Original Article

Nasotracheal Intubation: An Effective Forgotten Method In The Difficult Airway Management Of Acute Burns Patients

Reza Salehi[1], Taymaz Amiraslani[2*], HamidReza Alizadeh Otaghvar[3], Mohammad Reza Ghodraty[4], Aliakbar jafarian[5], Hadis Najafimehr[6], Shayan Sanati[7]

[1]Assistant professor of Anesthesiology, Department of Anaesthesiology, School of medicine, Iran University of Medical Sciences, Tehran, Iran Email:Rsalehi45@yahoo.com
[2]Assistent professor of Anesthesiology, Department of Anaesthesiology, School of Medicine, Hazrat-e-Fatemeh Hospital, Iran University of Medical Sciences, Tehran, Iran Email: amiraslani.ta@iums.ac.ir
[3]Associate Professor of Plastic Surgery, Trauma and Injury Research Center, Iran University of Medical Sciences, Tehran, Iran Email: Drhralizade@yahoo.com
[4]Professor of Anesthesiology, Department of Anesthesiology, School of Medicine, Iran University of Medical Sciences, Tehran. Ira Email: ghodrati.mr@iums.ac.ir
[5]Associate Professor of Anesthesiology, Department of Anaesthesiology, School of Medicine, Iran University of Medical Sciences, Tehran, Iran Email: aajafari41@gmail.com
[6]PhD student in Biostatistics, Tehran University of Medical Sciences, Tehran, Iran Email: Najafi.mehr@yahoo.com
[7]Anesthesiologist, Department of Anaesthesiology, School of Medicine, Iran University of Medical Sciences, Tehran, Iran Email:shayansanati@yahoo.com
Corresponding Author: Taymaz Amiraslani
Corresponding Author Email: amiraslani.ta@iums.ac.ir
DOI: 10.47750/pnr.2023.14.S02.95

Abstract

Introduction: Inhalation injury has a significant impact on patient outcome, with a 30% increased mortality rate when present. Management of difficult airway and respiratory and hemodynamic stability is an important challenge during their treatment. Complications such as multiple intubation attempts, prolonged direct laryngoscopy, hypoxia, and cardiac arrest are more common in emergency orotracheal intubation outside (OI) the operating room. Blind Nasotracheal Intubation (BNI) is a technique in which a tracheal tube is passed through the nose into the trachea without the use of a laryngoscope (also anesthetic drugs) and with the help of the patient's breathing sound. We conducted a randomized clinical trial to investigate the efficacy of BNI and OI in difficult airway management of patients requiring immediate intubation.
Method: Thirty patients with inhalation injury and difficult airway (Mallampati III-IV) who need to be intubated were randomly assigned in the orotracheal intubation Group (O) and the nasotracheal intubation (N) group. The outcome measures were speed and ease of intubation, respiratory and hemodynamic parameters in three time points, as well as complications.
Results: One eligible patient was excluded from the nasotracheal intubation group because the tube did not pass through the nasal cavities (7.14%). The intubation time in the nasotracheal intubation group (58.50±28.54 S) is significantly shorter than the other group (112.40±60.88 S) (P=0.006). Intubation attempts in the nasotracheal group (1.14±0.36) are almost half of the attempts in the other group (2.27±0.79) (P=0.001). In terms of hemodynamics, there was no significant difference between the heart rate (HR) at three time points between the two groups. Despite of the comparable mean arterial pressure (MAP) in the 5 minutes before intubation, there was a significant difference in MAP between the two groups during the intubation (OI: median=84 mmHg VS BNI: median 63 mmHg, P=0.012) and the 5 minutes after the tube fixation (OI: median=83 mmHg VS BNI: median 70 mmHg, P=0.007. Respiratory rate (RR) had significant differences during intubation (OI: median=0 VS BNI: median 20/min, P=0.001)

and the 5 minutes after the tube fixation (OTI: median=10 VS NTI: median 19/min, P=0.001). There were similar differences in blood oxygenation saturation (SpaO2) during (OI: median=60% VS BNI: median 87%, P=0.001) and 5 minutes after the tube fixation (OI: median=93% VS BNI: median 97%, P=0.001) between the two groups. in the orotracheal intubation group, seven patients had apnea (46.66%) and three patients suffered cardiac arrest (severe bradycardia) during intubation.
Conclusion: Data showed the superiority of nasotracheal intubation technique in difficult airway management of patients with inhalation injury requiring emergency intubation.

