

## REVIEW ARTICLE

# Preoperative fasting in children: review of existing guidelines and recent developments

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## Abstract

The current guidelines for preoperative fasting recommend intervals of 6, 4, and 2 h (6–4–2) of fasting for solids, breast milk, and clear fluids, respectively. The objective is to minimize the risk of pulmonary aspiration of gastric contents, but also to prevent unnecessarily long fasting intervals. Pulmonary aspiration is rare and associated with nearly no mortality in paediatric anaesthesia. The incidence may have decreased during the last decades, judging from several audits published recently. However, several reports of very long fasting intervals have also been published, in spite of the implementation of the 6–4–2 fasting regimens. In this review, we examine the physiological basis for various fasting recommendations, the temporal relationship between fluid intake and residual gastric content, and the pathophysiological effects of preoperative fasting, and review recent publications of various attempts to reduce the incidence of prolonged fasting in children. The pros and cons of the current guidelines will be addressed, and possible strategies for a future revision will be suggested.

**Keywords:** anaesthesia; aspiration pneumonia; children; gastric emptying; preoperative period

Preanaesthetic or preoperative fasting is a universally applied principle in elective cases to minimize the risk of pulmonary aspiration of gastric content posed by the combination of regurgitation and loss of protective airway reflexes by anaesthetic agents. In the early days of anaesthesia, a light breakfast was often recommended before anaesthesia, but several reports of pulmonary aspiration associated with anaesthesia, including the classic report of a series of 66 obstetric cases by Mendelson,<sup>1</sup> resulted in the implementation of various nil by mouth (NBM)-from-midnight recommendations, increasingly

enforced from around 1970.<sup>2</sup> Subsequently, guidelines published and adopted by the North American and European anaesthesiology organizations—the ASA in 1998/2011, the European Society of Anaesthesiology (ESA) in 2011, and the Scandinavian Society of Anaesthesiology and Intensive Care (SSAI) in 2003—have cemented the principle that solids (including semi-solid food and milk-containing products) should be avoided 6 h and clear fluids 2 h before anaesthesia induction, respectively (6–4–2 regimen).<sup>3–5</sup> Infants are usually allowed ingestion of breast milk up to 4 h before anaesthesia.

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**Editor's key points**

- Pulmonary aspiration associated with anaesthesia is rare. Many children are fasted excessively in spite of the current guidelines.
- This review provides a summary of the physiological, epidemiological, and practical aspects of ensuring safe anaesthesia with regard to fasting in children.
- A suggestion for a revision of the guidelines for preoperative fasting in children is provided.

Guidelines on perioperative fluid management and fasting have recently been reviewed by Lambert and Carey,<sup>6</sup> who found that only two recommendations could be graded as level A: firstly, that preoperative fasting should be minimized, and secondly, that clear fluids may be ingested until 2 h before the administration of anaesthesia.

Recent research has contributed with new insights concerning preoperative fasting in children: firstly, that children are often fasted for unnecessarily long intervals in spite of the implementation of current guidelines; secondly, that prolonged fasting could have detrimental metabolic and behavioural effects in small children; thirdly, that the rationale for 6–4–2 h limits in current guidelines may be questioned; and fourthly, that reducing fasting intervals within or even beyond the 2 h limit may be safe and result in a reduced risk of negative metabolic effects of fasting.

In this review, we will analyse the risk of pulmonary aspiration in paediatric anaesthesia; examine the physiological basis for various fasting recommendations, the temporal relationship between fluid intake and residual gastric content, and the pathophysiological effects of preoperative fasting; and review recent publications of various attempts to reduce the incidence of prolonged fasting in children. The pros and cons of the current guidelines will be addressed, and possible strategies for a future revision will be suggested.

