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# PULMONARY ASPIRATION DURING PROCEDURAL SEDATION : A SYSTEMATIC REVIEW

[1*]Fajar Nurochman Sidik, [2]Dhimas Muhammad Suharyo, [1]Hipni Solehudin, [1,3]Fitria Lesmana Putri

*[1]Jampangkulon Regional General Hospital, Sukabumi, Indonesia*
*[2]Primaya General Hospital, Sukabumi, Indonesia*
*[3]Jampangkulon Community Health Center, Sukabumi, Indonesia*

***Correspondence Author:***
***fajar.nurch@gmail.com***

## ABSTRACT

***Background:*** *Aspiration of the pulmonary during sedation procedural of anesthesia has received considerable research attention, little is known about the aspiration of pulmonary during operational general anesthesia.*

***Aims :*** *This systematic review is to review the association of sedation anesthesia and its effects on pulmonary aspiration.*

***Methods:*** *By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2014 and 2024 were taken into account. Several differe nt online reference sources, like Pubmed and SCIENCE DIRECT, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.*

***Result:*** *In the PubMed database, the results of our search brought up 418 articles, whereas the results of our search on SCIENCE DIRECT brought up 372 articles. The results of the search conducted for the last year of 2014 yielded a total 16 articles for PubMed and 32 articles for SCIENCE DIRECT. In the end, we compiled a total of 5 papers, 4 of which came from PubMed and 1 of which came from SCIENCE DIRECT. We included five research that met the criteria.*

***Conclusion:*** *In summary, pulmonary aspiration complicating non-endoscopic procedure sedation was found in this systematic review with complete recovery as the usual outcome. Aspiration of pulmonary occurred not in any of the individuals. Aspiration under anesthesia with sedation appears to be uncommon, unique and generally benign, however careful vigilance is still advised.*

**Keyword:** *Pulmonary aspiration, sedation anesthesia*

## INTRODUCTION

One of the most dreaded complications during anesthesia is pulmonary aspiration. Although deaths from aspiration during procedural sedation are rare, it is likely that the frequency is underreported. When undergoing procedural anesthesia for gastrointestinal endoscopy, the risk of pulmonary aspiration is higher when lying supine. The cornerstone of care for aspiration during anesthesia has always been immediate oral endotracheal intubation; however, this may not necessarily be advantageous when aspiration occurs during procedural sedation.[1]

Aspiration during general anesthesia has received a lot of attention, but aspiration after procedural sedation is still not well documented in the literature. The reported incidence ranges from 0.10 to 0.16%; however, given that 3% of patients were screened using a scintigraphic approach, it is likely that underreporting occurred. Pulmonary aspiration of stomach material during colonoscopy.[2]

Subsequent investigations revealed variable fatality rates between 4.5% and 6.6% to as high as 70% in at-risk impaired inpatients, following Mendelson's 1946 finding of a 3.0% mortality rate from pulmonary aspiration. Although there are less data, aspiration-related deaths under procedural sedation seem to be substantially less common.[2]

In the practice of anesthesia, pulmonary aspiration is a feared consequence. Although it happens seldom, anesthesia-related deaths are most frequently caused by this reason. Pulmonary aspiration can be classified into two categories: quiet, frequently undetected microaspiration, which involves the aspiration of tiny amounts of stomach or oropharyngeal contents, and macroaspiration, which involves the inhalation of substantial volumes of gastric content. Much more frequent are micro aspirations, which can happen at any point during the perioperative phase and manifest as postoperative pulmonary problems, sometimes occurring days or even weeks after the anesthetic operation.[3]

Numerous defense mechanisms against pulmonary aspiration are present in human physiology, such as the intricate laryngeal reflex systems that guard the airway and the esophageal sphincters that stop stomach regurgitation. Since dysphagia is the main cause of aspiration pneumonia, an additional crucial defense against pulmonary aspiration is an intact swallowing function. These defense systems are impacted by anesthetics in different ways.[3]

