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Perioperative hospital mortality at a tertiary paediatric institution

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Abstract

Background: Research in postoperative mortality is scarce. Insight into mortality and cause of death might improve and innovate perioperative care. The objective for this study was to report the 24-hour and 30-day overall, and surgery and anaesthesia-related, in-hospital mortality at a tertiary paediatric hospital.

Methods: All patients <18 yr old who underwent anaesthesia with or without surgery between January 1, 2006, and December 31, 2012, at the Wilhelmina Children's Hospital, Utrecht, The Netherlands, were included in this retrospective cohort study. Causes of death within 30 days were identified and tabulated into four major categories according to principal cause.

Results: A total of 45 182 anaesthetics were administered during this 7-yr period. The all-cause 24-hour hospital mortality was 13.1 per 10 000 anaesthetics (95% CI: 9.9–16.8) and the all-cause 30-day in-hospital mortality was 41.6 per 10 000 anaesthetics (95% CI: 35.9–48.0). In total five patients were partially contributable to anaesthesia (30-day mortality: 1.1/10 000, 95% CI: 0.4–2.6) and four patients were partially contributable to surgery (30-day mortality: 0.9/10 000, 95% CI: 0.2–2.3). Mortality was higher in neonates and infants, children with ASA physical status III and IV, and emergency- and cardiothoracic surgery.

Conclusions: Neonates and infants, children with ASA physical status III or poorer, and emergency- and cardiothoracic surgery are associated with a higher postoperative mortality. Anaesthesia- or surgery-related complications contribute to mortality in only a small amount of the deaths, indicating the relative safety of paediatric surgical and anaesthetic procedures.

Key words: anaesthesia; child mortality; hospital mortality; infants, paediatrics, surgery

Mortality is a basic and objective measure for quality and safety in surgery. As a result of improvements in monitoring and patient care during the last decades, surgery and anaesthesia-related mortality has become infrequent.[1 2] A better understanding of the aetiology of death after surgery and anaesthesia might improve perioperative care, by allowing better prediction and preemptive management of future problems. The analysis of mortality may help caregivers to determine which patients are at higher risk, in order to guide planning, resourcing, and expert staffing for high-risk patients.

However, research in perioperative anaesthesia and surgery related mortality is scarce. As far as we know there have been no data published from Europe on post-surgical and anaesthesia mortality in children in specific groups recently. The incidence of

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Editor's key points

- Anaesthesia-related mortality is rare in paediatric practice but contributing factors offer insights to further improve care
- Electronic anaesthesia information systems enhance objective retrospective analysis of critical incidents
- There is a need for international standardization of terminology to evaluate anaesthesia-related mortality

perioperative cardiac arrests that occurred during procedures requiring anaesthesia services has been studied in a voluntary registry in a single institution in the USA.[3] However, voluntary reports are likely to underestimate the true incidence. Another large study in a single tertiary institution in Australia also studied the incidence and nature of anaesthesia related 30-day mortality-voluntarily. Yet, they used hand-written anaesthesia charts which may be more inaccurate than electronic records.[4]

There is limited information about the risk of specific subgroups of patients [e.g. the risk differences between cardiac and non-cardiac surgeries and the variance among age-groups (neonates, toddlers and infants)] and about the incidence of the contribution of anaesthesia and surgical factors to short and long-term mortality. Electronic anaesthesia information systems (AIMS) and electronic patient charts are likely to reduce underreporting of intraoperative problems – for example, severe hypoxaemia or hypotension – and allow objective review of the anaesthesia charts to define the possible contribution of anaesthesia and surgery to perioperative deaths.

Therefore, the aim of this study was to determine the incidence and nature of mortality in paediatric practice occurring within 24 h, or 30 days after the termination of surgery and anaesthesia at a large tertiary institution, using AIMS and electronic patients charts to define the anaesthesia and surgery related contribution to death.