### **Pulmonary aspiration of gastric contents in paediatric anaesthetic practice**

In the last decades, there have been a number of reports in the anaesthetic literature looking at the issue of pulmonary aspiration in both adult and paediatric practice.<sup>7,8</sup> A recent report of pulmonary aspiration in paediatric practice is a multicentre study of specialist paediatric centres that took place in the United Kingdom.<sup>9</sup> This study revealed a very low incidence of aspiration of 2 and 2.2 per 10 000 cases for both elective and emergency cases, respectively. The study was conducted in the United Kingdom where the 6–4–2 h rule is widespread for fasting. Although the recent multicentre study reports a very low incidence, there are other studies in children that report higher incidences of 9–10 cases per 10 000 cases.<sup>7,8,10</sup> The most recent of these, the Anaesthesia Practice in Children Observational Trial (APRICOT) study, was a prospective, multicentre, pan-European study of the incidence of severe critical events in paediatric anaesthesia.<sup>10</sup> In the APRICOT study, the aspiration event led to treatment with suctioning (54%), bronchodilators (30%), intubation/prolonged intubation (9.3%), antibiotics (4.7%), and continuous positive airway pressure (CPAP) (2.3%). The outcome was uneventful in 54% of cases, but led to prolonged intubation (12%), hypoxaemia (30%), or pneumonia (3%) in the remaining cases. Interestingly, not a

single admission to intensive care as a result of the aspiration event was registered, in spite of several children needing prolonged intubation or CPAP. If this is not attributable to under-reporting, none of the aspiration events appear to be associated with long-term morbidity or mortality.

In an earlier single-centre study, Warner and colleagues<sup>11</sup> reported a low incidence in elective patients of 2 per 10 000, but a 10-fold higher incidence in emergency cases. This was corroborated neither by the APRICOT study nor by the UK report.<sup>9,10</sup>

The aforementioned studies all suggest that pulmonary aspiration during anaesthesia is a low-risk event in children, but this view should be balanced with two other reports. The review from the Australian Incident Monitoring Study in 1999 report on 133 cases of pulmonary aspiration in adults and children.<sup>12</sup> Approximately 20% of the cases were children, and there were five deaths in the group as a whole. The National Audit Project 4, from the Royal College of Anaesthetists and the Difficult Airway Society in the United Kingdom entitled 'Major Complications of Airway Management in the UK', found that pulmonary aspiration was the commonest cause of death during anaesthesia in adults and accounted for 50% of anaesthesia-related deaths overall in the study period.<sup>13</sup> Therefore, although aspiration of gastric contents is an uncommon event, it can have devastating consequences. Importantly, no single paediatric case of perioperative aspiration-related death and no long-term sequelae from perioperative fluid aspiration have been published so far, although there may have been under-reporting in the literature because of medicolegal restrictions.<sup>14</sup>

### **Fasting times and the risk of pulmonary aspiration**

Although having a large meal just before anaesthesia is probably a very bad idea, there is no solid evidence in the form of randomized controlled trials linking the length of preoperative fasting with the risk of aspiration of gastric contents during anaesthesia.

In a recent multicentre trial with more than 139 000 procedural sedations or anaesthetics in children, the incidence of aspiration was reported to be similar whether the children were fasted or not.<sup>15</sup> Other factors, such as patient- and anaesthetic-related issues, are more likely to be responsible for an aspiration event in the elective situation. Fasting times have, over the last 50 yr or so, come down, particularly relating to clear fluid intake, and this time period has seen the incidence of aspiration events decrease in parallel. The latter development is likely attributable to several factors, such as changes in practice and improvement in the standard of care, but at the very least does not support longer clear fluid fasting intervals than 2 h for elective cases, and may be taken into account when we discuss even shorter fasting times.

The recent studies show that the main risk period for an aspiration event is during induction, but may also occur during maintenance of anaesthesia or during emergence.<sup>8,10,11</sup> The patient factors associated with aspiration of gastric contents include a full stomach, bowel obstruction, abdominal pain, diabetes, or associated trauma with reduced gastric emptying. Anaesthetic risk factors from the studies include drug-related issues (e.g. opioids), patient positioning, the choice of airway management, and often 'light' or inadequate anaesthesia.<sup>9,11–13</sup>

Recurrent themes from all the recent reports include emergency patients, inadequate anaesthesia, obesity,

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