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RESEARCH ARTICLE

STUDY OF THE FACTORS AFFECTING DIFFICULT ENDOTRACHEAL INTUBATION WHO PRESENTED TO EMERGENCY DEPARTMENT IN RAMKRISHNA CARE HOSPITAL, RAIPUR, CHHATTISGARH

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Abstract

Background: A thorough but brief airway assessment is important and challenging for patients requiring advanced airway assessment. The study aimed to provide knowledge about the factors leading to difficult endotracheal intubation, reduce the number of attempts which will lead to more successful intubation and improve the overall quality of the procedure.

Material Methods: A total of 293 patients were selected based on consecutive sampling methods. After ethical committee clearance data was collected using a data collection form. Age, gender, obesity,pre-existing medical conditions, and facial malformations were recorded for each participant. Airway assessment tests such as mouth opening, thyromental distance, hyomental distance, short neck, and Mallampati classes were conducted by investigators.

Inclusion criteria were based on

1. The patient who is alive
2. The patient who needs advanced airway management

The exclusion criteria were

1. The patient presented in the emergency department with ventilator support
2. Patient who didn't give consent
3. Patients below 14 years of age(pediatric age group)

Data was initially entered into an Excel data sheet and then exported to SPSS Statistics version 22 for analysis.

Results: From July 2022 to Aug 2023, a total of 293 patients were included in the study. Of these, 170 were male and 123 were female. Under 65 years of age 40 (43.5%) had difficult intubation whereas above 65 years 52(56.5%) had difficult intubation. 134 patients were obese resulting in difficult intubation. Female patients, those suffering from systemic diseases and facial malformation or fracture were found to be more difficult to intubate. We recognized that Mallampati classes ≥3, mouth opening < 4cm, short thyromental distance, and hyomental distance, were also associated with difficult intubation. Multiple logistic regression analysis of the related factors determined that the

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odds ratio was highest for mouth opening <4 cm (OR = 3.613) and Thyromental distance <6cm (OR = 3.157)
Conclusion: Factors affecting difficult intubation were constructed from the patient's demographic characteristics and clinical examination. This may help in discriminating against difficult intubation.This will also help in the overall success rate of first attempts of endotracheal intubation in the emergency department.

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Introduction:-

A thorough but brief airway assessment is essential for patients requiring advanced airway management (invasive technique). Airway management is one of the key challenges for emergency physicians. Tracheal intubation is one of the supports in airway management.[1]

As the brain sustains only a few minutes without oxygen delay the inability to manage the airway may cause brain damage or death. Indications for airway management are a failure to oxygenate, ventilate, or maintain a patent airway. The modality of airway management primarily depends on factors associated with patients, environmental factors, and clinical skills. [2]

Demographic factorslike age, gender preexisting diseases, or obesity rarely affect endotracheal intubation. Risk factors reported for difficult endotracheal intubations are short neck, thyromental distance, hyomental distance, less mouth opening, and high Mallampati score.

Environmental and lifestyle disorders have made a great impact on immunity and are a leading cause of preoperative procedures in hospitals. The elderly age group is presented with degenerative changes and underlying diseases, limited end organ reserve, and stress of the preoperative period. [3]

Complications in endotracheal intubation are generally noticed in elderly patients due to aging factors like loss of dentition, and head and neck joint stiffness.[4, 5,6,7] Elderly patients also report with commodities which further challenges the emergency physician to successfully perform the invasive life-saving procedure. **Rose et al.**investigated the frequency of difficult endotracheal intubation according to age group and reported that the highest frequency was observed in those aged 40-59.[4]

Several attempts during endotracheal intubation under direct laryngoscopy in need of advanced airway management of the patient can cause injuries in the trachea, edema, bleeding, brain hypoxia, and even cardiac arrest. Unsecured airway and failed attempts of intubation can lead to situations resulting in a “cannot ventilate, cannot intubate” condition because of bleeding and edema.[8]

The current study was done to determine factors affecting difficultendotracheal intubation in adult patients. Accurate preoperative prediction of difficult intubation might reduce the frequency of complications.

Aims And Objective:-

This study aims to

1. To determine the factors because repeated attempts are associated with poor outcomes and various adverse events ranging from transient desaturation to the death of a patient.
2. This studyhas emphasized that successful intubation should be sought especially in the emergency department where most of the patients being intubated are already critically ill.
3. Knowledge about these factors can be useful in predicting high-risk airway procedures as well as in improving the overall quality of endotracheal intubation in the emergency department.

Review Of Literature:-

1. **En-Chih Liao et al**stated four independent predictive factors leading to difficult endotracheal intubationwhich are high BMI,low thyromental distance, obstruction in the upper airway, and class III, IV Mallampati scores.[9]

2. **Kamal et al**stated that thyromental distance, Mallampati score, and interincisal distance are diagnostically more accurate bedside predictors of difficult intubation. The highest sensitivity for predicting difficult intubation was observed with interincisal distance > thyromental distance > Mallampati score[10]
3. **Prakash et al.** stated Mallampati score class III and IV, range of neck movement< 80, Interincisal distance ≤ 3.5 cm, thyromental distance < 6 cm, and snoring were independently related to difficult laryngoscopy. [11]
4. **Dhanger et al.**concluded that the diagnostic accuracy of neck circumference/ thyromental distance and Mallampati score was better as compared to the various other bedside tests to predict difficult endotracheal intubation in the Indian population.[12]
5. **Shiga et al**stated that the Mallampati score and thyromental distance are the most predictive bedside tests when used in combination have greater discriminative power than as independent parameters.[13]
6. **Panjiar et al.**stated upper lip bite test and thyromental distance resulted as predictive factors in evaluating difficult laryngoscopy in geriatric patients[14]

Materials And Method:-

The study was conducted in Ramkrishna Care Hospital, Raipur, and C.G. which is a 359-bed tertiary hospital. It has a well-established Emergency department. Patient care is provided by dedicated Emergency residents, Consultants, and Senior residents.

