

# Pre-procedural fasting in emergency sedation

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## ABSTRACT

Emergency physicians frequently undertake emergency procedural sedation in non-fasted patients. At present, no UK guidelines exist for pre-procedural fasting in emergency sedation, and guidelines from the North American Association of Anesthesiologists (ASA) designed for general anaesthesia (GA) are extrapolated to emergency care. A systematic review of the literature was conducted with the aim of evaluating the evidence for risk of pulmonary aspiration during emergency procedural sedation in adults. All abstracts were read and relevant articles identified. Further literature was identified by hand-searching reference sections. Papers were objectively evaluated for relevance against pre-determined criteria. The risk of aspiration in emergency procedural sedation is low, and no evidence exists to support pre-procedural fasting. In several large case series of adult and paediatric emergency procedural sedation, non-fasted patients have not been shown to be at increased risk of pulmonary aspiration. There is only one reported case of pulmonary aspiration during emergency procedural sedation, among 4657 adult cases and 17 672 paediatric cases reviewed. Furthermore, ASA guidelines for fasting prior to GA are based on questionable evidence, and there is high-level evidence that demonstrates no link between pulmonary aspiration and non-fasted patients. There is no reason to recommend routine fasting prior to procedural sedation in the majority of patients at the Emergency Department. However, selected patients believed to be significantly more prone to aspiration may benefit from risk:benefit assessment prior to sedation.

## INTRODUCTION

### Synopsis

Emergency physicians frequently undertake emergency procedural sedation in non-fasted patients. At present, no UK guidelines exist for pre-procedural fasting in emergency sedation, and guidelines from the American Association of Anesthesiologists (ASA) designed for general anaesthesia (GA) are extrapolated. The literature shows that the risk of aspiration in emergency procedural sedation is low, and no evidence exists to support pre-procedural fasting. Furthermore, ASA guidelines for fasting prior to GA are based on questionable evidence, and there is high-level evidence that demonstrates no link between pulmonary aspiration and non-fasted patients.

### Background to procedural sedation

The administration of procedural sedation has become widespread practice in UK Emergency Departments (ED). It allows potentially painful and distressing procedures to be undertaken in a timely fashion with minimal distress to the patient. Emergency physicians now increasingly

possess the necessary skills to safely manage procedural sedation and its possible complications. Potentially life-threatening complications include apnoea, hypoxia, hypotension and pulmonary aspiration. To date, there has been only one published case report of pulmonary aspiration occurring during ED procedural sedation.<sup>1</sup> The aim of this study was to evaluate the evidence for risk of pulmonary aspiration during emergency sedation in adults.

### Pathophysiology of pulmonary aspiration

Pulmonary aspiration can be defined as 'the inhalation of oropharyngeal or gastric contents into the larynx and lower respiratory tract'.<sup>2</sup> The consequences of pulmonary aspiration exist on a continuum from asymptomatic to fatal aspiration pneumonia. The syndrome of aspiration pneumonia describes a collection of features including cough, dyspnoea, hypoxia and bronchospasm,<sup>3</sup> from which the majority of patients recover completely, and mortality is extremely rare.<sup>4</sup>

### Changing theories in risk of aspiration

Mendelson was the first to describe the pathophysiology of aspiration of gastric contents as a consequence of general anaesthesia in 1946.<sup>5</sup> Mendelson described a series of 44 016 obstetric patients undergoing general anaesthesia between 1932 and 1945. He reported 45 cases of aspiration, resulting in two deaths. He went on to instil a variety of solutions into rabbit lungs and observed the consequences, and concluded that the severity of pulmonary damage in humans and animals is worse in large-volume, low-pH aspirate. He advocated the introduction of preoperative fasting to prevent aspiration of gastric acid, and subsequent studies aimed to determine the characteristic of stomach contents that were likely to produce aspiration pneumonia. An oft-quoted study by Roberts in 1974<sup>6</sup> concluded that the risk of aspiration pneumonia is increased if the patient has gastric volumes exceeding 25 millilitres, with a pH less than 2.5. These values were extrapolated from work done on monkeys. It has been historically taught that the degree of pulmonary injury from aspiration is directly related to volume and acidity of gastric contents, a theory that has since been disproved.<sup>7-9</sup> Similarly, there is insufficient evidence to show that a decreased preoperative fasting time is associated with an increased risk of pulmonary aspiration.<sup>10-14</sup>

