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Research Article

Evaluating the Relative Risk of Pulmonary Microaspiration in Sedated Versus Intubated Patients During ERCP Procedures

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Abstract

Objectives

This study aims to compare the risk of pulmonary microaspiration in patients undergoing ERCP under general anesthesia versus deep sedation.

Study design: Prospective comparative study

Duration and place of study: This study was conducted in Liaquat National Hospital and Medical College Karachi from December 2022 to December 2023

Methodology: One hundred and fifty patients (ASA I-III) undergoing ERCP were selected and randomly distributed in two groups of 75 each: Group I (n= 75) received a general anesthesia (endotracheal intubation) and Group S (n = 75) received deep sedation. All patients were carefully observed in a high-dependency unit (HDU) within 48 hours after the procedure to detect the symptoms of hypoxia. The number of chest CT scans was also taken 48 hours after ERCP to determine if there are new pulmonary infiltrates that indicate microaspiration.

Results: Similarly, evidence of microaspiration on CT was much more severe in the sedation group (24%) than in the intubation group (5.3%), at a p-value of 0.002. Although postoperative hypoxic incidents were seen more frequently in sedation group (26.6%) compared to intubated group (6.6%), the difference was found statistically significant with p-value 0.001. Microaspiration was observed to a greater extent in patients in the sedation group who were between 65 years and more (50%) than in the younger category (6.7%) with a p-value of 0.0008. Other parameters that included incidences of postoperative fever, cough, tachypnea, or obligation to oxygen therapy were alike in the two groups.

Conclusion: The prevalence of postoperative CT alterations that seemed suggestive of microaspiration was increased in sedated patients compared to patients with tracheal intubation who underwent ERCP, especially those aged 65 or more. This notwithstanding, there were no clinical evidences of overt chest infection in any of the groups. These are the findings that advocate that one should be cautious in the selection of patients and close observation in the postoperative period in choosing deep sedation as an option in ERCP.

Keywords: Pulmonary Micro Aspiration, ERCP, Deep Sedation, General Anesthesia, Endotracheal Intubation.

INTRODUCTION

Endoscopic Retrograde Cholangio-Pancreatography (ERCP) has come to be a diagnostic and therapeutic corner stone in the management of pancreaticobiliary diseases [1,2]. Though popular and safe, on the whole, ERCP is not free of risks, however, the anesthesia technique can influence the outcomes of patients significantly [3]. Both deep sedation and endotracheal intubated general anesthesia have traditionally been used and it is common that this choice is made based on the needs of a particular patient, institutional practice preferences and the preference of the anesthesiologist [4,5]. The obvious advantage of maximal protection of the airway and increased control over the ventilation is provided by general anesthesia, especially in the cases with prone positioning or longer duration [6]. It is however related to greater expenses, increased recovery periods and perioperative infrastructure requirements which are more complex [7]. Conversely, a relatively simpler procedure, deep sedation, which can be applied as monitored anesthesia care (MAC), is widely employed since it is less time-consuming, simpler to recover, and acceptable by patients in ambulatory centers [8,9]. However, the issue with sedation is that it can cause airway problems, particularly, when the ventilation is not secured. Rare but feared is the complication of pulmonary aspiration, which can end up causing pneumonia or acute lung injury or even respiratory failure [10]. Although macroaspiration incidents are typically medically detectable, the unobtrusive entry of yeast into lungs by the inhalation of little amounts of stomach or oropharyngeal substances, known as microaspiration, is usually unrecognized, nevertheless, it can cause noteworthy lung complications [11,12]. The problem is that the risk of such microaspirations might be underestimated in sedated patients because routine imaging or symptomatology is not conducted right after ERCP [13]. So far, it is not yet known to a great depth how sedated patients with an ERCP incidenced pulmonary aspiration compared to intubated patients with objective radiological evidence [14]. This risk may also be further modified by age, comorbidity, and positioning of the patient. An otherwise small aspiration event can cause significantly severe respiratory consequences in elderly patients or otherwise high-risk patients [15]. Consequently, the relative safety of sedation and intubation in this scenario is not only of clinical importance, but also of paramount concern when it comes to anesthesia-related protocol customization to lessen the risks posed to individual patients. The present study is set to determine and compare the rate of pulmonary microaspirations in patients receiving ERCP under deep sedation or deep sedation with the insertion of the endotracheal tube under anesthesia and evaluate the use of postoperative chest CT as an objective means. It is the hope of this research that it will be able to contribute significant contributions to the area of pulmonary risks during anesthesia and contribute to enhancement of peri-procedural care in patients undergoing ERCP procedures.