For the study, we have collected data from patients undergoing endotracheal intubations at the emergency department. The sample size of the study was 293. The inclusion criteria of the patient were

1. The patient who is alive
2. The patient who needs advanced airway management

The exclusion criteria were

1. The patient presented in the emergency department with ventilator support
2. Patient who didn't give consent
3. Patients below 14 years of age(pediatric age group)

To determine the factors affecting difficult intubation after recording the age into two groups (i.e. below 65 years and 65 years or above) and gender of the patient, pre-existing medical or systemic diseases were mentioned in the form after ethical committee clearance from the institute.

A clinical examination for obesity, short neck, thyromental distance, hyomental distance, and mouth opening was conducted. Mallampati's score was also mentioned in the form. Facial malformations or fractures were examined to assess the endotracheal intubation method. After mentioning the above parameters, the procedure for endotracheal intubation using a laryngoscope was performed.

The number of attempts taken by the investigator was also recorded for differentiating easy and difficult intubation. All the data was entered into an Excel sheet and exported for statistical analysis.

Statistical analysis was carried out using statistical packages for IBM SPSS vs. 22 for Windows. Continuous and categorical variables were expressed as mean ± SD and percentages, respectively. Two-sided p values were considered statistically significant at $p<0.05$

A chi-square test was done to see the association of age group, gender, obesity, short neck, pre-existing medical condition, facial malformation, Thyromental distance, Mouth opening,Mallampati score, and Hyomental distance with Difficult Intubation.

- Binomial logistic regression was done to see the Risk factors associated with Difficult Intubation.
- $P<0.05$ was considered as significant; $p<0.001$ considered highly significant.

Results:-

The sample size of the study was 293. Ofthese 131 were below 65 years old and 162 were above 65 years of age. Table 1 shows the association of difficulty of intubation with the two age groups. Based on the number of attempts, easy intubation, and difficult intubation were recorded.

Table 1:- Association of difficulty of intubation with age group.

Age Group	Easy Intubation		Difficult Intubation	
	N=201	%	N=92	%
Below 65 yrs	91	45.3	40	43.5
Above 65 yrs	110	54.7	52	56.5

Chi-square value=0.082; p=0.774(NS)

There was no significant association (p=0.774) between age group and difficulty in intubation

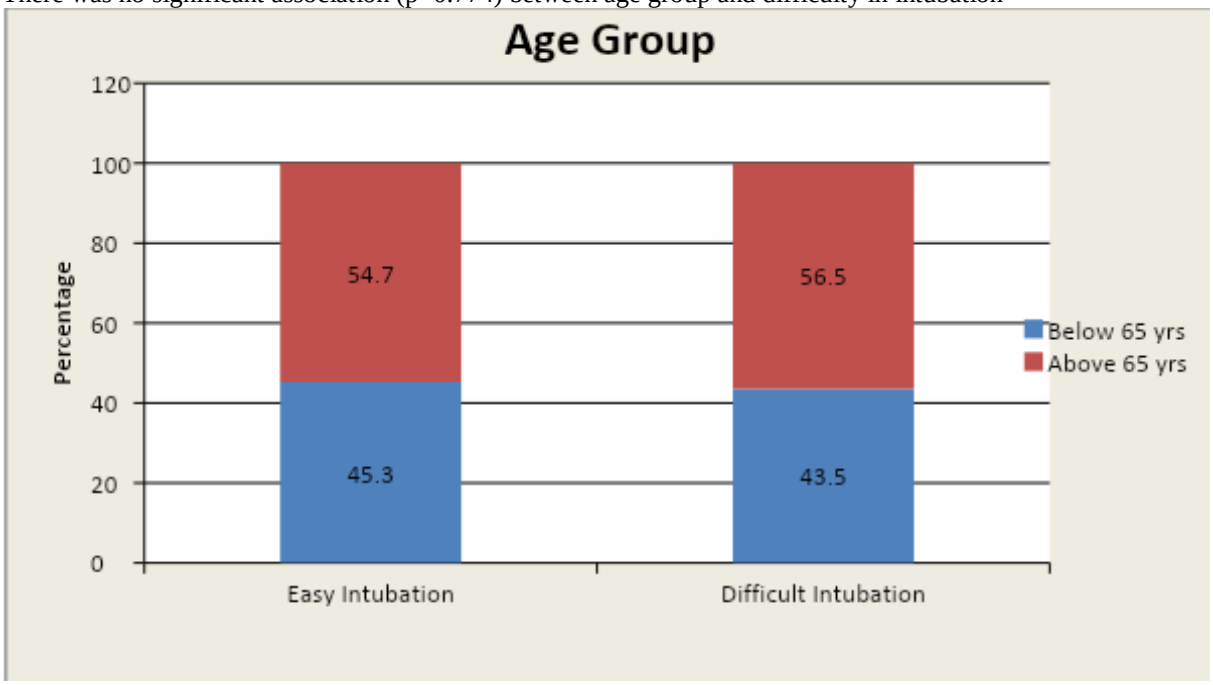

Figure 1:- shows Association of difficulty of intubation with age group.

