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COMPARATIVE ANALYSIS OF ULTRASONOGRAPHIC SKIN-TO-EPIGLOTTIS DISTANCE (DSE) AS A PREDICTOR OF DIFFICULT INTUBATION IN OBESE AND NON-OBESE PATIENTS

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ABSTRACT **Introduction:** Airway management is a critical component of anesthesia practice, and successful intubation is essential for patient safety during surgical procedures. Obesity presents unique challenges for airway management due to altered anatomical features, such as increased soft tissue in the neck, which complicates intubation. Ultrasonographic measurement of the Distance from Skin to Epiglottis (DSE) is a promising predictor of intubation difficulty, offering an objective tool for preoperative airway assessment. This study aims to explore the relationship between DSE, Body Mass Index (BMI), and Cormack-Lehane (CL) grading to determine if DSE can serve as a reliable predictor of intubation difficulty in obese and non-obese patients. **Materials and Methodology:** A prospective, cross-sectional study was conducted in the Department of Anesthesiology and Critical Care at Al-Ameen Medical College, Vijayapura, over six months. Sixty patients aged 18-60 years, classified as ASA I or II and scheduled for elective surgery under general anesthesia, were recruited. Patients were divided equally into non-obese (BMI ≤ 25 kg/m²) and obese (BMI > 25 kg/m²) groups. Ultrasonographic DSE measurements were performed preoperatively, followed by intubation using direct laryngoscopy, during which the Cormack-Lehane grading was recorded. The need for modifications during intubation, such as the BURP maneuver or the use of a bougie, was also documented. Data analysis included Pearson's correlation to assess relationships between DSE, BMI, and CL grading. **Results:** The study found that obese patients had a significantly greater DSE (mean: 2.68 cm) compared to non-obese patients (mean: 2.02 cm). A positive correlation was observed between DSE and BMI in both groups, with a stronger correlation in non-obese patients ($r = 0.782$, $p < 0.001$) compared to obese patients ($r = 0.421$, $p = 0.021$). A strong positive correlation was also found between DSE and CL grading, with higher DSE values associated with more challenging intubation. The correlation was more pronounced in non-obese patients ($r = 0.885$, $p < 0.001$) compared to obese patients ($r = 0.734$, $p < 0.01$). The need for modifications during intubation was significantly higher in the obese group, with 33.3% requiring the BURP maneuver and 13.3% requiring both BURP and a bougie. **Discussion and Conclusion:** This study demonstrates that ultrasonographic measurement of DSE is a reliable predictor of intubation difficulty, particularly in obese patients. The greater DSE values in obese patients correlate with higher Cormack-Lehane grades and increased intubation difficulty. Implementing ultrasonographic DSE assessment in routine preoperative evaluations could improve the prediction of difficult intubation, allowing for better preparation and reduced risks during airway management. Further research is warranted to validate these findings in larger, diverse populations and to explore additional ultrasonographic parameters for assessing airway difficulty.

KEYWORDS : Airway management, Ultrasonography, Distance from Skin to Epiglottis (DSE), Obesity, Cormack-Lehane grading, Intubation difficulty.

INTRODUCTION

Airway management is a critical aspect of anesthesia practice, with successful endotracheal intubation being a cornerstone for ensuring patient safety during surgery. The ability to predict difficult intubation preoperatively is essential for anesthesiologists to plan appropriately, mitigate risks, and prevent potentially life-threatening complications. Despite advancements in airway management techniques, difficult intubation remains a significant challenge, particularly in certain patient populations, such as those with obesity. Obese patients present unique anatomical and physiological challenges that can complicate airway management, making accurate prediction and preparation even more crucial.