Aspiration of non-particle materials may be safely handled without immediate oral endotracheal intubation provided sufficient oxygen saturation is maintained, however aspiration containing particulate matter should be managed by endotracheal intubation. Endotracheal intubation should be seriously considered in a patient who has experienced aspiration and is hemodynamically unstable, since it is a predictor of the need for ventilatory assistance in the intensive care unit. It would be advantageous to provide guidelines especially for the control of aspiration during procedural sedation.[1]

When administering procedural sedation, anesthesiologists must be aware of the variables that increase the risk of aspiration. Compared to other procedures, gastric endoscopy carries a greater risk of aspiration, and shifting positions might trigger the danger. It may be safer to control aspiration that arises after procedural sedation by delaying oral endotracheal intubation.

## METHODS

### Protocol

By following the rules provided by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

### Criteria for Eligibility

For the purpose of this literature review, we review published literature contains the association of sedation anesthesia and its effect on pulmonary aspiration. This is done to provide an explanation and improve the handling of treatment at the patient. As the main purpose of this paper, to show the relevance of the difficulties that have been identified as a whole.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English. In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2013, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

### Search Strategy

We used "pulmonary aspiration" and “sedation” as keywords.The search for studies to be included in the systematic review was carried out using the PubMed and SCIENCE DIRECT databases by inputting the words: *(("respiratory*

*aspiration"[MeSH Terms] OR ("respiratory"[All Fields] AND "aspiration"[All Fields]) OR "respiratory aspiration"[All Fields] OR ("pulmonary"[All Fields] AND "aspiration"[All Fields]) OR "pulmonary aspiration"[All Fields]) AND ("distress"[All Fields] OR "distressed"[All Fields] OR "distresses"[All Fields] OR "distressful"[All Fields] OR "distressing"[All Fields]) AND ("sedate"[All Fields] OR "sedated"[All Fields] OR "sedating"[All Fields] OR "sedation"[All Fields] OR "sedations"[All Fields])) AND ((clinicaltrial[Filter]) AND (2014:2024[pdat]))* used in searching the literature.

## Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and can't have been seen anywhere else.