Table 2 shows association of the difficulty of intubation with gender which shows in our study we had 170 males and 123 females. Easy intubation was seen in 60.7 % of the males and 39.3 % of the females. Difficult intubation was seen in 52.2% of the males when compared to females.

There was no significant association (p=0.170) between gender and difficulty in intubation.

Table 2:- Association of difficulty of intubation with gender.

Gender	Easy Intubation		Difficult Intubation	
	N=201	%	N=92	%
Male	122	60.7	48	52.2
Female	79	39.3	44	47.8

Chi-square value=1.882; p=0.170(NS)

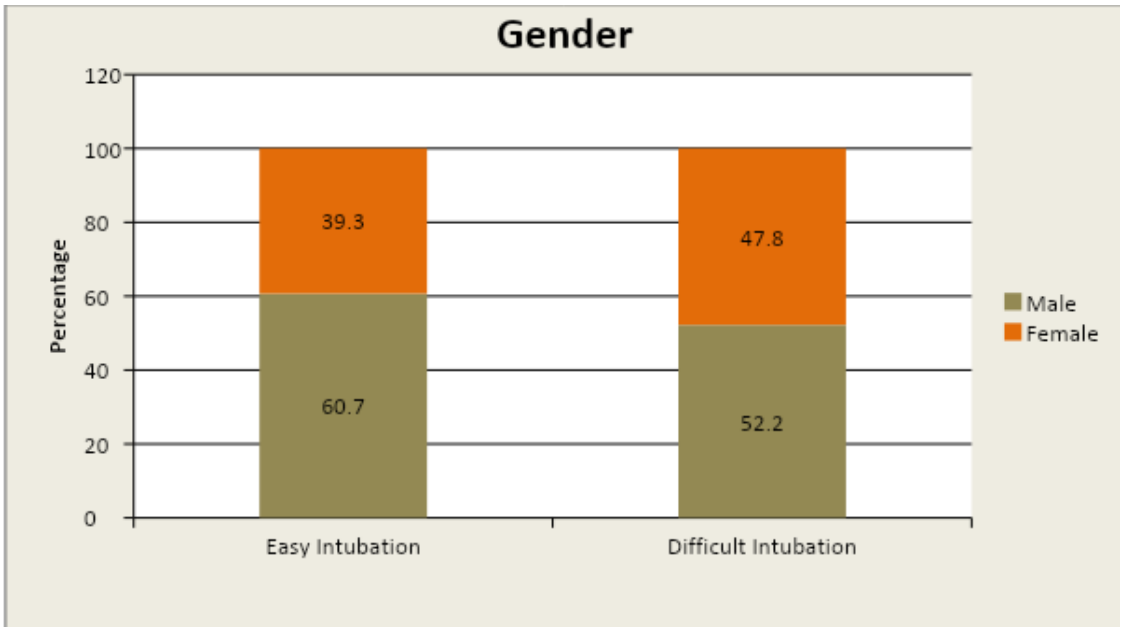

Figure 2:- shows Association of the difficulty of intubation with gender.

Table 3 shows the association of difficulty of intubation with obesity. Out of 293 subjects, 134 were obese. The table shows a significant association (p=0.012) between obesity and difficulty in Intubation. Among those who had difficulty in Intubation, 56.5% were obese.

Table 3:- Association of difficulty of intubation with obesity.

Obese	Easy Intubation		Difficult Intubation	
	N=201	%	N=92	%
Yes	82	40.8	52	56.5
No	119	59.2	40	43.5