Keywords: Inhalation injury, Blind nasotracheal intubation (BNI), Orotracheal intubation (OI), Acute burns, Apnea, cardiac arrest, Mean Arterial Pressure (MAP), Difficult Airway management

Introduction

Inhalation injury should be considered an integral part of major burns that can compromise patient outcome. Direct thermal injury [1], chemical irritation, and systemic toxicity are pathways by which ventilation, respiration and ultimately oxygen-carrying capacity are compromised during inhalation injury [2-6]. Inhalation injury has a significant impact on patient outcome, with a 30% increased mortality rate when present.[7-8] Sometimes it is necessary to intubate patients urgently to secure an established airway or to provide adequate oxygen in the acute phase[2]. In this condition, patients are usually anxious, dehydrated, hemodynamically unstable, and have respiratory complications. In many cases, the airway management is also difficult due to progressive edema in the head and neck regions[9]. Hypoxemia, hemodynamic instability, and difficult intubation are integral parts of intubation-related complications[10].
Deciding how to manage the airway in these patients is very important [11]. An aggressive approach puts patients at risk of more complications due to anesthetic drugs injections, laryngoscopy, mechanical ventilation, sedation, immobilization, and etc., especially in emergency situations outside the operating room[12-19]. Therefore, it is better to avoid invasive procedures as much as possible, and if any invasive procedures are needed, choosing minimally invasive methods will help stabilize the patient's clinical condition as much as possible. Anuradha Borle et al indicated that burn patients have several limitations to the potentially lifesaving "awake fiberoptic intubation"[20].
In this regard, maybe, blind nasotracheal intubation (BNI), which was used by Fritz Kuhn[21-22] as early as 1902 and was discovered by Sir I. W. Magill and E. S. Rowbotham [23] in 1917-21 is a better choice. Fritz Kuhn believed that blind nasal intubation provides more physiological effect than oral tracheal intubation in creating better clinical conditions during the intubation of these patients [21-22]. During this forgotten technique, the tracheal tube is passed through the nose into the trachea without the use of a laryngoscope (also anesthetic drugs) and with the help of the patient's breathing sound [23]. Therefore, perhaps the patients' hemodynamic and respiratory systems are less suppressed during intubation[33-35].
Numerous articles have been published and stated that oral intubation is a safe, quick, painless and easy-to-learn technique due to anesthetic drugs injection[24]. But the important challenge is whether oral intubation is the preferred method of intubation in acute burn patients with difficult airways? Blind nasotracheal intubation is a forgotten procedure that can be performed blindly in conscious patients without the need for sedation and laryngoscopy. Tracheal intubation without the use of a laryngoscope is a valuable capability. Other nasotracheal intubation advantages include better tolerance of the endotracheal tube due to avoidance of gag reflex stimulation, more secure fixation of the tube, lesser risk of soft tissue injury, lesser chances of unplanned extubation, and possibly lower rate of post-extubation airway obstruction (PEAO)[24].
The aim of this study is to investigate whether blind nasotracheal intubation (BNI) is an easier and safer technique to manage difficult airway in patients with inhalation injury.

Method

This is a randomized clinical trial study that was conducted in Shahid Motahari Burn Hospital between 1 January 2021 and 1 August 2022. After the approval of the IUMS Ethics Committee, acute burn patients aged 15 to 60 years, American Society of Anesthesiologists (ASA) physical classification I to III, who had an indication for emergency intubation and also had a difficult airway (Mallampati Score 3 and 4) were included in the study. Of course, patients with GCS<8, evidences of shock, a suspected clinical history of head and neck trauma, nasal surgery, deviated nasal septum, nasal rhinorrhea, facial deformity, severe respiratory distress, apnea, hypertension, and patients who used hemodilution drugs or known blood disorders were excluded from the study[25]. Patients were randomly assigned to one of two groups (oral tracheal intubation (O) or blind nasogastric intubation (N)) by a computer-generated random table, and using sealed envelopes that were opened at the time of intubation. The nurse who was responsible for recording the data would open the envelope if the patients were to be intubated to determine the intubation method.

All patients had a suitable IV line and were under non-invasive monitoring of heart, blood pressure and pulse oximetry. They were intubated based on the technique written in the envelope by resident anesthesiologists with more than ten years of experience in burn hospitals.

Professionals who intubate patients through the mouth try to preserve a patent upper airway and spontaneous breathing as much as possible. Typically, after 3 minutes of preoxygenation, sedatives (midazolam), analgesics (fentanyl), and hypnotics (ketamine) drugs are slowly administered intravenously. Then; under relatively deep sedation anesthesia; Patients were intubated by direct laryngoscopy in such a way that the respiratory and hemodynamic status of the patients remained as stable as possible.

