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Anaesthesia and postoperative analgesia in surgical neonates with or without Down's syndrome: is it really different?

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Editor's key points

- There is limited knowledge about the analgesic requirements of neonates with Down's syndrome.
- This is a challenging patient group to study.
- This retrospective study looks at perioperative management and pain control using a validated scale.
- Neonates with Down's syndrome did not appear to have different analgesic requirements.
- Despite sample size limitations, this study provides useful evidence for future work.

Background. Reports conflict on optimal postoperative analgesic treatment in children with intellectual disability. We retrospectively compared postoperative analgesics consumption between neonates with and without Down's syndrome in relation to anaesthesia requirements and pain scores.

Methods. We analysed hypnotic and analgesic drug administration, pain scores [COMFORT-Behaviour (COMFORT-B) scale], and duration of mechanical ventilation during the first 48 h after surgical repair of congenital duodenal obstruction in neonates, between 1999 and 2011. Data of 15 children with Down's syndrome were compared with data of 30 children without Down's syndrome.

Results. General anaesthesia requirements did not differ. The median (inter-quartile range) maintenance dose of morphine during the first 24 h after operation was 9.5 (7.8–10.1) $\mu g\ kg^{-1}\ h^{-1}$ in the Down's syndrome group *vs* 7.7 (5.0–10.0) $\mu g\ kg^{-1}\ h^{-1}$ in the control group ($P=0.46$). Morphine doses at postoperative day 2 and COMFORT-B scores at day 1 did not significantly differ between the two groups. COMFORT-B scores at day two were lower in children with Down's syndrome ($P=0.04$). The duration of postoperative mechanical ventilation did not statistically differ between the two groups ($P=0.89$).

Conclusions. In this study, neonates with and without Down's syndrome received adequate postoperative analgesia, as judged from comparable analgesic consumption and pain scores. We recommend prospective studies in children of different age groups with Down's syndrome and in other groups of intellectually disabled children to provide further investigation of the hypothesis that intellectual disability predisposes to different analgesic requirements.

Keywords: anaesthesia, general; analgesia; Down syndrome; infant, newborn; intestinal atresia

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Research on systematic pain assessment and adequate analgesic therapy in children and neonates is on the rise.[1] It is not clear whether the 'standard' dosing regimens are applicable to intellectually disabled children,[2] although the evidence indicates potential differences in analgesic requirements for intellectually disabled children. Fewer children with intellectually disability were assessed for pain after spinal fusion surgery and they received smaller doses of opioids.[3] On the other hand, Gakhal and colleagues[4] found that children with Down's syndrome were more likely to receive morphine on day 3 after cardiac surgery than were controls.

Most studies in children with intellectual disability are limited by the sample heterogeneity in terms of aetiologies and intellectual disability levels. The reported incidence of congenital duodenal obstruction in children with Down's syndrome is 369 per 10 000 live births, far exceeding that in children without Down's syndrome, from 1.16 to 3.06 per 10 000 live births.[5] This makes repair of duodenal obstruction eminently suitable for comparison of anaesthesia, analgesia, and pain scores between a well-defined group of neonates likely to have future intellectual disability and a group of neonates with a lesser risk of future intellectual disability.

Methods

Participants and setting

After approval of the local ethics review board, we identified all patients who underwent surgical repair of congenital duodenal obstruction between March 1999 and February 2011 in Erasmus University Medical Centre—Sophia Children's Hospital, Rotterdam, the Netherlands, and reviewed their medical records. The Erasmus MC Department of Paediatric Surgery and ICU serves as the only level III facility for those patients in a referral area comprising about 4 million inhabitants and 35 000 newborns yr^{-1}.

Eligible subjects were those who underwent surgical repair of congenital duodenal obstruction within the first 28 postnatal days. Exclusion criteria were: sedation or analgesic treatment during the 24 h before surgery, other surgical interventions at the same time or within 48 h after primary surgery for duodenal obstruction, or no digital record available.