Over the years, many theories have been proposed, and much research has focused on identification of risk factors for aspiration during general anaesthesia. The first studies on animals showed that lungs exposed to stomach acid demonstrated histological changes of chemical

pneumonitis.<sup>5</sup> Consequently, the use of antacid therapies began, in order to reduce the likelihood of pneumonitis occurring should pulmonary aspiration of gastric contents occur. However, although antacid medications have been shown to lower gastric pH, there is no evidence that therapeutic prophylaxis lowers aspiration risk or improves outcomes<sup>15</sup> and it is not recommended by the ASA in healthy patients.<sup>7</sup> In obstetric anaesthesia, ASA guidelines advise anaesthetists to consider prophylaxis before caesarean delivery.

Another relevant theory is that a minimum volume of fluid needs to be aspirated into the lungs before a pneumonitis occurs, and that the gastric volume at the time of anaesthesia impacts on the volume aspirated.<sup>8</sup> This has been superseded by more recent evidence, demonstrating that clear liquids ingested up to 2 h prior to surgery do not increase gastric volume or decrease gastric pH.<sup>16</sup> Significantly, aspiration of clear fluids is associated with a low risk of pneumonitis,<sup>17</sup> and it is now recognised that asymptomatic aspiration of gastric contents occurs physiologically during normal sleep.<sup>2 18</sup> Research on intubated patients during general anaesthesia shows that silent aspiration frequently occurs despite airway protection.<sup>19 20</sup> Perhaps most importantly, it appears that the aspiration of particulate matter or food can result in pulmonary damage.<sup>4</sup> It is, therefore, the risk of particulate matter aspiration that should be the priority in the development of a guideline for procedural sedation.

Other factors have been implicated in the past such as pregnancy, obesity and opioid use, but these do not seem to be independent risk factors.<sup>3</sup> Confirmed risk factors for pulmonary aspiration include airway difficulties (eg, laryngospasm, technically difficult intubation), old age and conditions predisposing to gastro-oesophageal reflux (eg, hiatus hernia, bowel obstruction, raised intracranial pressure).<sup>15</sup> Significantly, pulmonary aspiration has also been reported in patients with no risk factors,<sup>4</sup> and may still occur when the precaution of rapid sequence of induction of anaesthesia and tracheal intubation is employed.<sup>15</sup> One theory of particular interest to emergency physicians, is that acutely stressful experiences can cause a delay in gastric emptying.<sup>21</sup> However, this theory remains controversial, and although distress is often quoted as a risk factor for pulmonary aspiration secondary to delayed gastric emptying, several studies have failed to show an association.<sup>22–24</sup>

Regarding general anaesthesia, a Cochrane review in 2003<sup>8</sup> concluded that 'there is no evidence to suggest a shortened fluid fast results in an increased risk of aspiration, regurgitation or related morbidity compared with the standard'. However, despite the myriad literature there are relatively few trials that specifically investigate the relationship between preoperative fasting and the risk of pulmonary aspiration. Several randomised controlled trials (RCTs)<sup>9–14</sup> indicate that despite deviance from ASA fasting guidelines there is no increased risk of pulmonary aspiration. It is difficult to apply this evidence to sedation in the emergency department for a number of reasons:

1. During general anaesthesia protective airway reflexes are lost, and airway manipulations are common. This is very different

to sedated patients who do not usually undergo airway manipulations, and are presumed to maintain their airway reflexes in most cases.

2. The anaesthetic literature relates to elective procedures. Patients being sedated in emergency departments are, by definition, unplanned.
3. The alternative oral intake regimens trialled by these studies included small volumes of clear fluids (maximum of 400 millilitres), which is very different to patients undergoing sedation in the ED, who have usually had unlimited fluid and solid intake prior to attendance.

However, it is clear from up to date evidence, that the ASA guidelines for fasting are not based on recent clinical trials, and that the evidence that historically led to the development of fasting guidelines, which remain in place today, has minimal scientific support.