In nasotracheal intubation group, first, the patient's most open nostril was determined by air flow, and then lidocaine (10%) was sprayed locally in the nasal cavity, nasopharynx, and oropharynx. After three minutes preoxygenation, a lubricated nasal cuffed-tracheal tube with a diameter of 7.5 for men and a diameter of 7 for women or (a tube with half to one size smaller than the size of the suitable oral tube size) was inserted into the nostril and directed toward the nasopharynx. In case of any resistance, in addition to changing the tube with a smaller diameter, maneuvers such as turning the tube 90 degrees counterclockwise, bending the patient's head, inflating the cuff, changing the operator and using Magill forceps were performed at the discretion of the operator. Finally, after entering the tube into the nasopharynx, the patients were blindly intubated by the guide of the patient's breathing sound[25]. It should be noted that in case of failure in intubation in any of the groups, glidescope or fiber optic was used depending on the clinical condition.

The difficulty of intubation (the Mallatmpati Score, the intubation time, the number of intubation attempts, first attempt success rate), the hemodynamic status (mean arterial pressure, Heart rate) and respiratory status (respiratory rate, the oxygen saturation of the blood ($Spao_2$) of patients and the events during intubation (cardiac arrhythmia, cardiac arrest, apnea) were considered as variables for comparing the two methods.

These parameters were measured at three time points, 5 minutes before intubation, during intubation and 5 minutes after fixing the tracheal tube by the assigned nurse in charge of the shift with NIBP, pulse oximeter and stopwatch devices. The orotracheal intubation time was measured from the insertion of the laryngoscope blade into the patient's mouth to the successful fixation of the tracheal tube in the trachea and the nasotracheal intubation time was the time elapsed from the insertion of the tube into the patient's nostril until the successful fixation of the tracheal tube. Data were recorded in a predetermined form.

Based on similar studies and the rarity of the desired cases, 30 patients were included in the study. Fifteen patients in Orotracheal intubation group (O) and in nasotracheal intubation (N) group were allocated.

Data analysis was done using SPSS 23 software and 0.05 was considered as the significance level. To describe the data, the number and percentage, standard deviation ± mean or median were used. The relationship between qualitative variables was investigated with the help of Fisher's exact test. Also, T-test was used to compare the mean of quantitative variables with normal distribution between two groups. Also, Mann-Whitney test was used to check this comparison if the assumption of normality was not established. In order to check the presence of significant changes in repeated sizes with non-normal distribution, Friedman's test was used.

Results

From January 1, 2021 to August 31, 2022, 212 patients who underwent emergency intubation were evaluated for eligibility (Fig. 1). 67 patients did not meet the inclusion criteria. Another 115 patients were excluded from the study for various reasons, and finally 30 patients were randomly assigned to two groups.

However, one eligible patient was excluded from the nasotracheal intubation group because the tube did not pass through the nasal cavities (7.14%). The groups were similar in terms of sex, age, gender, weight, burn surface area

(TBS), level of consciousness (GCS scoring system) American Society of Anesthesiologists (ASA) physical classification and the airway difficulty (Mallampati scoring system) (table-1). The intubation time in the nasotracheal intubation group (58.50±28.54 S) is significantly shorter than the other group (112.40±60.88 S) (P=0.006). Also, intubation attempts in the nasotracheal group (1.14±0.36) are almost half of the attempts in the other group (2.27±0.79) (P=0.001) (table-1). Therefore, it can be concluded that the patients' airways were more easily intubated with blind nasotracheal intubation technique.

From hemodynamic point of view, there was not significant difference between heart rate (HR) in three time points between the two groups. Also, despite of the comparable mean arterial pressure (MAP) (OTI: median=84 mmHg VS NTI: median 85 mmHg) in the 5 minutes before intubation, there was a significant difference in MAP between the two groups during the intubation (OTI: median=84 mmHg VS NTI: median 63 mmHg, P=0.012) and the 5 minutes after the tube fixation (OTI: median=83 mmHg VS NTI: median 70 mmHg, P=0.007) (table 2).

Respiratory rate (RR) had significant differences during intubation (OTI: median=0 VS NTI: median 20/min, P=0.001) and the 5 minutes after the tube fixation (OTI: median=10 VS NTI: median 19/min, P=0.001). There were similar differences in blood oxygenation saturation (SpO_2) during (OTI: median=60% VS NTI: median 87%, P=0.001) and 5 minutes after the tube fixation (OTI: median=93% VS NTI: median 97%, P=0.001) between the two groups (table 2).

It is noteworthy that, in the orotracheal intubation group, seven patients had apnea (46.66%) and three patients suffered cardiac arrest (severe bradycardia) during intubation. Unfortunately, despite successful tracheal intubation and cardiopulmonary resuscitation, one of them died. There was a significant relationship between cardiac arrest and apnea (P =0.034) and most of the people who had cardiac arrest (75%) had apnea.