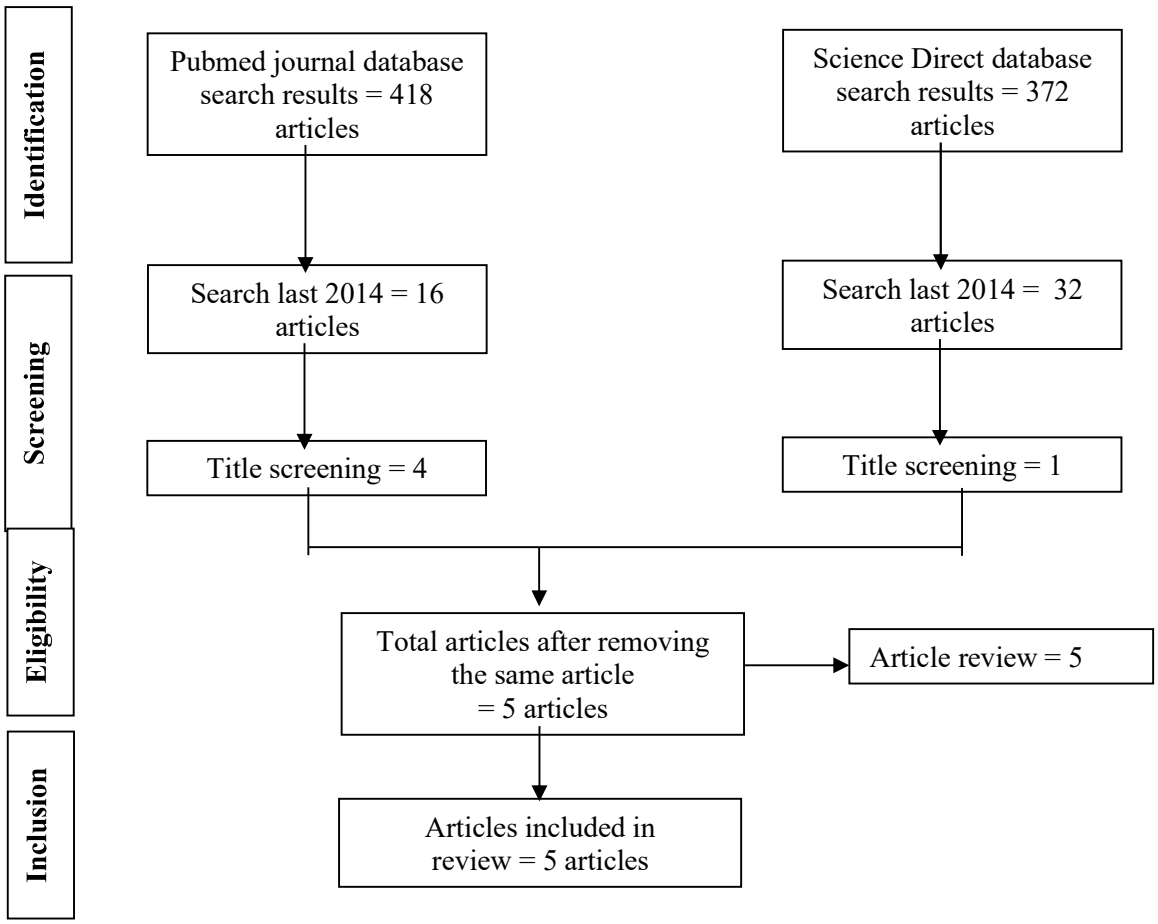


**Figure 1. Article search flowchart**

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

## Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. in order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

## RESULT

In the PubMed database, the results of our search brought up 418 articles, whereas the results of our search on SCIENCE DIRECT brought up 372 articles. The results of the search conducted for the last year of 2014 yielded a total 16 articles for PubMed and 32 articles for SCIENCE DIRECT. In the end, we compiled a total of 5 papers, 4 of which came from PubMed and 1 of which came from SCIENCE DIRECT. We included five research that met the criteria.

Beach, et al[4] (2016) showed that since there are very few ambitions, it is improbable that there is a link between NPO status and aspirations. Other variables including age, particular operations, emergency sedation status, and ASA physical state showed a favorable association.

Thornley, et al[5] (2016) showed that in comparison to endoscopist-administered conscious sedation (EAC), anaesthesiologist-administered sedation with propofol (AAP) sedation is linked to longer overall operation room times. Nonetheless, there was no discernible variation in process duration between the AAP and EAC groups. It is likely that the extra time originates from either pre-procedure consultation required by the anesthesiology team or post-procedure management prior to transfer out of the room to the recovery area, as the difference in total room time does not show up in a difference in procedure time itself. Techniques to lessen the requirement for anesthesiologist evaluation in-room might enhance the general effectiveness of the unit. Future research should compare the total cost-effectiveness of AAP vs EAC and directly compare the safety and efficiency of AAP vs EAC.

Cajander, et al[3] (2023) showed that when selecting a sedative medication for procedural sedation or manometric testing, clinical patient care should take into account the impact that dexmedetomidine has on pharyngeal swallowing and esophageal motility.

