled and appeared in discomfort. At 9 h after operation the morphine infusion was increased to the maximum prescribed rate (25 µg...
kg⁻¹ h⁻¹) but sedation and analgesia scores did not improve. At 12 h the infant was reviewed by the acute pain team and an additional bolus of morphine 17.5 µg (5 µg kg⁻¹) was given s.c. with some effect. Haemodynamic variables were within normal limits, but only 1 ml of urine had been passed in the preceding 6 h and peripheral perfusion was again noted to be poor. An infusion of 5 % albumin solution 35 ml was given over 30 min (between 16 and 17 h) and this produced an increase in urine output to 5 ml over the next hour. Shortly after the colloid infusion finished (17 h), the patient became cyanosed with an oxygen saturation of 73 % and the infusion was discontinued and an i.v. infusion of naloxone was commenced at 18 h although the naloxone infusion was continued until 20 h. No further morphine was administered and analgesia was maintained with paracetamol, rectal diclofenac and infiltration of 0.25 % bupivacaine 2 ml to the wound at 18 h. The infant made an otherwise uneventful recovery. The presumed cause of the ventilatory arrest was that the improved peripheral circulation resulting from the fluid challenge had allowed rapid absorption of morphine from the previously underperfused s.c. morphine depot.

### Discussion

The variable absorption of s.c. morphine in the patient with decreased intravascular volume is not a new concept. Cases reported during the Second World War [8] highlighted the risks of ventilatory depression after fluid resuscitation from sudden absorption of drug. Textbooks of anaesthesia written around this time [9] warned of the dangers of repeated administration of opioids to shocked patients because of delayed response to the drug. For this reason, i.m. or s.c. administration of opioids are contraindicated in burns victims [10] and their use has also been curtailed by mountain rescue services where hypothermia contributes to poor peripheral perfusion.

In the case described, the dose of morphine prescribed should have been sufficient to provide adequate analgesia and sedation. Postoperative pain relief may be produced reliably in children by an i.v. morphine infusion of 10–40 µg kg⁻¹ h⁻¹ [11] and opioid requirements may be considerably less in the spontaneously breathing infant [12]. This patient received an average rate of morphine infusion of 19 µg kg⁻¹ h⁻¹. The records showing inadequate analgesia at 1–17 h suggest that there was reduced absorption from the s.c. tissues resulting in rapid morphine absorption leading to ventilatory arrest.

Morphine 20–25 µg kg⁻¹ h⁻¹ represents a considerably larger dose than usual. The failure of morphine to achieve acceptable analgesia and sedation at this rate could be because of extreme resistance of the infant to opioids, but failure of absorption as a result of poor perfusion is a more plausible explanation. It is also possible that ventilatory arrest was caused by simple overdosage with morphine, but this does not accord with the observed sequence of events. The patient was showing behavioural signs of distress with inadequate sedation, implying a lack of effect right up to the time of ventilatory arrest. Moreover, ventilatory arrest occurred 5 h after the additional bolus dose of s.c. morphine.

Clearly, while the s.c. route has potential advantages in the older child undergoing elective surgery, it is contraindicated in the neonate undergoing a major procedure as an emergency. I.v. opioid infusions given by either continuous infusion [12] or more complex modes such as nurse-controlled analgesia would appear to be a more logical approach to produce controlled and reliable analgesia in this age group. This must be combined with frequent formal assessment of pain and sedation.

### References