### Pulmonary aspiration in emergency procedural sedation

Preoperative fasting guidelines have been extrapolated to procedural sedation. The ASA guidelines require at least 2 h of fasting for clear liquids and 6 h for solids,<sup>7</sup> and indicate that this should also apply to 'light pre-procedural sedation'. These guidelines are now in widespread use in the UK, and have been incorporated into ED sedation protocols.

For clarity, the following definitions for sedation level will be used throughout this review.<sup>7</sup>

Table 1 represents an attempt to categorise the continuum of sedation into discrete stages in terms of level of responsiveness, effect on airway reflexes, spontaneous respiration and cardiovascular function. The spectrum of sedation begins at minimal, in which a patient has a normal response to verbal stimulation and is able to adequately protect their own airway. At the opposite end of the sedation spectrum, general anaesthesia is reached, and the patient can be unresponsive and apnoeic, with an obstructed airway. Although the aim of sedation is not to reach this state, it is recognised that this may inadvertently occur due to inappropriate dosing, the effects of polypharmacy or individual pharmacokinetics.

However, there are several theoretical reasons why the risk of aspiration can be considered to be lower in procedural sedation than in general anaesthesia:

1. Depth of sedation: Airway reflexes are broadly assumed to be maintained during minimal and moderate sedation, and lost during general anaesthesia. It is not clear where the point of loss of reflexes lies, or even if such a point exists. It is likely that a variety of factors, specific to each individual patient, determine the depth of sedation at which they become unable to protect themselves from significant aspiration.<sup>4</sup> However, procedural sedation does not aim to provide sedation to the point of general anaesthesia, so in theory protective airway reflexes should be maintained, at least to some degree. Specifically, when ketamine is used for sedation airway reflexes are more likely to be preserved because of its dissociative effect.

**Table 1** Categories of sedation

	Minimal sedation	Moderate sedation	Deep sedation	General anaesthesia
Responsiveness	Normal response to verbal stimulation	Purposeful* response to verbal or tactile stimulation	Purposeful* response following repeated or painful stimulus	Unroutable, even with painful stimulus
Airway reflexes	Unaffected	No intervention required	Intervention may be required	Intervention often required
Breathing	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular	Unaffected	Usually maintained	Usually maintained	May be impaired

\*Reflex withdrawal from painful stimulus is NOT considered a purposeful response.

- Airway manipulation: During procedural sedation, airway manipulation does not routinely take place, unless there has been a complication. It is reported that two-thirds of aspirations during general anaesthesia occur during intubation or extubation.<sup>4</sup>
- Drugs: The drugs used routinely for procedural sedation are thought to be less emetic than the inhaled anaesthetic gases used for general anaesthesia.<sup>25 26</sup>
- Comorbidity of patients: Patients with pre-existing comorbidities have an increased risk of aspiration during general anaesthesia.<sup>17</sup> Patients requiring sedation for emergency procedures in the ED should be assessed in terms of the risk of aspiration. In those at high risk it is usual practice for the procedure to be performed by an alternative method, for example general anaesthesia with formal airway protection, or regional anaesthesia.

There are many other reasons why the ASA guidelines for fasting for elective anaesthesia should no longer be used as the gold standard for sedation in ED.<sup>27</sup> The guidelines are designed for a group of patients undergoing elective procedures, which is a very different target group from those found in the ED. It is often impractical to suggest fasting this group of patients before their procedure due to the urgency of the treatment required, for example, the cardioversion of a life-threatening dysrhythmia. Rigidly applying these guidelines could risk clinical deterioration, delay definitive treatment and cause ongoing pain and distress. These individuals represent a significant patient cohort, and in a busy ED there are not the facilities to house patients until they have reached the allocated period of fasting.<sup>27</sup> Evidence in adults is limited, but a case series of children undergoing procedural sedation in the ED shows that although 56% were not fasted according to ASA guidelines, there was no difference in airway complications or emesis when compared with the fasted children.<sup>28</sup> Indeed, only one case report<sup>1</sup> exists of pulmonary aspiration during procedural sedation in the ED, and this patient had no adverse outcome.