Chi-square value=6.289; **p=0.012 (S)**

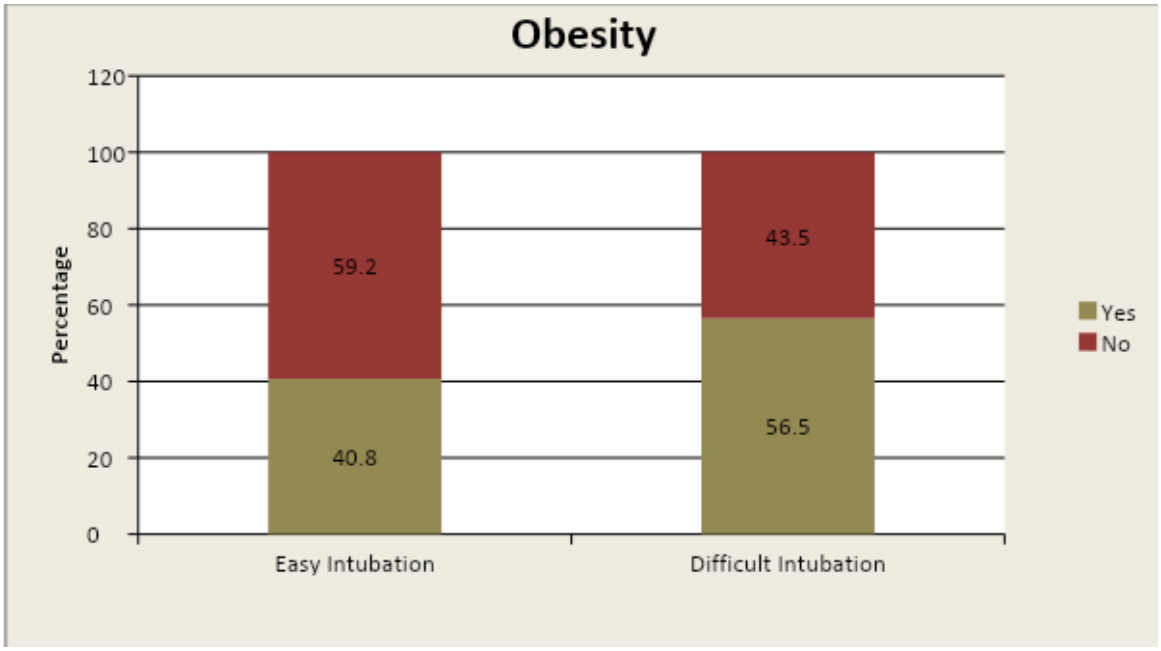

Figure 3:- shows the Association of difficulty of intubation with obesity.

Table 4 shows a short neck as a predictive factor for difficult intubation.There is a significant association (p=0.0007) between a short neck and difficulty in Intubation. Among those who had difficulty in Intubation, 60.9% had a short neck.

Table 4:- Association of difficulty of intubation with short neck.

Short neck	Easy Intubation		Difficult Intubation	
	N=201	%	N=92	%
Yes	78	38.8	56	60.9
No	123	61.2	36	39.1

Chi-square value=11.51; **p=0.0007 (HS)**

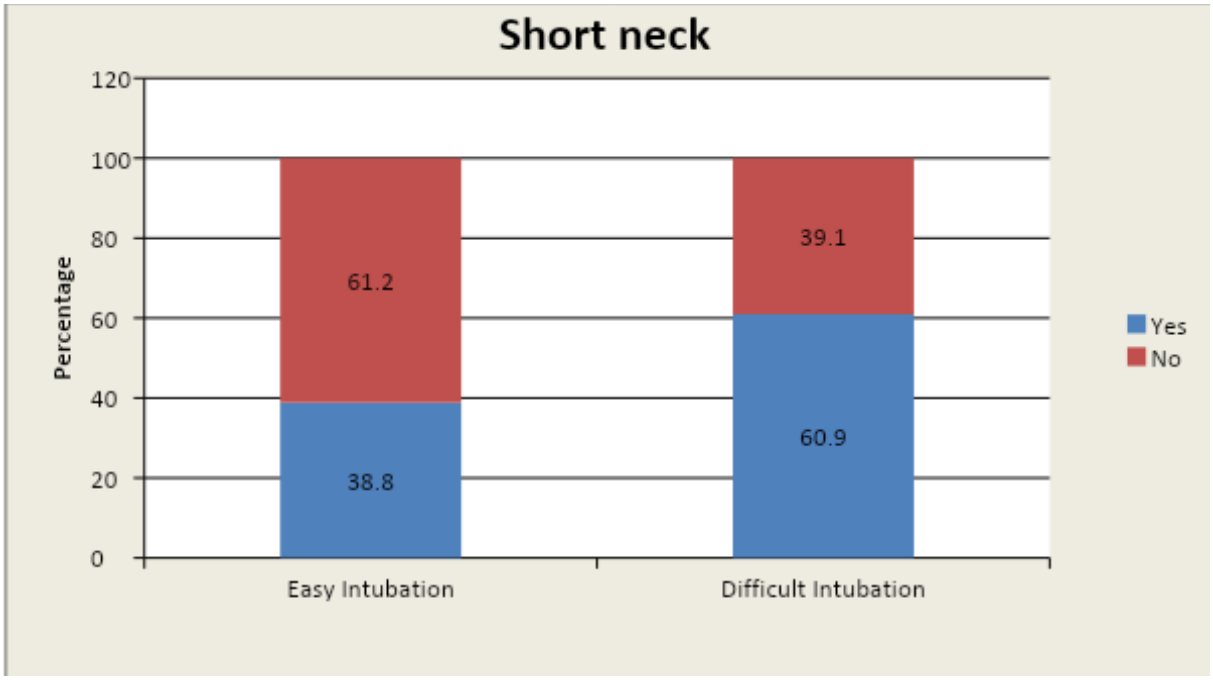

Figure 4:- Association of difficulty of intubation with a short neck.

Table 5 shows 178 subjects presented in the emergency department with pre-existing medical conditions. The result indicates a significant association (p=0.0002) between pre-existing medical conditions and difficulty in Intubation. Among those who had difficulty in Intubation, 73.9% had pre-existing medical conditions.

Table 5:- Association of difficulty of intubation with Medical condition.