Preoperative airway assessment is a systematic evaluation performed to identify patients who may present difficulties during intubation. The traditional approach to airway assessment includes physical examination techniques such as the Mallampati classification, thyromental distance, and mouth opening measurements. These methods, while useful, have limitations in their ability to predict difficult intubation with high accuracy. For instance, studies have shown that the Mallampati classification, which assesses the visibility of the oropharyngeal structures, has a variable sensitivity and specificity for predicting difficult laryngoscopy. Therefore, there is an ongoing need for more reliable and objective methods of airway assessment.^[1]

In recent years, ultrasonography has emerged as a non-invasive, bedside tool that can provide real-time imaging of airway structures. The use of ultrasound for airway assessment offers several advantages,

including the ability to visualize the airway anatomy directly, quantify soft tissue thickness, and assess the dynamic changes in airway structures during different maneuvers. Ultrasonography allows for the measurement of the distance from the skin to the epiglottis (DSE), a parameter that could potentially serve as a predictor for difficult intubation. This technique is particularly valuable in obese patients, where traditional assessment methods may be less reliable due to altered anatomy and increased soft tissue mass.^[2,3]

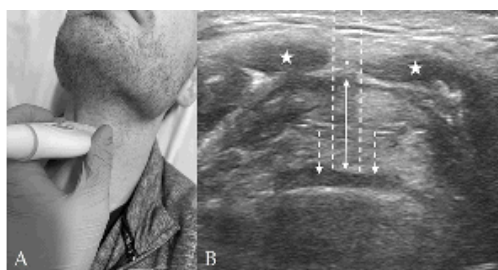
Obesity is a growing global health concern, with significant implications for anesthesia practice. The anatomical changes associated with obesity, such as increased fat deposition in the neck and upper airway, reduced pharyngeal airway space, and increased anterior neck soft tissue thickness, can complicate airway management. Obese patients are more likely to have a limited range of motion in the neck, reduced mouth opening, and increased difficulty in achieving optimal positioning for intubation. These factors contribute to a higher incidence of difficult laryngoscopy and intubation in obese patients compared to their non-obese counterparts.^[4]

The pre-epiglottic space (PES) is an anatomical region that plays a crucial role during laryngoscopy and intubation. It is bounded anteriorly by the hypo-epiglottic ligament and posteriorly by the epiglottis. During direct laryngoscopy, the blade of the laryngoscope is introduced into the oropharynx, and the tip of the blade rests against the hypo-epiglottic ligament, elevating the epiglottis to visualize the vocal cords. The size of the PES and the thickness of the anterior neck soft tissues can influence the ease with which the laryngoscope blade can manipulate these structures to achieve a clear view of the vocal cords.

In obese patients, an increase in PES size and soft tissue thickness may hinder the forward mobility of pharyngeal structures, leading to a more challenging laryngoscopy and intubation.^[5,6]

Given the challenges associated with airway management in obese patients, there is a need for more reliable and objective methods to predict difficult intubation in this population. Ultrasonographic measurement of DSE offers a promising approach by providing a quantifiable, objective metric that reflects the anatomical challenges posed by increased soft tissue thickness. Previous studies have suggested a correlation between increased DSE and the difficulty of intubation, but there is a paucity of research specifically comparing DSE measurements between obese and non-obese patients and correlating these measurements with established grading systems like the Cormack-Lehane (CL) grading.^[7]

The primary aim of this study is to explore the utility of ultrasonography in measuring the DSE as a predictive tool for difficult intubation. Specifically, the study seeks to determine whether there is a significant correlation between DSE measurements and the Cormack-Lehane grading in both obese and non-obese patients. By comparing these two groups, the study aims to establish whether DSE can serve as a reliable predictor of difficult intubation, particularly in the high-risk obese population. The findings of this study could have important implications for preoperative airway assessment practices, potentially leading to improved patient outcomes through better preparation and planning for difficult airway management scenarios.^[8]



Thyroid View. (A) Thyroid probe placement on subject's neck. (B) Thyroid view of anterior neck with linear probe in transverse orientation. The pre-epiglottic space (solid, double-headed arrow) appears between the thyrohyoid membrane (solid, single-headed arrow) and the epiglottis (dashed arrows). The strap muscles (stars) are again visible superficially to the thyrohyoid membrane. The distance from skin to epiglottis (DSE) is spanned by the two dashed lines.

MATERIALS AND METHODOLOGY

This study was designed as an analytical, prospective, and cross-sectional investigation aimed at exploring the utility of ultrasonographic measurement of the distance from skin to epiglottis (DSE) as a predictor for difficult intubation. The research was conducted over a six-month period at the Department of Anesthesiology and Critical Care and Pain Medicine, Al-Ameen Medical College, Vijayapura. This location was selected due to its comprehensive facilities and access to a diverse patient population undergoing elective surgical procedures.