**Table 1. The litelature include in this study**

| Author | Origin | Method | Sample | Result |
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| **Beach et al, 2016**[4] | USA | Cross sectional study | 139.142 patients | A total of 139,142 procedural sedation/anesthesia experiences were recorded. Ten aspirations, seventy-five significant problems, and zero fatalities occurred. Of the 107,947 patients whose NPO status was known, 25,401 (23.5%) did not have NPO status. In patients who were not PO and in those who were NPO, aspiration occurred in 8 of 82,546 (0.97 occurrences per 10,000) and 2 of 25,401 (0.79 events per 10,000), respectively (odds ratio, 0.81; 95% CI, 0.08 to 4.08; P = 0.79). Compared to 15 of 25,401 (5.91 occurrences per 10,000), major problems occurred in 46 of 82,546 (5.57 events per 10,000) (odds ratio, 1.06; 95% CI, 0.55 to 1.93; P = 0.88). The effect of NPO status was not significantly affected by multivariate correction. |
| **Thornley et al, 2016**[5] | Canada | Prospective non randomized study | 230 patients | Over the course of the trial, 230 individuals were enrolled, 126 of them were in the AAP group and 104 in the EAC group. Gender and patient age did not significantly predict outcomes. The procedure times for the two groups did not differ significantly (P = 0.941) when instances involving trainees |

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| | | | | were excluded; however, the AAP group's total room time was still longer (P = 0.019). With AAP, there was a decrease in pain (P = 0.02) and a general tendency toward greater patient satisfaction (P = 0.074). Two sedation-related adverse events occurred, one in the AAP group involving a patient treated with bronchodilators for hypoxia and the other involving an aspiration patient who needed to be hospitalized. |
| **Cajander et al, 2023**[3] | Finland | Randomized controlled study | | When pharyngeal swallowing occurs, dexmedetomidine causes the upper esophageal sphincter to contract less during the pre- and post-swallow phases and to retain more pressure during the swallow-related relaxation phase. The effects of dexmedetomidine on esophageal function were reduced proximal esophageal contractile vigor and increased peristaltic contraction wave velocity. Both the baseline EGJ resting pressure and residual pressures during swallow-related esophagogastric junction (EGJ) relaxation reduced. Although there was no obvious dose-dependent relationship between the effects on the functional measures, modest subjective swallowing problems were more prevalent at higher dosage levels. |
| **Gemma et al, 2016**[6] | Italu | Randomized controlled study | 80 patients | At 2 µg/mL TCI, 1 in 59 (73.75%) and 2 in 21 (26.25%) of the patients had an OAAS score. For all patients, the OAAS score was 1 at the 3 and 4 µg/mL TCI targets. Nineteen patients (24.36%) had a DSS of 3, and eighteen patients (23.18%) had a PAS of 7-8 (severe swallowing impairment) at the 3 µg/mL TCI goal. DSS was linked to rising TCI goal, body mass index, and age. DSS was linked to aging and declining OAAS in a different model that used OAAS in place of the TCI goal. PAS was linked to rising TCI goal, BMI, and age. In a different model that used |

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| | | | | OAAS in place of the TCI objective, PAS was linked to rising age and BMI and falling OAAS. |
| **Admass et al, 2023**[7] | Ethiopia | Cross sectional study | 200 patients | The OAAS score was 2 in 21 (26.25%) and 1 in 59 (73.75%) individuals at 2 µg/mL TCI. At 3 and 4 µg/mL TCI target, the OAAS score was 1 for every patient. At the 3 µg/mL TCI goal, 18 patients (23.08%) had a PAS = 7-8 (severe swallowing impairment), and 19 patients (24.36%) had a DSS = 3. Age, body mass index, and TCI aim all increased with DSS. DSS was linked to both a decrease in OAAS and an increase in age in a different model that used OAAS in place of TCI goal. Growing age, BMI, and TCI aim were linked to PAS. PAS was linked to rising age and BMI and falling OAAS in a different model that used OAAS in place of the TCI aim. |

Gemma, et al[6] (2016) showed that aspiration resulting from impaired swallowing can happen when severe sedation from propofol is administered at frequently utilized target-controlled infusion (TCI) targets. TCI objectives are associated with a higher likelihood of swallowing difficulty, as are age and body mass index (BMI).