History of pre-existing medical condition	Easy Intubation		Difficult Intubation	
	N=201	%	N=92	%
Yes	101	50	68	73.9
No	100	50	24	26.1

Chi-square value=13.53; **p=0.0002 (HS)**

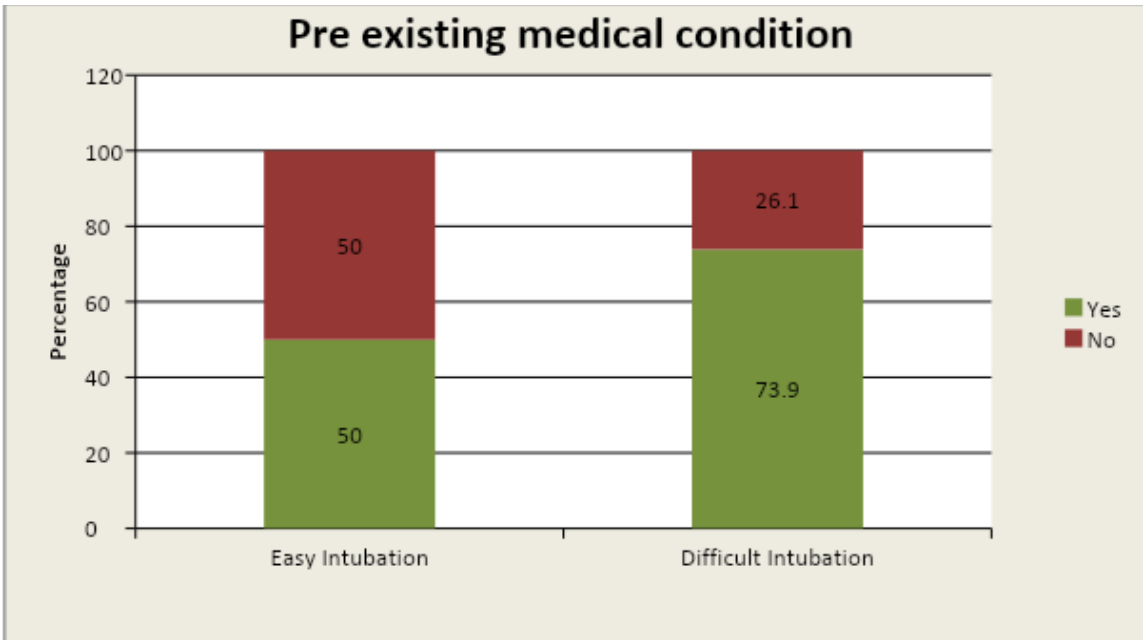

Figure 5:- Association of difficulty of intubation with Medical condition.

Patients reported to the emergency department were evaluated for facial malformations or fractures before intubation. **Table 6** shows among 293 subjects, 140 patients reported to the department with malformation or fracture. It shows a significant association (p=0.001) between facial malformation and difficulty in Intubation. Among those, who had difficulty in Intubation, 65.2% had facial deformation or fracture.

Table 6:- Association of difficulty of intubation with facial malformation.

Facial malformation or fracture	Easy Intubation		Difficult Intubation	
	N=201	%	N=92	%
Yes	80	39.8	60	65.2
No	121	60.2	32	34.8

Chi-square value=15.34; p=0.001 (HS)

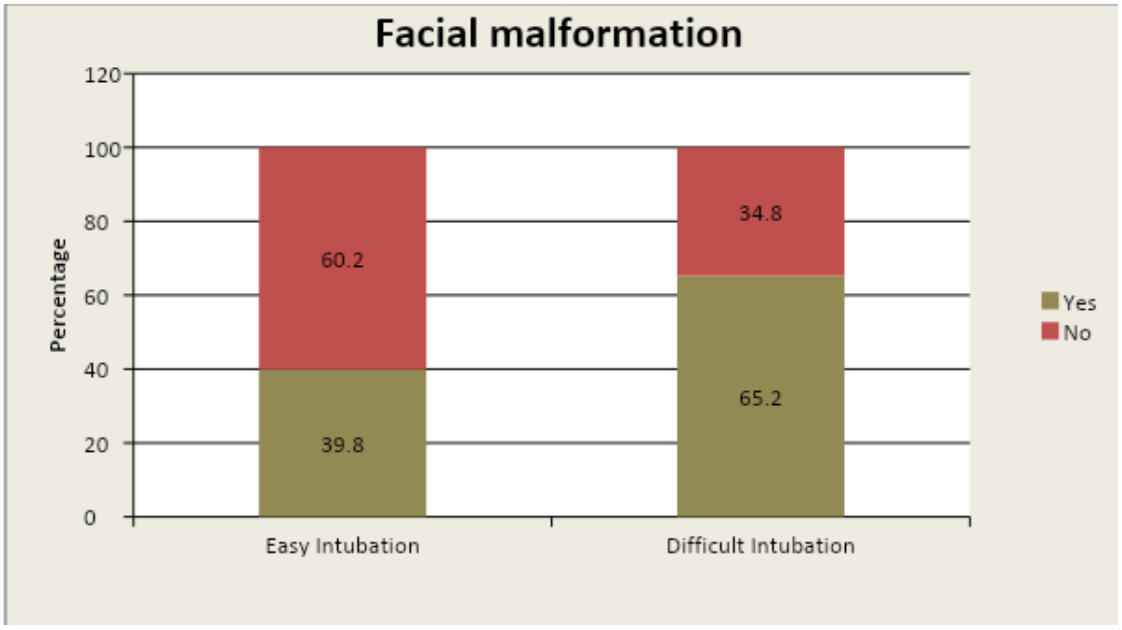

Figure 6:- Association of difficulty of intubation with facial malformation.

Less thyromental distance resulted in difficult intubation. 123 patients reported with thyromental distance < 6 cm. **Table 7** showsa significant association (p<0.001) between thyromental distance and difficult intubation. Among those, who had difficulty in Intubation, 73.9% had thyromental distance < 6 cm.