The study population comprised patients aged 18 to 60 years, classified as ASA I or II, and scheduled for elective surgeries under general anesthesia. Exclusion criteria included patients with known difficult airways, upper airway abnormalities, contraindications to general anesthesia, or conditions interfering with ultrasonographic assessment, such as severe cervical spine disease. The sample size was determined based on the availability of eligible patients during the study period, resulting in the inclusion of 60 patients, divided equally into obese (BMI >25) and non-obese (BMI ≤25) groups. A convenient sampling method was employed to ensure the inclusion of a sufficient number of participants within the study's timeframe.

Ethical considerations were rigorously adhered to throughout the study. Prior to the commencement of data collection, ethical approval was obtained from the Institutional Ethics Committee of Al-Ameen Medical College, Vijayapura. Informed consent was secured from all participants after a thorough explanation of the study's purpose, procedures, potential risks, and benefits. Patients were assured of their right to withdraw from the study at any time without affecting their medical care.

Pre-anesthetic evaluation was conducted for all patients, which included a detailed medical history, physical examination, and airway assessment. The airway assessment comprised the Mallampati classification, measurement of the thyromental distance (TMD), and evaluation of mouth opening. These assessments provided baseline data for comparison with the ultrasonographic measurements.

Ultrasonographic measurement of the DSE was performed using a linear array ultrasound probe with a frequency range of 10-13 MHz. Patients were positioned supine with their head in the sniffing position to optimize visualization of the airway structures. The ultrasound probe was placed transversely on the anterior neck at the level of the thyrohyoid membrane, midway between the hyoid bone and thyroid cartilage. The DSE was measured as the shortest distance from the skin to the anterior surface of the epiglottis at the level of the vocal cords. To ensure accuracy, the measurement was repeated three times, and the average value was recorded for each patient.

Following the ultrasonographic assessment, general anesthesia was induced using standard protocols, including pre-oxygenation, administration of intravenous induction agents, and maintenance with volatile anesthetics. Direct laryngoscopy was then performed using a Macintosh blade, with the laryngoscopist blinded to the DSE measurements to eliminate bias. The Cormack-Lehane (CL) grade was recorded, categorizing the laryngoscopic view as Grade I (full view of the glottis), Grade II (partial view of the glottis), Grade III (only the epiglottis visible), or Grade IV (neither the glottis nor the epiglottis visible). The number of intubation attempts and the need for adjunctive maneuvers, such as the BURP (Backward, Upward, Rightward Pressure) maneuver or bougie assistance, were also documented.

Data were systematically collected, including patient demographics, ultrasonographic DSE measurements, CL grading, and intubation outcomes. The data were analyzed using statistical software (e.g., SPSS). Descriptive statistics summarized the demographic and clinical characteristics of the study population, while Pearson's correlation coefficient assessed the relationship between DSE measurements and both BMI and CL grading. Comparative analysis using t-tests for independent samples evaluated differences in DSE values between obese and non-obese groups, as well as their association with CL grades. The chi-square test was employed to examine associations between categorical variables, such as the incidence of difficult intubation and obesity status. A p-value of <0.05 was considered statistically significant, indicating that the observed results were unlikely to have occurred by chance.

The null hypothesis posited that there was no significant correlation between DSE measurements and either CL grading or BMI, while the alternative hypothesis suggested a significant correlation between these variables. The statistical analysis aimed to determine whether DSE could serve as a reliable predictor of difficult intubation, particularly in obese patients, where traditional assessment methods may be less effective.

RESULTS AND ANALYSIS

The analysis of this study focuses on the relationship between the ultrasonographically measured distance from skin to epiglottis (DSE) and the Cormack-Lehane (CL) grading in obese and non-obese patients as a predictor of difficult intubation. The study's results are presented in detailed tables, followed by a comprehensive analysis of the findings.

PATIENT DEMOGRAPHICS

The study included a total of 60 patients, equally divided into obese and non-obese groups, with 30 patients in each group. The demographic characteristics, including sex distribution and age range, are presented in Table 1.