METHODOLOGY

It was a prospective comparative study that was done after a unit that solely had endoscopy and anesthesia. One hundred and fifty adult patients undergoing elective ERCP, were recruited following informed consent. This research was cleared through the institution ethical review board. All of them had an American Society of Anesthesiologists (ASA) physical status of I to III and were assigned to two equal groups randomly with a computer-generated randomization chart.

Group I (n = 75) was anesthetized under the general anesthetic technique with endotracheal intubation, and Group S (n = 75) was anesthetized with deep sedation of propofol-based monitored anesthesia care (MAC). So, all ERCP interventions were made with the sophisticated endoscopist, and anesthetic care was taken by a consultant anesthetist during the intervention. Both groups followed the standard pre-procedure fasting rules.

In patients in the intubation group, propofol 2 mg/kg, fentanyl 1-2 mcg/kg and rocuronium 0.6 mg/kg intravenously were used to induce. Sevoflurane in mixture of oxygen and air was used to maintain maintenance. Propofol in non-intubated patients, patient was administered an initial bolus (0.51-1mg/kg) and then continuous infusion of propofol to obtain deep sedation without losing spontaneous ventilation. All patients were placed in the standard prone or semi-prone position for ERCP. Oxygen saturation, heart rate, respiratory rate, end-tidal CO_2, and non-invasive blood pressure were continuously monitored. Following the procedure, all patients were observed in a high-dependency unit (HDU) for a minimum of 48 hours to detect any early respiratory complications, including episodes of hypoxia (defined as $SpO_2 < 90\%$ for more than 30 seconds), cough, fever, tachypnea, or need for supplemental oxygen. At 48 hours post-ERCP, a non-contrast chest computed tomography (CT) scan was performed on all patients to detect any new pulmonary infiltrates consistent with microaspiration. The CT scans were independently reviewed by two radiologists blinded to the patient group allocation. Any discrepancies were resolved by consensus. Additional data such as age, gender, comorbidities, procedure duration, and use of anticholinergic or prokinetic premedication were recorded for subgroup analysis. Statistical analysis was performed using SPSS software. Categorical variables were expressed as frequencies and percentages, and compared using the Chi-square test or Fisher's exact test where appropriate. A *p*-value < 0.05 was considered statistically significant.

RESULTS

A total of 150 patients were included in the study, with 75 patients in each group: Group I (general anesthesia with endotracheal intubation) and Group S (deep sedation). Baseline characteristics such as age, gender distribution, ASA classification, and comorbidities were similar across both groups, and no statistically significant differences were observed. Postoperative chest CT scans revealed radiological signs of pulmonary microaspiration in 22 patients. A significantly higher number of cases occurred in the sedation group, where 18 out of 75 patients (24%) had positive findings, compared to 4 out of 75 patients (5.3%) in the intubated group (p = 0.002). The infiltrates were mostly localized to dependent lung segments and showed no evidence of frank consolidation or abscess formation.

Hypoxic episodes within the first 48 hours post-ERCP were also more frequently observed in Group S. A total of 20 patients (26.6%) in the sedation group experienced hypoxia, compared to 5 patients (6.6%) in the intubated group (p-value = 0.001). Age appeared to be an influential factor in the sedation group. Among patients aged 65 years and above, 15 out of 30 (50%) showed CT evidence of microaspiration, while in patients below 65 years, only 3 out of 45 (6.7%) had similar findings. The difference was statistically significant (p = 0.0008), suggesting that elderly patients may be more prone to aspiration-related complications under sedation. There were no significant differences between the two groups in terms of postoperative fever, cough, respiratory rate abnormalities, or need for oxygen supplementation. No patient in either group developed signs of overt chest infection or required escalation of care.