## AIMS

There is a compelling need for a guideline to allow emergency physicians to practically and safely carry out procedural sedation, rather than extrapolating ASA guidelines. The aim of this article is to evaluate the evidence for risk of pulmonary aspiration during ED procedural sedation in adults.

## METHODS

The aim was to identify literature that would provide evidence regarding fasting in adults undergoing emergency sedation. However, it was expected that there would be little evidence available. If this was the case, the literature search would be expanded to identify relevant related topics such as paediatric emergency sedation.

In the preliminary literature search, an electronic search was carried out, using the terms: [exp EMERGENCY] or [exp EMERGENCY TREATMENT] or [emergency.mp] AND [exp CONSCIOUS SEDATION/OR exp DEEP SEDATION/] or

[sedation.mp] AND [procedur\$.mp]. Limit to Humans and (Age Groups All Adult 19 plus years) and English Language. Searches were made of the following databases via Athens: MEDLINE (1950 to 2008 187 titles), EMBASE (1974 to 2008, 413 titles). All abstracts were read and relevant articles identified. Further literature was identified by hand-searching reference sections. Papers were assessed for relevance by applying the following inclusion criteria: (1) Design: case series, trials, cohorts. (2) Population: studies recruiting adult patients undergoing sedation for emergency procedures. (3) Interventions: Sedation for urgent procedures carried out in ED. (4) Outcome measures: adverse effects reported. Exclusion criteria: studies that did not document fasting status, and whose authors, when contacted, could not provide information on fasting status in the study population.

Due to the lack of conclusive evidence in the published literature regarding fasting in adult procedural sedation, a search was also conducted for evidence in paediatric emergency medicine. An electronic search was carried out, using the same terms as above, but also limited to 'paediatric'. Searches were made of the following databases using the NHS library via Athens: MEDLINE (1950-2008, 226 titles), EMBASE (1974-2008, 423 titles). All abstracts were read and relevant articles identified. Further literature was identified by hand-searching reference sections. The same inclusion and exclusion criteria were applied. The results of the two literature searches will be discussed in two separate parts.

## ADULT PROCEDURAL SEDATION

### Results

One case report of pulmonary aspiration associated with sedation has been published to date, summarised in table 2.<sup>1</sup>

Several large series were identified in the literature search. None of these papers specifically addressed the risk of pulmonary aspiration in procedural sedation. However, all the papers listed in table 3 specifically reported any adverse events occurring procedural sedation, of which vomiting and pulmonary aspiration were specifically included.

### Comment

With the exception of one case report, there are no reports of pulmonary aspiration associated with emergency procedural sedation in the literature. However, cases of vomiting during sedation are described. In total 4657 cases of emergency sedation appear in table 3, all of which describe adults requiring emergency procedures, using a variety of sedative drugs, who had not been fasted according to ASA guidelines. In total, 17 cases of vomiting were reported during sedation, but none of the patients who vomited showed evidence of pulmonary aspiration. Of the cases that vomited during procedural sedation, one was being intubated for decreased level of consciousness, and was later found to have had a hypertensive intracranial haemorrhage prior to sedation. Another patient vomited after a period of apnoea for which they received bag-valve-mask ventilation (but no airway manipulation). The other cases had no specific additional cause for vomiting reported.

**Table 2** Case report

Reference	Subjects	Study design	Findings	Comments
Cheung <sup>1</sup> 2007	Single patient, fasted for 5 h undergoing manipulation of a fractured ankle	Case report	Pulmonary aspiration occurred	Alcohol consumed. Sedated on two occasions. Sedation administered by orthopaedic team