Table 1: Demographic Characteristics of Study Participants

Demographic Variable	Non-Obese (n=30)	Obese (n=30)	Total (n=60)
Sex			
Male	16 (53.3%)	18 (60%)	34 (56.7%)
Female	14 (46.7%)	12 (40%)	26 (43.3%)
Age (years)			
18-20	2 (6.7%)	1 (3.3%)	3 (5%)
21-30	6 (20%)	8 (26.7%)	14 (23.3%)

31-40	8 (26.7%)	9 (30%)	17 (28.3%)
41-50	9 (30%)	7 (23.3%)	16 (26.7%)
51-60	5 (16.7%)	5 (16.7%)	10 (16.7%)
Mean Age (years)	37.1 ± 9.5	36.7 ± 10.1	36.9 ± 9.8

The mean age of the study participants was approximately 36.9 years, with a relatively balanced distribution of males and females across both groups. The age distribution shows that the study sample primarily represents a middle-aged population, which is appropriate considering the focus on elective surgeries commonly performed within this age range.

The body mass index (BMI) of the patients ranged from 18 to 40, with a median BMI of 22 in the non-obese group and 34 in the obese group. The frequency distribution of patients according to BMI is shown in Table 2.

Table 2: Frequency Distribution of Patients by BMI

BMI Category (kg/m²)	Non-Obese (n=30)	Obese (n=30)	Total (n=60)
18-20	3 (10%)	0 (0%)	3 (5%)
21-24	22 (73.3%)	0 (0%)	22 (36.7%)
24-27	5 (16.7%)	0 (0%)	5 (8.3%)
27-30	0 (0%)	5 (16.7%)	5 (8.3%)
30-33	0 (0%)	20 (66.7%)	20 (33.3%)
33-36	0 (0%)	3 (10%)	3 (5%)
36-40	0 (0%)	2 (6.7%)	2 (3.3%)
Median BMI (kg/m²)	22	34	28

The BMI distribution confirms that the study effectively categorized patients into distinct groups based on their BMI. The non-obese group predominantly had a BMI between 21-24 kg/m², while the obese group primarily had a BMI between 30-33 kg/m². This categorization is crucial for analyzing the impact of BMI on DSE (Direct Sublaryngeal Examination) measurements and the difficulty of intubation, allowing for a better understanding of how body weight influences these clinical parameters.

MOUTH OPENING

Mouth opening, measured in finger breadths, ranged from 2 to 3.5 fingers among the study participants. The distribution of patients according to mouth opening is presented in Table 3.

Table 3: Frequency Distribution of Patients by Mouth Opening

Mouth Opening (Fingers)	Non-Obese (n=30)	Obese (n=30)	Total (n=60)
2 fingers	1 (3.3%)	5 (16.7%)	6 (10%)
2.5 fingers	8 (26.7%)	10 (33.3%)	18 (30%)
3 fingers	15 (50%)	11 (36.7%)	26 (43.3%)
3.5 fingers	6 (20%)	4 (13.3%)	10 (16.7%)

The majority of patients in both the non-obese and obese groups had a mouth opening of 3 fingers, which was the most common finding (43.3%). However, a greater proportion of obese patients had a limited mouth opening of 2 fingers (16.7%) compared to the non-obese group (3.3%). This limited mouth opening among obese patients may increase the difficulty of intubation and necessitates special consideration during airway management in this population.

MALLAMPATI CLASSIFICATION

The Mallampati classification, used to assess the airway view during laryngoscopy, is summarized in Table 4. This classification helps determine the potential difficulty of intubation by evaluating the visibility of oropharyngeal structures.

Table 4: Frequency Distribution of Patients by Mallampati Classification

Mallampati Grade	Non-Obese (n=30)	Obese (n=30)	Total (n=60)
I	15 (50%)	9 (30%)	24 (40%)
II	14 (46.7%)	17 (56.7%)	31 (51.7%)
III	1 (3.3%)	4 (13.3%)	5 (8.3%)

In the non-obese group, half of the patients (50%) were classified as Mallampati Grade I, indicating a clear view of the oropharyngeal structures, which generally predicts easier intubation. In the obese group, the majority of patients (56.7%) were classified as Mallampati

Grade II, indicating a more restricted airway view, and a larger proportion of obese patients (13.3%) presented with Mallampati Grade III, which is associated with a more challenging airway. These findings suggest that obesity is correlated with a higher likelihood of difficult airway management due to decreased visibility of the oropharyngeal structures.