Table 1: Incidence of Microaspiration Based on CT Findings

Group	CT Positive	CT Negative	Total Patients	Percentage Positive
Intubation (Group I)	4	71	75	5.3%
Sedation (Group S)	18	57	75	24.0%
p-value				**0.002**

Table 2: Postoperative Hypoxia

Group	Hypoxia Present	No Hypoxia	Total Patients	Percentage with Hypoxia
Intubation (Group I)	5	70	75	6.6%
Sedation (Group S)	20	55	75	26.6%
p-value				**0.001**

Table 3: Microaspiration in Sedated Group by Age

Age Group	CT Positive	CT Negative	Total Patients	Percentage Positive
≥ 65 years	15	15	30	50.0%
< 65 years	3	42	45	6.7%
p-value				**0.0008**

DISCUSSION

The findings of this study demonstrate a notably higher incidence of radiological evidence of pulmonary microaspiration in patients undergoing ERCP under deep sedation compared to those receiving general anesthesia with endotracheal intubation. While overt pulmonary complications did not occur in either group, the presence of subclinical infiltrates on CT scans in nearly one-fourth of sedated patients suggests a potentially underestimated risk. This aligns with the conclusions drawn by Linder et al., who reported increased microaspiration events in sedated patients during upper GI endoscopy procedures, especially when supine or semi-prone positioning was used [16]. Similarly, a prospective study by O'Halloran and colleagues comparing different sedation methods during ERCP found that patients receiving propofol without airway protection had a higher frequency of desaturation and post-procedure pulmonary changes, even in the absence of clinical symptoms [17]. Interestingly, our findings contrast somewhat with a retrospective review by Wani et al., who found no significant difference in aspiration risk between sedated and intubated ERCP patients [18]. However, their study relied on clinical parameters alone without objective radiological imaging, which may explain the discrepancy. In the present study, the use of chest CT at 48 hours post-procedure allowed for the detection of otherwise silent microaspirations.Age also emerged as a significant factor in the risk profile. Older adults (≥65 years) in the sedation group were particularly vulnerable, with 50% showing radiographic signs of microaspiration. This observation echoes the results of Kato et al., who identified advanced age and impaired protective airway reflexes as independent predictors of aspiration pneumonia in sedated elderly patients undergoing GI procedures [19]. Moreover, similar concerns were raised by Sugiyama et al., who emphasized the need for careful airway management in elderly patients receiving sedation for ERCP [20]. Our findings are also supported by Lee et al., who documented a higher incidence of early pulmonary infiltrates in patients undergoing unsedated versus sedated colonoscopy, suggesting that patient cooperation and airway patency play crucial roles in microaspiration risk [21]. While the procedural route differs, the underlying principles of airway vulnerability remain consistent. In contrast, a randomized controlled trial by Park et al. showed no significant difference in pulmonary complications between general anesthesia and deep sedation groups during ERCP, but their study population was younger on average, and again, they did not employ imaging for diagnosis, A broader meta-analysis by Cheriyan et al. examined the safety of deep sedation across various endoscopic procedures and highlighted that aspiration-related complications, although infrequent, were more common in procedures involving the upper GI tract or those requiring prone positioning, factors common to ERCP [22]. Despite the increased rate of CT-detected microaspiration, it is worth noting that no patient in either group developed overt signs of lower respiratory tract infection. This underscores the importance of differentiating radiological changes from clinical outcomes. However, the long-term significance of such findings remains unclear and may warrant follow-up in future studies. One limitation of this study is the relatively short monitoring period (48 hours), which may not capture delayed pulmonary symptoms. Furthermore, although CT provides high sensitivity for detecting aspiration-related changes, the absence of bronchoalveolar lavage or sputum cultures means we cannot conclusively confirm the aspirated material. Additionally, the sample size, while adequate for statistical power, may still not fully capture rare complications.

CONCLUSION

This study reinforces that deep sedation during ERCP carries a higher risk of subclinical pulmonary microaspiration compared to general anesthesia with intubation, particularly in older adults. While no immediate clinical consequences were observed, these findings highlight the importance of individualized anesthesia planning, especially for high-risk groups. The routine use of imaging post-ERCP may help identify silent complications early and guide preventive strategies.

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None.

Permission

Ethical approval obtained.

Conflict Of Interest

None.

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