Admass, et al[7] (2023) showed that preventive agent delivery for pulmonary aspiration and preoperative fasting are quite uncommon. Furthermore, there was inadequate adherence to the guidelines provided by the American Society of Anesthesiologists (ASA) and the European Society of Anesthesiologists (ESA). We highly advise medical professionals to follow local guidelines on preventing pulmonary aspiration and to administer the proper preventive medication for the suitable patient.

## DISCUSSION

In contrast to what is known about aspiration during general anesthesia and procedural sedation practices, we provide the first systematic study of aspiration in procedural sedation and descriptively evaluate the biggest available sampling.

One of the most dreaded complications during anesthesia is pulmonary aspiration. Although deaths from aspiration during procedural sedation are rare, it is likely that the frequency is underreported. When undergoing procedural anesthesia for gastrointestinal endoscopy, the risk of pulmonary aspiration is higher when lying supine. The cornerstone of care for aspiration during anesthesia has always been immediate oral endotracheal intubation; however, this may not necessarily be advantageous when aspiration occurs during procedural sedation. It may be safer to control pulmonary aspiration during procedural sedation without performing an immediate oral endotracheal intubation.[1]

In order to make operations such as tooth extraction, endoscopy, bronchoscopy, fracture reduction, abscess drainage, laceration repair, bone marrow aspiration, arthrocentesis, and radiographic and cardiac imaging easier for patients of all ages, procedural sedation is frequently used.[8]

Preprocedural fasting recommendations aim to prevent pulmonary aspiration, an uncommon but potentially fatal sedation-related complication. There aren't many papers about aspiration during procedural sedation, despite the fact that aspiration complicating general anesthesia in theaters has been thoroughly investigated. The literature that is currently available consists mostly of gastrointestinal endoscopy-related case reports and infrequent references in retrospective sedation audits.[9]

Current and previous methods to prevent aspiration during procedural sedation naturally resemble those that have long been recommended for the theater, such as the establishment of nil by mouth (NBM) recommendations. Modification of

aspiration techniques (prophylaxis, management, and treatment) may be necessary if the conditions, nature, and results of aspiration during procedural sedation do not resemble those associated with aspiration under general anesthesia.[4]

Severe sedation is the primary goal of the operations and sedatives utilized (mostly propofol), which supports the prevailing belief that severe sedation poses a larger risk of aspiration than moderate or light sedation. An additional often reported symptom was neuroimaging, and it is plausible that increased intracranial pressure had a role in some cases.

Ketamine is still a popular first or second option for procedural sedation, especially in pediatrics, even though propofol is perhaps the most often used sedative in most settings. It is commonly recognized that ketamine maintains protective airway reflexes. Because of this, dissociative sedation with ketamine may be a better option in situations when there is a higher risk of aspiration or worry, however it has well-documented drawbacks compared to propofol, such as longer recovery, vomiting, and agitation throughout the recovery process.[6]

Fasting is commonly used for elective sedation and is usually considered necessary to reduce the risk of aspiration. Large-scale procedural sedation studies, however, have not found a connection between fasting and aspiration or other unfavorable outcomes. Many believe that the current NBM criteria are excessively stringent. Fasting can lead to dehydration and hypoglycemia and is painful, especially for kids whose parents frequently disobey them. Additionally, there is data that suggests extended fasting raises the possibility of unsuccessful sedations by causing anxiety.Preprocedural fasting is frequently disregarded or left unenforced in a number of sedation settings, including dentistry, therapeutic abortions, cardiac catheterization, echocardiography, and cataract surgery, with no documented complications. Similar to this, emergency rooms have to sedate patients for urgent or emergent treatments even when they are not fasting, thus it makes sense that these individuals would make up a disproportionate share of our sample.[6]

## CONCLUSION

In summary, pulmonary aspiration complicating non-endoscopic procedure sedation was found in this systematic review with complete recovery as the usual outcome. Aspiration of pulmonary occurred not in any of the individuals. Aspiration under anesthesia with sedation appears to be uncommon, unique and generally benign, however careful vigilance is still advised.

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