CORMACK-LEHANE GRADING

The Cormack-Lehane (CL) grading, recorded during laryngoscopy, is a critical measure for assessing the difficulty of intubation. It evaluates the visibility of the vocal cords, which directly correlates with intubation difficulty. The distribution of CL grades among study participants is shown in Table 5.

Table 5: Frequency Distribution of Patients by Cormack-Lehane Grade

Cormack-Lehane Grade	Non-Obese (n=30)	Obese (n=30)	Total (n=60)
I	14 (46.7%)	6 (20%)	20 (33.3%)
IIA	16 (53.3%)	8 (26.7%)	24 (40%)
IIB	0 (0%)	9 (30%)	9 (15%)
IIIA	0 (0%)	4 (13.3%)	4 (6.7%)
IIIB	0 (0%)	3 (10%)	3 (5%)

In the non-obese group, all patients had a Cormack-Lehane (CL) grade of either I or IIA, indicating a relatively easy intubation with clear visualization of the vocal cords (46.7% and 53.3%, respectively). In contrast, the obese group had a significant proportion of patients with more challenging CL grades: IIB (30%), IIIA (13.3%), and IIIB (10%), indicating increased difficulty in visualizing the vocal cords and performing intubation. These findings suggest that obesity is associated with a higher likelihood of difficult laryngoscopy and intubation due to limited airway visibility.

ULTRASONOGRAPHIC MEASUREMENT OF DSE

The DSE (Distance from Skin to Epiglottis) was measured ultrasonographically, and the frequency distribution of these measurements is presented in Table 6. The DSE is an important factor influencing intubation difficulty, with larger measurements typically indicating a more challenging procedure.

Table 6: Frequency Distribution of Patients by Ultrasonographic DSE

DSE (cm)	Non-Obese (n=30)	Obese (n=30)	Total (n=60)
1.7 - 1.9	8 (26.7%)	0 (0%)	8 (13.3%)
1.9 - 2.1	11 (36.7%)	0 (0%)	11 (18.3%)
2.1 - 2.3	11 (36.7%)	0 (0%)	11 (18.3%)
2.3 - 2.5	0 (0%)	1 (3.3%)	1 (1.7%)
2.5 - 2.7	0 (0%)	16 (53.3%)	16 (26.7%)
2.7 - 2.9	0 (0%)	13 (43.3%)	13 (21.7%)

The DSE measurements in the non-obese group ranged from 1.7 to 2.3 cm, with a mean of 2.02 cm, while in the obese group, DSE measurements ranged from 2.3 to 2.9 cm, with a mean of 2.68 cm. The greater DSE observed in the obese group suggests a thicker neck anatomy, which correlates with increased intubation difficulty, as reflected by the higher Cormack-Lehane (CL) grades observed among obese patients. These findings indicate that ultrasonographic DSE measurements can serve as a useful predictor of intubation difficulty, particularly in patients with higher body mass index.

INTUBATION ATTEMPTS

The number of intubation attempts required is an important indicator of intubation difficulty, with more attempts reflecting increased challenges during the procedure. The distribution of patients by the number of intubation attempts is shown in Table 7.

Table 7: Frequency Distribution of Patients by Number of Intubation Attempts

Number of Attempts	Non-Obese (n=30)	Obese (n=30)	Total (n=60)
One	26 (86.7%)	14 (46.7%)	40 (66.7%)
Two	4 (13.3%)	16 (53.3%)	20 (33.3%)

In the non-obese group, 86.7% of patients were successfully intubated on the first attempt, indicating a relatively easy procedure for the majority. In contrast, 53.3% of obese patients required a second attempt, highlighting the increased difficulty of intubation in this

group. The higher rate of multiple intubation attempts among obese patients underscores the challenges associated with airway management in individuals with higher BMI, likely due to anatomical differences such as a greater DSE and more restricted airway views.

NEED FOR MODIFICATIONS

The need for modifications, such as the BURP (Backward, Upward, Rightward Pressure) maneuver or the use of a bougie, is an important indicator of intubation difficulty. These modifications are often employed when visualization of the vocal cords is insufficient. The distribution of patients by the need for modifications is summarized in Table 8.