**Table 3** Summary of adult sedation papers

Reference	Subject	Study design	Findings	Comments
Frazeo BW <sup>71</sup>	136 patients sedated using propofol	Prospective observational study	One patient vomited, after apnoea requiring assisted ventilation: no evidence of aspiration	Patients fasted for 6 h for solids, 2 h for liquids
Campbell SG <sup>72</sup>	979 patients sedated using propofol, fentanyl or midazolam	Retrospective case series	No cases of vomiting or aspiration reported	Patients not fasted
Miner JR <sup>73</sup>	62 patients, ASA three or four sedated using propofol or etomidate	Prospective observational study	No cases of vomiting or aspiration reported	Fasted for 3 h for solids
Swanson ER <sup>74</sup>	20 patients sedated using propofol and fentanyl	Convenience sample	No cases of vomiting or aspiration reported	Patients not fasted
Chudnofsky CR <sup>75</sup>	77 patients sedated using ketamine and midazolam	Prospective observational trial	Two cases of post-procedural vomiting, no aspiration	Patients not fasted
Lermann B <sup>76</sup>	76 patients sedated using methohexital	Prospective observational study	One patient vomited, who was being intubated for a low GCS. CT showed hypertensive intracranial haemorrhage	Patients not fasted
Miner JR <sup>77</sup>	103 patients sedated using propofol or methohexital	Prospective randomised study	No cases of vomiting or aspiration reported	Fasted for 3 h for solids
Vinson DR <sup>78</sup>	134 patients aged 6-93 sedated using etomidate, opiates and benzodiazepines	Retrospective observational study	One case of vomiting requiring suctioning, no evidence of aspiration	Patients not fasted
Ruth WJ <sup>79</sup>	60 patients sedated with etomidate	Two-part feasibility study	One cases of post-procedural vomiting. No cases of vomiting while sedated, or aspiration	Patients not fasted
Burton JH <sup>80</sup>	792 patients sedated with propofol	Prospective observational study at three sites	One case of vomiting, no evidence of aspiration	Patients not fasted
Coll-Vinent B <sup>81</sup>	32 patients sedated using propofol, etomidate, midazolam ± flumazenil	RCT of four regimes	No cases of vomiting or aspiration reported	Patients fasted for 4 h
Miner JR <sup>82</sup>	108 patients sedated using propofol, methohexital, etomidate or benzodiazepines	Prospective observational study	No cases of vomiting or aspiration reported	Patients fasted for 3 h for solids
Sokolowski J <sup>83</sup>	145 patients over 70 years old sedated using etomidate	Prospective observational study	No cases of vomiting or aspiration reported	Patients not fasted
Willman EV <sup>84</sup>	114 patients sedated using ketamine and propofol	Prospective observational study	No cases of vomiting or aspiration reported	Patients not fasted
Chan KLL <sup>85</sup>	87 patient sedated using etomidate or midazolam	RCT	No cases of vomiting or aspiration reported	Patients not fasted
Sacchetti A <sup>70</sup>	687 patients sedated using various agents	Prospective multicentre observational study	No cases of vomiting or aspiration reported	Patients not fasted
Engel J <sup>86</sup>	308 adults sedated using propofol	Prospective observational study	No cases of vomiting or aspiration reported	Patients not fasted
Dunn T <sup>87</sup>	48 patients sedated using propofol	Prospective observational study	No cases of vomiting or aspiration reported	Patients not fasted
Miner JR <sup>88</sup>	214 patients sedated using propofol or etomidate	Randomised prospective trial	No cases of vomiting or aspiration reported	Patients fasted for 3 h for solids
Newton A <sup>89</sup>	92 patients sedated using ketamine	Prospective observational study	Three patients vomited, no reports of aspiration	Patients not fasted
Vardy JM <sup>90</sup>	210 patients sedated for emergency procedures	Prospective observational study	Three patients vomited, no reports of aspiration	Patients not fasted
Sim TB <sup>91</sup>	15 patients sedated for abscess drainage in the ED using ketamine and midazolam	Prospective observational study	Two patients vomited, no reports of aspiration	Patients fasted for 3 h
Messenger DW <sup>92</sup>	63 patients sedated with ketamine or fentanyl	Double blind RCT	No cases of aspiration or vomiting reported	4 h fast recommended
Wright SW <sup>93</sup>	69 patients sedated with midazolam and diazepam	Double blind RCT	No cases of aspiration or vomiting reported	Not routinely fasted. Fasting times decided on an individual basis
Green SM <sup>94</sup>	26 patients sedated with ketamine	Prospective observational study	Two patients vomited but no cases of aspiration reported	Patients fasted for 3 h

ASA, American Society of Anesthesiologists; CT, computed tomography; GCS, Glasgow Coma Scale; RCT, randomised controlled trial.