Table 7:- Association of difficulty of intubation with thyromental distance.

Thyromental distance	Easy Intubation		Difficult Intubation	
	N=201	%	N=92	%
<6 cm	55	27.4	68	73.9
6 cm or > 6 cm	146	72.6	24	26.1

Chi-square value=54.25; p<0.001 (HS)

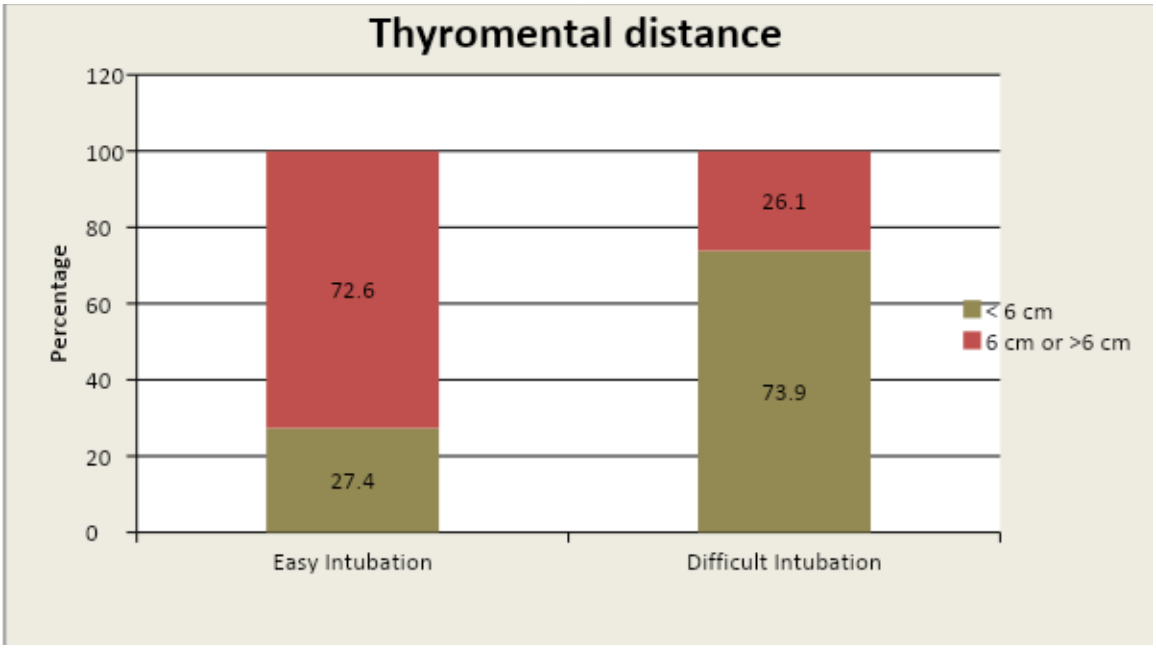

Figure 7:- Association of difficulty of intubation with thyromental distance.

Table 8 shows 163 subjects presented in the emergency department with mouth opening < 4cm. The result indicates a significant association (p=0.001) between mouth opening and difficult Intubation. Among those who had difficult Intubation, 69.6% had mouth opening < 4cm

Table 8:- Association of difficulty of intubation with mouth opening.

Mouth Opening	Easy Intubation		Difficult Intubation	
	N=201	%	N=92	%
<4 cm	99	49.3	64	69.6
4 cm or > 4 cm	102	50.7	28	30.4

Chi-square value=10.54; **p=0.001 (S)**

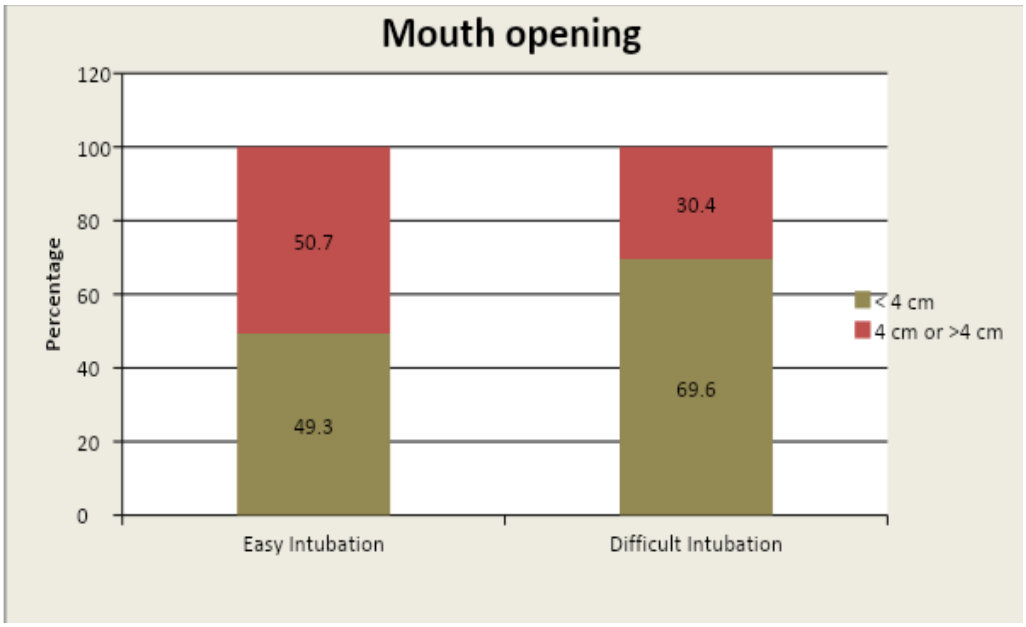

Figure 8:- Association of difficulty of intubation with mouth opening.