Anaesthesia management

Anaesthesia management is not standardized in our centre and has changed over the years, reflecting new developments. Management of neonates with Down's syndrome generally does not differ from neonates without Down's syndrome, although, anaesthetists may anticipate possible airway management difficulties in neonates with Down's syndrome. Atracurium was the preferred neuromuscular blocking agent until around 2008, when it was replaced with cisatracurium. Until 2008, most patients received barbiturates (thiopental or pentothal) as the hypnotic agent, which was then replaced with propofol. After 2008, a single-shot caudal block was used more frequently as anaesthetists became familiar with this technique. Evidence of specific anaesthesia for surgical repair of congenital duodenal obstruction is missing.

Postoperative pain protocol

A postoperative pain protocol has been in place since 1999 (Supplementary Fig. S1). The first step was regular pain assessment by an intensive care nurse; at least every 2 h during the first postoperative days and then every 8 h. The nurse used both the COMFORT-Behaviour (COMFORT-B) scale and the Numeric Rating Scale (NRS) for pain assessment.[6–8] The COMFORT-B scale includes six items, each rated from 1 to 5. Adding the ratings for all six items provides a pain rating between 6 and 30. The COMFORT-B scale has been validated for use in children with and without Down's syndrome.[8 9] The NRS score for pain is a validated tool that asks a proxy (the nurse) to rate pain intensity (0, no pain at all; 10, worst imaginable pain). The NRS expresses the observer's expert rating of the patient's level of pain, taking the patients' circumstances (disease-related, treatment related, and environmental- and patient-specific) into account.[10] The NRS assessments—part of the pain management protocol since 1999—serve to differentiate between pain and distress. The second step of the protocol is analgesic therapy. At the end of surgery, neonates receive a loading dose of 100 $\mu g\ kg^{-1}$ morphine, followed by a maintenance dose of 10 $\mu g\ kg^{-1}\ h^{-1}$. The protocol-associated decision-tree suggests that score combinations of COMFORT-B $\geq$17 and NRS $\geq$4 indicate moderate to severe pain, warranting opioid analgesia. Otherwise, maintenance doses of morphine are gradually decreased on the guidance of COMFORT-B and NRS scores. The pain management protocol makes no difference between children with or without Down's syndrome. The sedation algorithm has been described previously.[11]

In the study period, four children with Down's syndrome and four without had been included in a randomized controlled trial about the potential morphine-sparing effects of rectal acetaminophen to continuous morphine infusions.[12] No differences in outcomes between the two treatment modes were seen; therefore, those neonates were not excluded from our study.

Measurements

The following patient characteristics were recorded: sex, gestational age at birth, post-natal age at the day of surgery, weight at the day of surgery, presence of trisomy 21 and diagnosis of associated congenital abnormalities (in particular, cardiac anomalies). We recorded amounts of anaesthetics, neuromuscular blocking agents, and analgesics (i.v. or caudal) given intraoperatively. From the surgeons' report, we retrieved the cause of duodenal obstruction (duodenal atresia, duodenal web, or annular pancreas), duration of the surgery, and whether a central venous catheter had been placed. Furthermore, we recorded all hypnotics and analgesics administered during the first 48 h after operation and the duration of postoperative mechanical ventilation. Prospectively collected COMFORT-B scores and NRS ratings were retrieved from the Patient Data Management System (PDMS). Postoperative day 1 is defined as 0–24 h after surgery and postoperative day 2 as 24–48 h after surgery.

Statistical analysis

Data were analysed using SPSS version 19.0 (IBM, Chicago, IL, USA). The χ^2 test (or Fisher's exact test in the case of low predicted cell counts) was used to compare nominal data for the neonates with and without Down's syndrome. Continuous data are presented as median (inter-quartile range) and the two groups were compared using the Mann–Whitney *U*-test. The duration of morphine use is presented as mean (SD) and the two groups were compared using the *t*-test. All reported *P*-values are two-sided, and *P*-values of <0.05 are considered to indicate statistical significance.

Results

From 1999 to 2011, 107 children underwent surgical repair of congenital duodenal obstruction in our hospital. Figure 1 gives a flowchart showing that 45 were included in this study; that is 15 with Down's syndrome (Down's syndrome