In summary, there is no high-level evidence that specifically addresses the risk of pulmonary aspiration associated with sedation for emergency procedures. However, large numbers of patients are described in these studies, and there remains only one case report of pulmonary aspiration in the literature to date.

### PAEDIATRIC PROCEDURAL SEDATION

Paediatric emergency physicians, like their counterparts in the adult ED, are increasingly undertaking sedation for painful and unpleasant procedures such as suturing and joint/fracture

manipulations.<sup>29</sup> Similar to adult emergency sedation, there are no guidelines that specifically relate to sedation for paediatric emergency procedures. Again, the ASA guidelines are frequently applied to this group of patients, despite general acceptance that most procedural sedation is not likely to result in loss of protective airway reflexes.<sup>27</sup> For emergency procedures, the ASA believes that the same fasting rules should apply as for elective procedures, that is, 2 h for clear liquids, 4 h after breast milk and 6 h after food or formula milk.<sup>7</sup> The ASA states that if the patient is not starved and requires an emergency procedure, sedation should be modified to be lighter.<sup>7</sup>

**Table 4** Summary of paediatric sedation papers

Reference	Subject	Study Design	Findings	Comments
Bassett KE <sup>29</sup>	393 children sedated using propofol	Prospective observational study	No vomits during procedure, no cases of aspiration reported	Patients fasted for 3 h
Newman DH <sup>32</sup>	1351 children sedated using various agents	Prospective observational study	Three cases of vomiting during sedation, no cases of aspiration reported	Patients fasted for 3 h
Agrawal D <sup>28</sup>	1014 children sedated using various agents	Prospective observational study	15 cases of vomiting during procedure. No cases of aspiration reported	56% subjects not fasted according to ASA guidelines
Roback MG <sup>30</sup>	2085 sedated using various agents	Cohort study	156 children vomited, no cases of pulmonary aspiration reported. No difference in vomiting between fasted and non-fasted groups	1/3 of 2085 patients not fasted according to ASA guidelines
Pena BMG <sup>25</sup>	1180 children sedated using various agents	Prospective observational study	Two cases of vomiting during procedure. No cases of aspiration reported	Patients not fasted
Sachetti A <sup>33</sup>	341 children sedated with various agents	Prospective multicentre observational study	No cases of vomiting or aspiration reported	Patients not fasted
Pitetti RD <sup>34</sup>	1244 children sedated using midazolam and/or ketamine	Prospective observational study	Vomiting occurred in 13 patients, no cases of aspiration reported	Patients fasted for >3 h
Dickinson R <sup>35</sup>	53 children sedated using etomidate	Retrospective chart review	No cases of vomiting or aspiration reported	Patients kept nil by mouth from arrival at ED
Bell A <sup>31</sup>	400 children sedated for using propofol	Prospective observational study	One patient vomited during sedation, no cases of aspiration reported	70% cases not fasted according to ASA guidelines
Skokan EG <sup>36</sup>	40 children sedated using propofol	Prospective observational study	No cases of vomiting or aspiration reported	Patients fasted for >4 h
Woolard D <sup>37</sup>	759 children sedated using various agents	Retrospective chart review	18 cases of vomiting, no cases of aspiration reported	Patients not fasted
Kennedy RM <sup>38</sup>	260 children sedated using midazolam or ketamine	Prospective partially blinded trial	18 cases of vomiting, no cases of aspiration reported	Patients not fasted
Godambe SA <sup>39</sup>	113 children sedated using various agents	Prospective partially blinded trial	Two cases of vomiting, no cases of aspiration reported	Patients fasted for >4 h
Pohlgeers AP <sup>40</sup>	133 children sedated using fentanyl and diazepam	Retrospective chart review	One case of vomiting, no cases of aspiration reported	Patients kept nil by mouth from time of arrival to ED
Holloway VJ <sup>41</sup>	100 children sedated using ketamine	Retrospective chart review	No cases of vomiting or aspiration reported	Patients fasted for 3 h
Younge PA <sup>42</sup>	59 children sedated for using oral ketamine and midazolam	Prospective randomised double blind trial	Five cases vomited, no cases of aspiration reported	Patients not fasted
Treston G <sup>43</sup>	272 children sedated using ketamine	Prospective observational study	No vomits during procedure, no cases of aspiration reported	Patients not fasted
Luhmann JD <sup>44</sup>	55 children sedated using ketamine	Randomised comparison	Two children vomited, no cases of aspiration reported	Patients fasted for 2 h
Kim G <sup>45</sup>	20 children sedated using ketamine	Prospective observational study	No cases of vomiting or aspiration reported	No full meal within 3 h
Ng KC <sup>46</sup>	500 children sedated using ketamine	Retrospective observational study	No reports of aspiration. Vomiting not reported	Patients fasted for 3 h
Heinz P <sup>47</sup>	83 children sedated using ketamine	Prospective randomised double blind study	No reports of aspiration. No vomits during procedure reported	Patients fasted for minimum of 3 h
McGlone R <sup>48</sup>	87 children sedated using ketamine and midazolam	Prospective comparative study	One report of vomiting, no cases of aspiration reported	Patients fasted for 3 h
McGlone RG <sup>49</sup>	501 children sedated using ketamine	Prospective observational study	No vomits during sedation, no cases of aspiration reported	Patients fasted for 3 h
Ellis DY <sup>50</sup>	89 children sedated using ketamine	Prospective observational study	One case of vomiting during procedure. No cases of aspiration reported	Patients fasted for 4 h
Roback MG <sup>51</sup>	2500 children sedated using various agents	Prospective observational study	No cases of aspiration.	
181 patients vomited, not clear if during procedure or recovery	One-third of patients not fasted according to ASA guidelines			
Green SM <sup>52</sup>	156 children sedated using ketamine	Retrospective chart review	No cases of aspiration, One case of vomiting reported	No full meals within 3 h
Langston WT <sup>53</sup>	268 children sedated using ketamine	Double blind RCT	No cases of aspiration. 22 cases of vomiting in the ED or after discharge	>50% of patients not fasted to ASA guidelines