Methods

We retrospectively analysed the causes of 30-day postoperative in-hospital mortality of all children younger than 18 yr, who had been operated on in a tertiary paediatric university hospital (Wilhelmina Children's Hospital, University Medical Centre Utrecht, The Netherlands, 48.000 attendances per year, 220 beds) between January, 2006, and December, 2012. The institution provides surgical services in all areas, and one of the four national centres for paediatric congenital heart deformities in the Netherlands.

The study protocol has been reviewed by the Institutional Review Board of the University Medical Centre Utrecht, which waived the need for informed consent, as patients were not subjected to investigational actions (#13-627, November 25th, 2013). Patient confidentiality was guaranteed according to the Dutch law on personal data protection. Data were obtained from the Anaesthesia Information Management System (AIMS, AnStat®, Carepoint, Ede, The Netherlands) and the electronic hospital registration and billing administration (EZIS, Chipsoft®, The Netherlands) of the hospital. Anaesthetics performed outside locations might not be registered in AIMS. Therefore, additionally we coupled the hospital's general patient records and billing system to find the missing cases of children who underwent a surgical procedure outside the operation room or emergency department with anaesthesia by an anaesthesiologist. We excluded all deaths that occurred outside the hospital according to the definition of 'in hospital mortality'.

Surgical, anaesthetic and clinical charts of children who died within the hospital during administration - or within 30 days after the commencement - of the last procedure were reviewed. The characteristics of the patients, diagnosis, indications for surgery, ASA PS, type of operation, anaesthetic technique and duration, and the time, place and cause of death were recorded. Children were categorized into five groups according to age: neonates up to 30 days of age, infants from 31 days to 12 months of age, preschool children of one–to three yr of age, children aged four to nine yr and older children aged 10–17 yr. The principal causes of death were examined and tabulated into four major categories:

1. attributable to preoperative child condition or disease (when comorbidities were the only or the major contributory factor);
2. attributable to a preoperative trauma event (with subsequent surgery);
3. anaesthesia either fully or partially contributed to the death (when the child's disease or condition were primary factors but anaesthesia-related problems represented an additional factor);
4. the surgical procedure either fully or partially contributed to the death (when the child's disease or condition were primary factors but surgery-related problems represented an additional factor);

Categories 1 and 2 include all deaths in which the panel agreed that neither surgery nor the anaesthetic procedure contributed to death. Deaths where anaesthesia contributed were defined using the definition by Griend and colleagues[4]: patients for which the panel agreed that anaesthesia or factors under the responsibility of the anaesthetist contributed to death. The same panel-based assessment was applied to the category 'surgery-related death'. The medical records of children who died within 30 days after anaesthesia were examined by one author (L.B.), two paediatric anaesthetists (J.G. and D.W.) and two paediatric surgeons (F.H. and D.Z). Patients were discussed and anaesthesia- and surgery-related death was determined until consensus was reached by the entire team. Children receiving intraoperative care for organ donation were excluded.

Statistical methods

Mortality incidence is expressed per 10 000 procedures with 95% Confidence Interval (95% CI). In reporting the 95% CIs, the risk is per anaesthetic. The reported 95% CIs around risk were not adjusted to account for the non-uniform risk introduced by children having multiple procedures.[4] We performed univariate and a multivariate logistic regression analyses to identify risk factors (age, gender, emergency status, surgical procedure) for 30-day in-hospital mortality. For children who had received multiple anaesthetics we included only the last anaesthetic, to reduce the potential unequal influence of repeated anaesthetics. All statistical analyses were performed using SPSS statistics version 20, (IBM, Chicago, IL, USA) with exception of the 95% CI's of risk differences which were calculated by Confidence Interval Analysis binomial exact method (Clopper-Pearson).

Results

A total of 45 182 anaesthetics in 26 436 patients were administered during a seven-yr period (Fig. 1). Hospital mortality within 24 h was 13.1 per 10 000, and 41.6 per 10 000 procedures within 30 days (Table 1). Most patients received a single anaesthetic (18 121/26 436; 68.5%). Approximately 17.1% received two anaesthetics