Table 8: Frequency Distribution of Patients by Need for Modifications

Modification	Non-Obese (n=30)	Obese (n=30)	Total (n=60)
BURP	0 (0%)	10 (33.3%)	10 (16.7%)
BURP + Bougie	0 (0%)	4 (13.3%)	4 (6.7%)
No Modification	30 (100%)	16 (53.3%)	46 (76.7%)

In the non-obese group, all patients were intubated without the need for modifications, indicating relatively straightforward airway management. However, in the obese group, 33.3% of patients required the BURP maneuver to improve the view of the vocal cords, and 13.3% required both BURP and a bougie for successful intubation. These findings highlight the increased complexity of airway management in obese patients, which may be attributed to anatomical factors such as restricted mouth opening, higher Mallampati grades, and greater DSE measurements. The need for additional maneuvers and tools emphasizes the challenges associated with intubation in obese patients and underscores the importance of preparing for potential airway difficulties in this group.

The correlation between the Distance from Skin to Epiglottis (DSE) and Body Mass Index (BMI), as well as the correlation between DSE and Cormack-Lehane (CL) grade, was assessed using Pearson's correlation coefficient. The results are summarized in Table 9.

Table 9: Correlation Between DSE, BMI, and CL Grade

Correlation Pair	Pearson Correlation Coefficient (r)	p-value (2-tailed)
DSE vs. BMI (Non-Obese)	0.782**	0.000
DSE vs. BMI (Obese)	0.421*	0.021
DSE vs. CL Grade (Non-Obese)	0.885**	0.000
DSE vs. CL Grade (Obese)	0.734**	0.001

A significant positive correlation was found between DSE and BMI in both non-obese and obese groups, with a stronger correlation observed in non-obese patients ($r = 0.782$, $p < 0.001$) compared to obese patients ($r = 0.421$, $p = 0.021$). This indicates that as BMI increases, DSE also tends to increase, particularly in non-obese individuals, where the relationship appears more pronounced.

Furthermore, a strong positive correlation was found between DSE and CL grade in both groups, suggesting that higher DSE values are associated with more difficult intubation, as indicated by higher CL grades. The correlation was notably stronger in the non-obese group ($r = 0.885$, $p < 0.001$) compared to the obese group ($r = 0.734$, $p < 0.01$). This suggests that, regardless of obesity status, greater DSE contributes to more challenging airway visualization during intubation, but this relationship is slightly more marked in non-obese patients. These findings underline the importance of considering DSE as a predictive factor for intubation difficulty in both patient populations.

DISCUSSION

The findings of this study highlight the complexity of airway management in different patient populations, particularly obese versus non-obese patients, by focusing on multiple predictors of intubation difficulty, including ultrasonographically measured Distance from Skin to Epiglottis (DSE), Mallampati classification, Cormack-Lehane (CL) grading, and the number of intubation attempts. The study aimed to determine if DSE could be used as a reliable predictor for intubation difficulty, especially in obese patients who present unique anatomical challenges.

Patient Demographics and BMI Distribution

The demographic characteristics showed a balanced distribution of males and females in both groups, with a mean age of approximately 37 years. The age distribution indicates that the study population primarily consisted of middle-aged adults, which is typical of patients undergoing elective surgeries. The BMI distribution confirmed the effective categorization of patients into non-obese and obese groups. Non-obese patients had a median BMI of 22 kg/m², whereas obese patients had a median BMI of 34 kg/m². This difference in BMI is crucial for understanding the impact of body mass on airway management. Obesity is a well-known risk factor for difficult intubation, as increased soft tissue in the neck can complicate visualization of airway structures, necessitating more careful preoperative planning.

Mouth Opening and Mallampati Classification

The assessment of mouth opening showed that 86.7% of non-obese patients had a mouth opening of 3 or more fingers, while only 50% of obese patients had a similar opening. The increased frequency of limited mouth opening (2 fingers) among obese patients (16.7%) compared to non-obese patients (3.3%) suggests greater potential difficulty during laryngoscopy and intubation in obese patients. Mouth opening is a simple yet effective predictor of the ability to accommodate the laryngoscope and intubate successfully, and limited mouth opening in obese patients contributes to increased challenges.

The Mallampati classification also indicated that obesity is associated with a higher risk of difficult intubation. While 50% of non-obese patients were classified as Mallampati Grade I, which predicts easier intubation, only 30% of obese patients were in this category. Moreover, 13.3% of obese patients were classified as Grade III, compared to 3.3% of non-obese patients. This increased frequency of higher Mallampati grades in obese patients is likely related to the increased soft tissue in the upper airway, which obscures the visibility of pharyngeal structures.