Continued

Table 4 Continued

Reference	Subject	Study Design	Findings	Comments
Pruitt JW <sup>54</sup>	37 children sedated using ketamine and midazolam	Prospective observational series	No cases of aspiration reported, one case of vomiting during recovery phase	No full meals within 3 h of procedure
Green SM <sup>55</sup>	108 children sedated using ketamine	Prospective uncontrolled trial	No cases of aspiration. One case of vomiting during sedation	No full meal within 3 h of procedure
McCarty EC <sup>56</sup>	114 children sedated using ketamine	Prospective case series	No cases of aspiration reported. No cases of vomiting during procedure	No full meal within 3 h of procedure
Dachs RJ <sup>57</sup>	30 children sedated using ketamine	Prospective observational study	No cases of aspiration or vomiting during procedure. Two cases of post procedural vomiting	Patients fasted for 3 h for solids.
Green SM <sup>58</sup>	1022 children sedated using ketamine	Prospective consecutive case series	No cases of aspiration reported, 6.7% of cases vomited	No full meal for 3 h
Sherwin TS <sup>59</sup>	104 children sedated using ketamine and midazolam	RCT	No cases of aspiration reported. No cases of vomiting during procedure	No full meal within 3 h
Wathen JE <sup>60</sup>	266 children sedated using ketamine and midazolam	RCT	No cases of aspiration reported. No cases of vomiting during procedure	Length of fast varied between 3.6 and 8.1 h
Priestley SJ <sup>61</sup>	28 children sedated using ketamine and midazolam	Prospective observational study	No cases of aspiration reported. No cases of vomiting during procedure	Patients fasted for 4 h for solids
Luhmann JD <sup>62</sup>	42 children sedated using various agents	Consecutive prospective case series	No cases of aspiration reported. One patient vomited.	Fasting times between 1.6 and 8.8 h
Losek JD <sup>63</sup>	116 children sedated using ketamine and midazolam	Retrospective chart review	No cases of aspiration or vomiting reported.	Patients not fasted
Waterman GD <sup>64</sup>	858 children sedated using ketamine	Retrospective chart review	No cases of aspiration reported. 10 cases of vomiting	Patients fasted for 4 h
Sharieff GQ <sup>65</sup>	20 children sedated with ketamine and propofol	Prospective observational study	No cases of aspiration or vomiting reported during procedure	Patients fasted for 6 h for solids and 4 h for liquids
McKee MR <sup>66</sup>	471 children sedated with ketamine	Retrospective chart review	No cases of aspiration reported. 17 patients vomited	Patients fasted for 4 h for solids and 2 h for liquids
Langston WT <sup>53</sup>	255 children sedated with ketamine	Double blind RCT	No cases of aspiration reported. 25 patients vomited.	>50% of patients not fasted according to ASA guidelines
Acworth JP <sup>67</sup>	53 children sedated with ketamine and/or midazolam	Randomised trial	No cases of aspiration reported. One case of vomiting during procedure	Patients not fasted
Connors K <sup>68</sup>	58 children sedated with midazolam	Double blind, randomised trial	No cases of aspiration or vomiting reported	Patients not fasted
Shane SA <sup>69</sup>	34 children sedated with midazolam or placebo	Double blind randomised trial	No cases of aspiration or vomiting reported	Patients fasted for 2 h

