Infraorbital nerve block in neonates for cleft lip repair: anatomical study and clinical application

A. T. Bösenberg AND F. W. Kimble

Summary
Infraorbital nerve block in neonates is not well described although it has been suggested that bilateral infraorbital nerve block is the local analgesic technique of choice for early repair of cleft lip. The purpose of this study was to determine the location of the infraorbital nerve in neonatal cadavers and to identify clinically useful landmarks. Thirty infraorbital nerves were identified in 15 neonatal cadavers with a mean weight of 2.85 (SD 0.32) kg (range 2.45-3.5 kg) via an upper buccal sulcus incision. The mean distance from the infraorbital nerve to the base of the alae nasi was 7.7 (SD 1.3) mm on the left and 7.5 (0.8) mm on the right. A line drawn from the angle of the mouth to the midpoint of the palpebral fissure measured 30.6 (1.9) mm (left) and 30.7 (1.8) mm (right). The nerve was situated approximately halfway along this line at a point 15.5 (1.5) mm (left) and 15.2 (1.4) mm (right) from the angle of the mouth. These measurements were used to perform bilateral infraorbital nerve blocks in four neonates undergoing cleft lip surgery under general anaesthesia, thereby providing analgesia with minimal risk of respiratory depression. (Br. J. Anaesth. 1995; 74: 506-508)

Key words

The infraorbital nerve supplies sensory innervation to the skin and mucous membrane of the upper lip and lower eyelid, the skin between them and to the side of the nose [1]. It has been suggested that bilateral infraorbital nerve block is the local analgesic technique of choice for early repair of cleft lip [2] as early postoperative analgesia can be provided without the potential risk of respiratory depression which may occur when opioid analgesics are used [3].

Recently published paediatric regional anaesthetic texts [4, 5] do not describe infraorbital nerve block in children. The infraorbital foramen, easily palpable in adults and older children, is difficult to locate in neonates and small infants. The surface anatomy of the infraorbital nerve in the neonate is not described.

The purpose of this study was first to identify the location of the infraorbital nerve in neonatal cadavers and to determine useful landmarks that could be used in the clinical situation, and second to use these landmarks in clinical practice to provide peroperative analgesia for neonates undergoing cleft lip repair.

Patients and methods
This study was approved by the Faculty Ethics Committee and permission was obtained from the Chief Medical Superintendent of the institution. Before dissection of the neonatal cadavers, a neonatal skull was examined to identify the infraorbital foramen, supraorbital foramen and mental foramen, that is the landmarks used to perform an infraorbital nerve block in adults.

The infraorbital nerve was dissected bilaterally via an upper buccal sulcus incision on neonatal cadavers. The nerve was traced to the point of emergence from the infraorbital foramen. When located, a marker pin was inserted perpendicularly through the skin into the nerve or infraorbital foramen under direct vision. Measurements were then made from this point to external surface landmarks which included the base of the alae nasi, the palpebral fissure and the angle of the mouth (fig. 1). Additional measurements which included the philtral width and the interalar base width were made in order to compare these with standard tables of lip and nose measurements in neonates, as recorded by Millard [6].

In the clinical study, bilateral infraorbital nerve blocks were performed, using the surface landmarks and measurements as determined from the cadaver study, on neonates presenting for primary repair of cleft lip. Anaesthesia consisted of inhalation induction with halothane and nitrous oxide in oxygen. No additional analgesics were given either before or during operation. Tracheal intubation was facilitated with suxamethonium 1 mg kg⁻¹. The lungs were ventilated with a Siemens 900C ventilator and anaesthesia maintained with 0.5% halothane and 70% nitrous oxide in oxygen. No further neuromuscular blockers were given. Monitoring consisted of non-invasive arterial pressure, heart rate, ECG, capnography, oxygen saturation and temperature.

Bilateral infraorbital nerve blocks were performed using 0.5% bupivacaine 0.5-0.75 ml with adrenaline.
1:200000. A 25-gauge needle was introduced perpendicular to the skin and advanced until bony resistance was felt. The needle was then withdrawn slightly and the local anaesthetic injected after obtaining a negative aspiration test. If resistance to injection was noted, the position of the needle tip was adjusted.

The infraorbital nerve blocks were regarded as being successful if there was less than a 5% increase in arterial pressure or heart rate or no increase in ventilatory frequency on surgical incision. End-tidal carbon dioxide ($\text{PeCO}_2$) was recorded with the neonate breathing spontaneously before tracheal extubation to determine any evidence of respiratory depression.

Pain relief in the initial postoperative period was assessed using behavioural and physiological variables, as described by Robinson and Gregory [7]. The duration of action and the need for further analgesia were recorded.

**Results**

Thirty infraorbital nerves were identified in 15 African neonatal cadavers. The cadavers were all fresh stillborns whose mean weight was 2.85 (SD 0.32) kg (range 2.45-3.5 kg). There were 10 males and five females.

The mean distance from the marker pin (infraorbital nerve) to the alar base was 7.7 (SD 1.3) mm on the left and 7.5 (0.8) mm on the right. A line drawn through the marker pin from the angle of the mouth to the midpoint of the palpebral fissure on the ipsilateral side measured 30.6 (1.9) mm on the left and 30.7 (1.8) mm on the right. The marker pin was noted to be approximately halfway along this line at a point 15.5 (1.5) mm (left) and 15.2 (1.4) mm (right) from the angle of the mouth. The measurements, together with interalar base width and philtral wedge, are shown in Table 1.