Table 9 shows Out of 293 subjects 92 patients had difficult intubation. Statistical results show a significant association (p= 0.013) between Mallampati score and difficult intubation. Patients presented with a class III score was 92 out of which 28(31.5%) had difficult intubation and with a class IV score were 12 out of which 8 (66.6%) had difficult intubation.

Table 9:- Association of difficulty of intubation with Mallampati score.

Mallampati score	Easy Intubation		Difficult Intubation	
	N=201	%	N=92	%
Class I	47	23.4	28	30.4
Class II	86	42.8	28	30.4
Class III	64	31.8	28	30.4
Class IV	4	2	8	8.7

Chi-square value=10.67; **p=0.013 (S)**

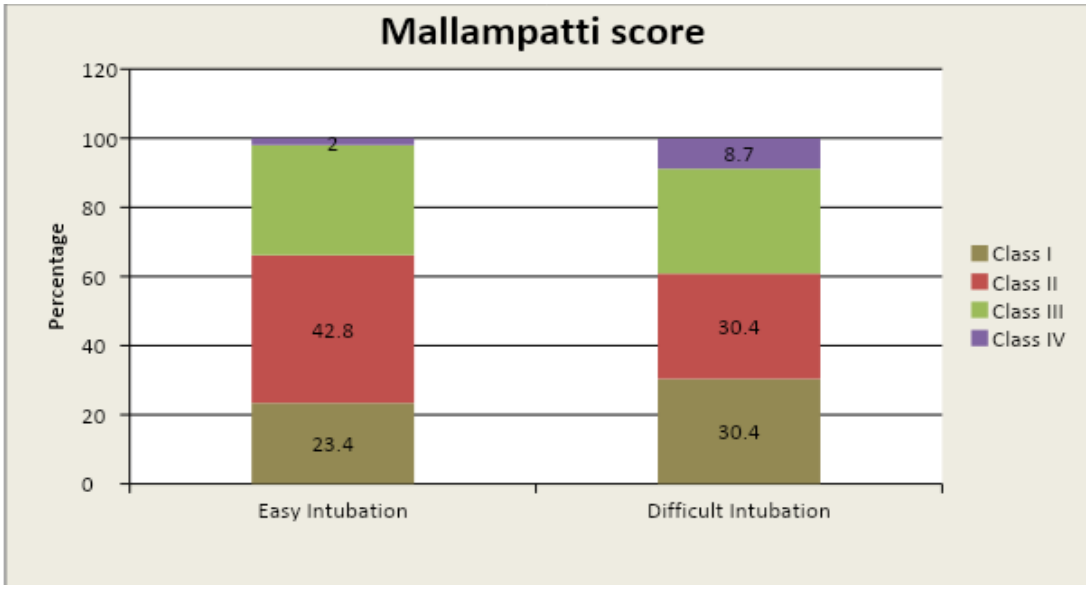

Figure 9:- Association of difficulty of intubation with Mallampati score.

67 patients reported with hyomental distance < 4 cm. **Table 10** showsa significant association (p<0.001) between hyomental distance and difficult intubation. Among those, who had difficulty in Intubation, 65.2% had hyomental distance < 4 cm.

Table 10:- Association of difficulty of intubation with Hyomental distance.

Hyomental distance	Easy Intubation		Difficult Intubation	
	N=201	%	N=92	%
<4 cm	107	53.2	60	65.2
4 – 6 cm	90	44.8	24	26.1
>6 cm	4	2	8	8.7