Cormack-Lehane Grading and Intubation Difficulty

The Cormack-Lehane (CL) grading system, recorded during laryngoscopy, is a well-established predictor of intubation difficulty, with higher grades indicating greater difficulty. The results showed that all non-obese patients had a CL grade of I or IIA, which generally predicts a straightforward intubation. In contrast, obese patients had a significant proportion with higher CL grades (IIB, IIIA, and IIIB), indicating a more challenging intubation process.

This increased frequency of higher CL grades in obese patients highlights the impact of increased soft tissue and altered airway anatomy in making intubation more difficult. As CL grades increase, the need for additional intubation attempts and the requirement for adjunctive maneuvers, such as the BURP maneuver or the use of a bougie, also increase. The study showed that 53.3% of obese patients required a second intubation attempt, compared to only 13.3% of non-obese patients, further underscoring the challenges associated with airway management in the obese population.

Ultrasonographic Measurement of DSE and Correlation with BMI and CL Grade The ultrasonographic measurement of DSE revealed important insights into the impact of neck anatomy on intubation difficulty. Non-obese patients had a DSE ranging from 1.7 to 2.3 cm, with a mean of 2.02 cm, whereas obese patients had a DSE ranging from 2.3 to 2.9 cm, with a mean of 2.68 cm. The greater DSE observed in obese patients correlates with increased soft tissue in the neck and anterior pharyngeal structures, contributing to a more challenging intubation.

The correlation analysis showed a significant positive relationship between DSE and BMI, with a stronger correlation observed in non-obese patients ($r = 0.782$, $p < 0.001$) compared to obese patients ($r = 0.421$, $p = 0.021$). This suggests that DSE increases as BMI increases, but the relationship is more pronounced in non-obese individuals, possibly because of greater variability in neck anatomy in obese patients that may reduce the consistency of the relationship.

The correlation between DSE and CL grade was also significant, with higher DSE values associated with more difficult intubation (higher CL grades). The correlation was stronger in non-obese patients ($r = 0.885$, $p < 0.001$) than in obese patients ($r = 0.734$, $p < 0.01$). This suggests that, regardless of obesity status, an increased DSE contributes to more challenging airway visualization during

intubation. The slightly stronger correlation in non-obese patients may reflect the greater variability in the anatomy of obese patients, which can introduce other factors that influence intubation difficulty.

Need for Modifications During Intubation

The need for modifications during intubation, such as the BURP maneuver or the use of a bougie, was significantly higher in obese patients. While all non-obese patients were successfully intubated without the need for modifications, 33.3% of obese patients required the BURP maneuver, and 13.3% required both the BURP maneuver and a bougie. These findings emphasize the increased complexity of airway management in obese patients, which may be attributed to factors such as increased DSE, limited mouth opening, and higher Mallampati grades. The need for additional maneuvers suggests that preoperative identification of potential airway difficulties is crucial in obese patients to ensure that appropriate strategies and equipment are available during intubation.

CONCLUSION

This study provides valuable insights into the impact of obesity on airway management, emphasizing the increased difficulty of intubation in obese patients due to altered anatomy. The ultrasonographic measurement of DSE emerged as a promising predictor of intubation difficulty, with higher DSE values correlating significantly with increased BMI and higher Cormack-Lehane grades. The findings indicate that obese patients present unique challenges, including higher CL grades, increased need for multiple intubation attempts, and the requirement for modifications during intubation.

The strong correlation between DSE and intubation difficulty, particularly in non-obese patients, suggests that ultrasonographic DSE measurements can serve as a reliable and objective tool for predicting difficult intubation. Implementing ultrasonographic airway assessment in clinical practice, especially for obese patients, could improve preoperative airway assessment and preparedness, ultimately reducing the risks associated with difficult intubation.

Given the increasing prevalence of obesity globally, these findings have important implications for anesthesiology practice. Incorporating DSE measurements into routine preoperative airway assessments could help identify patients at higher risk for difficult intubation, allowing anesthesiologists to better plan and mitigate potential airway complications. Further research is recommended to validate these findings in larger and more diverse populations and to explore the utility of other ultrasonographic measurements in predicting airway difficulty.

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