ASA, American Society of Anesthesiologists; ED, emergency department; RCT, randomised controlled trial.

## Results

Three studies were found that specifically investigated the relationship between pre-procedural fasting and adverse effects. All three studies show no association between the two. Agrawal *et al*<sup>28</sup> report a consecutive series of 1014 children undergoing procedural sedation, of whom 56% were not fasted in accordance with ASA guidelines. There were no reported cases of pulmonary aspiration, and 15 reported cases of vomiting. There were no differences in airway complications, vomiting or any other adverse events between fasted and non-fasted groups. Roback *et al*,<sup>30</sup> in a study of 2085 children undergoing emergency procedural sedation, found no association between pre-procedural fasting and incidence of adverse events. Although 156 (7.5%) patients vomited there were no cases of pulmonary aspiration, and when the fasting time was divided into 2-h groups (0-2, 2-4, 4-6, 6-8 and >8 h) no association was found. The higher rates of vomiting in this study compared to others may be explained by a higher percentage of cases sedated using ketamine. An observational study by Bell *et al*<sup>31</sup> reports 400 cases

of paediatric sedation using propofol for emergency procedures. Seventy per cent of cases had eaten between 2 and 6 h prior to the procedure. No adverse outcomes were reported. In this study two patients vomited, the first during sedation and the other after recovering to the extent of being able to talk. Neither case showed evidence of aspiration.

A number of other paediatric sedation papers are listed in table 4, describing 17 672 cases of paediatric procedural sedation. There are no reports of pulmonary aspiration among them.

## Comment

There are several important considerations when applying the evidence from paediatric emergency sedation to adults. Ketamine is generally used more commonly in children, although its use has been widely reported in all ages. Ketamine is known to produce a dissociative state, rather than true sedation or anaesthesia,<sup>55</sup> and is therefore believed to be less likely to suppress protective airway reflexes. It is also thought to be more emetic than other drugs.<sup>70</sup> The paediatric population as a whole

are also believed to have a higher incidence of vomiting than adults. Nevertheless, there are no reports of pulmonary aspiration in children undergoing emergency procedural sedation, the majority of whom were not fasted in line with ASA guidelines.

## CONCLUSION

The risk of aspiration during emergency procedural sedation is very low, and no evidence exists to support pre-procedural fasting. In several large case series of adult and paediatric emergency procedural sedation, there have been no published reports of pulmonary aspiration. Evidence to support ASA guidelines for fasting prior to general anaesthesia, which have been extrapolated for use in emergency sedation, has minimal scientific support. Indeed, several randomised trials have failed to show any link between non-fasted patients and pulmonary aspiration. Therefore, there is no reason to recommend fasting patients prior to procedural sedation in the ED.

However, selected patients believed to be significantly more prone to aspiration may benefit from a risk:benefit assessment prior to sedation. This assessment should consider the relative risks and benefits of the proposed procedure and sedation technique, including factors that may increase the risk of aspiration such as old age and conditions predisposing to gastro-oesophageal reflux.

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