Chi-square value=7.86; **p=0.0196 (S)**

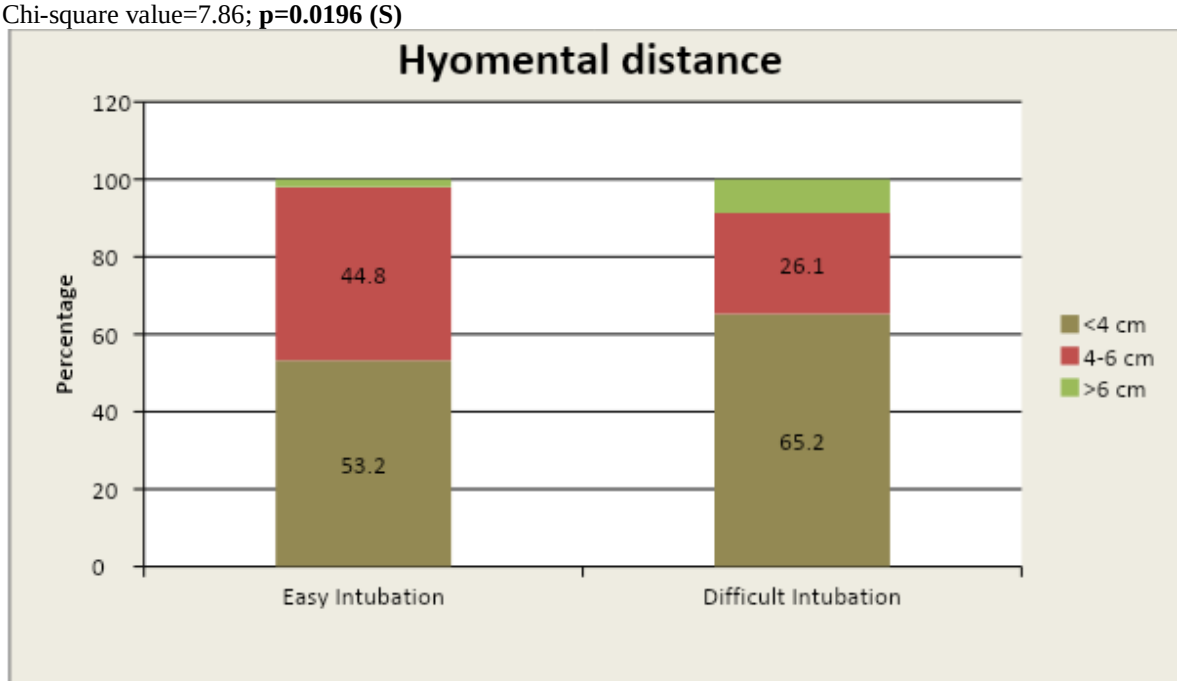

Figure 10:- Association of difficulty of intubation with Hyomental distance.

Table 11:- Risk Factors Associated with Difficult Intubation.

Risk Factors	Odds Ratio	95 CI for OR		p value
		Lower	Upper	
Above 65 years	.775	.381	1.575	.935
Female	.732	.370	1.451	.372
Obese	1.755	1.870	3.539	**0.006**
Short neck	1.970	1.458	2.055	**0.009**
Pre-existing medical condition	1.379	1.513	3.678	**0.045**
Facial malformation	1.753	1.379	2.495	**0.041**
Thyromental distance< 6 cm	3.157	2.335	21.941	**0.001**
Mouth opening <4 cm	3.613	1.517	8.606	**0.004**
Class III, IV Mallampati score	1.221	.090	.543	**0.001**
Hyomental distance <4 cm	.469	.224	.982	**0.045**

Using binomial logistic regression, odds ratios were calculated for risk factors, it was found that obese, short neck, pre-existing medical condition, facial malformation, Thyromental distance < 6cm, Mouth opening <4 cm,Class III, IV Mallampati score and Hyomental distance<4 cm havesignificant (p<0.05) associationwithdifficult Intubation, whereas age group and Gender had no significant association with difficulty in intubation.

The odds ratio was highest for mouth opening <4 cm(OR = 3.613) and Thyromental distance <6 cm (OR = 3.157)

Discussion:-

Intubation has always been a life-saving procedure. Difficult endotracheal intubation presents a formidable challenge in clinical settings, characterized by complexities in securing the airway during procedures. It involves encountering anatomical or pathological factors that impede the smooth passage of the endotracheal tube into the trachea, jeopardizing patient safety and procedural success. Difficult endotracheal intubation requires precise assessment, swift decision-making, and proficient airway management techniques to mitigate risks of complications, such as hypoxia or airway trauma. Addressing difficult endotracheal intubation demands a multidisciplinary approach, emphasizing preparedness, skill, and adaptability among emergency physicians.

The purpose of the study was to increase the number of successful attempts in patients with anatomical and physiological variations. The study indicates thatpre-procedural examinations will help in evaluating and securing the pathway easily.

This study indicates there is no significant association between difficult intubation and gender. No significant association between age and difficult intubation was concluded similarly to **J V Doran et al**[15]. The association between difficult intubation and obesity was significant (p=0.006) similar to **En-Chih Liao et al**[9]. Thyromental distance < 6cm(OR = 3.157) and Mallampati score class (class III and Class IV) (p=0.001)resulted in significant association with difficult intubation as resulted in **Oria MS et al**. Similar to **Oria MS et al**, this study indicates presence of systemic disease is associated with difficult intubation[16]. The Odds Ratio was highest (OR= 3.613) for mouth opening <4cm and can be considered as a significant factor for difficult intubation similar to **Karouki K et al** [5]. **Vasudevan et al** stated a significant association between hyomental distance <4cm and difficult intubation.[17]

Limitations Of Study

1. The Sample size was low
2. The study was carried out in a tertiary care hospital, so hospital bias cannot be ruled out.
3. There were multiple operators for intubation with different experiences.
4. The Mallampati score lacks the accuracy, reliability, and feasibility required to supplement a standard airway evaluation before ED airway management or procedural sedation.

Conclusion:-

Factors affecting difficult intubation were constructed from the patient's demographic characteristics and clinical examination. This may help in discriminating against difficult intubation.This will also help in the overall success rate of first attempts of endotracheal intubation in the emergency department.
The findings of the study show that obese, short neck, pre-existing medical condition, facial malformation, Thyromental distance<6cm, Mouth opening<4 cm,Class III, IV Mallampati score, and Hyomental distance<4 cm have significant ($p<0.05$) association with difficult Intubation, whereas age group and gender had no significant association with difficulty in intubation.

Emergency physicians working under the guidance and experts in multispecialty hospitals have achieved success in initial intubation attempts. As the Emergency Medicine specialty has emerged and then matured over the last decades, practitioners of Emergency Medicine have become increasingly proficient in this skill, and have modified their approaches to airway management significantly, relying less and less on assistance from other medical specialists.

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