These measurements were used clinically in four neonates who presented for primary repair of cleft lip. All were term babies whose weights were 2.4 kg, 2.72 kg, 3.2 kg and 3.0 kg and surgery was performed at 5, 7, 4 and 9 days, respectively. The nerve blocks were considered to be successful as evidenced by the lack of cardiorespiratory response to surgical incision. Postoperative awakening was rapid and smooth with no respiratory depression, as evidenced by normal $\text{PeCO}_2$, values before tracheal extubation. All four babies appeared comfortable in the early postoperative period and no additional analgesia was required. There was no evidence of complications related to the technique.

The duration of action was difficult to assess accurately. Duration of surgery ranged from 1.5 to 2.5 h. Cardiorespiratory variables remained within 5% of baseline recordings during this time. However, further evaluation in the postoperative period was abandoned for fear of interfering with the surgical repair. Subsequent "distress" was allayed with tilidine in two patients and feeding.

**Discussion**

The appropriate timing of surgery for primary cleft lip repair remains controversial. Historically, surgery is delayed until 3–6 months [8] and the patient fulfills Kilner's rule of 10, 10 weeks of age, 10 lb body weight, haemoglobin 10 g and white blood cell count of less than 10000 [9].

Repair in the neonatal period is increasing in popularity [2, 10–12] and has many advantages. These include aesthetic improvement [12], improved parental bonding [2, 10, 12], improved development of the alveolar ridge [2, 12], and ability to breast feed [11, 12] and hence improved nutrition. However, anaesthesia should not add to the operative risk in these patients who are frequently preterm and who may have associated congenital anomalies, some of which may involve the upper airway.

Unpredictable neonatal sensitivity and pharmacokinetic responses to opioids [13, 14] have resulted in a reluctance to prescribe postoperative analgesia for neonates, particularly those who are required to breathe spontaneously in the postoperative period [15, 16]. A recent review of anaesthesia for cleft lip repair reported profound respiratory depression after opioid administration [3]. Inadequate postoperative sedation with vigorous crying on the other hand may lead to wound dehiscence [12]. For these reasons regional anaesthesia has been advocated to provide analgesia without the risk of respiratory depression [13, 14].

Infiltration of the surgical field with local anaesthetic solution has been used [3, 10]. While providing satisfactory analgesia this results in distortion of the surgical field which may affect the surgical result. Infraorbital nerve block via the oral

**Table 1** Surface landmark measurements (mean (SD) mm) from 15 neonatal cadavers including the relationship between the infraorbital nerve (ION) and the alar base (AB), angle of mouth (AOM) and palpebral fissure (PF), as shown in figure 1

<table>
<thead>
<tr>
<th></th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB-ION (A in fig. 1)</td>
<td>7.7 (1.3)</td>
<td>7.5 (0.8)</td>
</tr>
<tr>
<td>AOM-ION (B in fig. 1)</td>
<td>15.5 (1.5)</td>
<td>15.2 (1.5)</td>
</tr>
<tr>
<td>AOM-PF (C in fig. 1)</td>
<td>30.6 (1.9)</td>
<td>30.7 (1.8)</td>
</tr>
<tr>
<td>Palpebral fissure</td>
<td>21.5 (2.0)</td>
<td>21.5 (1.8)</td>
</tr>
<tr>
<td>Intercanthal</td>
<td>22.7 (1.5)</td>
<td>23.5 (1.1)</td>
</tr>
<tr>
<td>Alar base width</td>
<td>23.5 (1.1)</td>
<td>8.0 (1.4)</td>
</tr>
<tr>
<td>Philtrum</td>
<td>23.5 (1.1)</td>
<td>8.0 (1.4)</td>
</tr>
</tbody>
</table>
route has been advocated as a suitable local analgesic technique [2]. However, substantially larger volumes of local anaesthetic are suggested compared with those used in our patients. Reducing the volume of local anaesthetic with the use of our approach would be advantageous as it would result in less tissue distortion and also lessen the risk of toxicity.

Infraorbital nerve block in adults has been well described [17]. The infraorbital foramen is in line with the supraorbital notch and mental foramen or second upper premolar tooth. These landmarks are difficult to palpate or are absent in the neonate. Furthermore, the facial configuration of a neonate is considerably different from that of an adult. In adults the facial region below the orbits, including the mandible, accounts for about one-half of the skull. In the newborn the air sinuses are rudimentary, the mandible and maxillae are small, the teeth are absent and thus the face below the orbit makes up only one-eighth of the skull [18]. The orbital opening is large and nearly circular and the supraorbital notch is near the middle of the supraorbital margin [18], whereas it lies more medial in the adult. As the maxilla is small, the distance between the alveolar ridge and orbit is short [18]. For this reason it was considered necessary to perform the anatomical study on neonates as it was clearly impractical to use landmarks described for adults.

An upper buccal sulcus incision was chosen because of its proximity to the infraorbital foramen in neonates and to minimize disfigurement of the cadavers being studied. The route is also an alternative approach to performing an infraorbital nerve block [2, 19].

Our results showed that the infraorbital nerve lies halfway between the midpoint of palpebral fissure and the angle of the mouth, approximately 7.5 mm from the alar base. Allowing for postmortem changes, there was little difference between the position of the infraorbital nerve on the left and right.

Our measurements of the alar base width and the philtral width concur with the measurements made by Millard [6] in live white and black neonates and suggest that other values, which Millard did not measure, are valid for these races. Further studies would, however, be required to validate this point.

The landmarks described are identified easily and we have applied them with success in the clinical situation. The exact duration of action was difficult to determine; however, analgesia extended well into the postoperative period after up to 2.5 h of surgery and awakening was quiet, with no evidence of respiratory depression.

References