One of the patients who suffered cardiac arrest also had vomiting and pulmonary aspiration. There was no significant difference in complications (obvious bleeding, vomiting, pulmonary aspiration) between the two groups (table-1). The linear diagram (in fig.-2) shows that the hemodynamic and respiratory condition of patients in the nasotracheal intubation group is more stable, especially during the operation (intubation). The lines of the graphs in the orotracheal intubation group appear to be indented during intubation, indicating hemodynamic instability during intubation (Fig.-2). It seems that, while hemodynamic function was preserved during intubation in both groups, respiratory function was more suppressed during orotracheal intubation. It should be noted that all patients who suffered cardiac arrest experienced severe hypoxia due to protracted intubation process (direct laryngoscopy, glidoscopy, use of fiberoptic).

Discussion

The turning point in the treatment of patients with inhalation injuries is the decision on tracheal intubation. When, the physician must manage a difficult airway while the patient is clinically vulnerable. Therefore, three important issues should be considered and addressed during intubation, ease of intubation, maintenance of stable clinical conditions (hemodynamic and respiratory function), and fewer complications occurrence.

Most of the research in this field have been done under elective setting. Depoix J. P et al reported the time for the placement of the tube into the trachea under elective cardiac surgery was significantly shorter for the oral than the nasal route: 26 ± 30 s v. 62 ± 41 s [26] Although orotracheal intubation in patients with a normal airway (mallampati I-II) has been considered a safe and rapid method, its efficacy in managing a difficult airway in the emergency setting is unclear.

Our suggestion was that in this critical situation, since blind nasotracheal intubation was performed without the need for direct laryngoscopy and intravenous injection of anesthetics, so the patient's hemodynamic and respiratory function would be preserved as much as possible. Since we are not "burning bridges behind us", other facilities can be used if needed.

The present study is unique in that we attempted to use a less invasive technique for difficult airway management in acute burns. The decision to intubate an acute burn patient is a critical issue[27-28]. Sometimes the limitation in the patient's mouth opening is so severe that laryngoscopy and even mask ventilation is not possible due to the swelling of the lips and tongue [7]. Therefore, the use of nasal oxygen will be efficient.

For decades, patients with inhalation injury were intubated only based on clinical indications, and many patients were intubated unnecessarily. Kathleen S. Romanowski et al conducted a retrospective study to evaluate the appropriateness of intubation indications in 416 patients who were intubated in the prehospital or emergency department setting.
He reported that more than a third of patients were unnecessarily intubated and extubated within two days [11]. Klein MB et al reported that 53.1% and 64.8% of 111 patients intubated for transport to a regional burn center for more than 90 miles were extubated within the first 24 hours and within the first 2 days, respectively [29].
For a decade, our approach to intubation of patients with inhalation injuries in Shahid Motahari Burn Hospital has been very strict, so that we have tried to avoid tracheal intubation as much as possible. Due to this non-invasive approach, many patients benefit from it, while the airway of some patients who require intubation for any reason become more difficult.
In present study, all patients had a difficult airway (mallampati IV) and were intubated significantly easier (intubation attempts = 1.14±0.36) and faster (intubation time= 58.50±28.54) with blind nasotracheal intubation (table-1). These findings are not comparable with the majority of researches that show orotracheal intubation as a painless, easy and quick and ultimately superior method. Because in our research, patients with the difficult airways were included in the study and it was supposed to evaluate the ability of nasotracheal intubation in managing difficult airway in patients with critical clinical conditions compared to orotracheal intubation method. In addition, there are situations where access to orotracheal intubation facilities such as laryngoscope, medicine, suitable space (helicopter, airplane, etc.) is not possible and That is where nasotracheal intubation can be useful. Hence, nasotracheal intubation can be performed in the most difficult conditions (almost everywhere) with the least facilities (without need to laryngoscope, medicine). Of course, one patient was excluded from the study because the tube did not pass through the nasal cavity (7.14%). This was comparable to the report of Depoix J. P et al (1987) and Fletcher et al (1984) who observed that nasal intubation was impossible in 13.2% and 17.3% of patients, respectively[26].
Our findings show that not only heart rate (HR) and mean arterial pressure (MAP) did not increase during the intubation phase (procedure), but also heart rate decreased slightly and mean arterial pressure decreased significantly, although 5 minutes after the tube fixation, it has almost returned to initial values.
Usually, following direct laryngoscopy, the catecholamine surge cause increased hemodynamic responses (tachycardia and increased blood pressure)[30-31]. Of course, in major burns, due to the activation of SIRS and the release of inflammatory mediators in the blood, the physiology of the body and the cardiovascular and pulmonary functions of the patients change. Hemodynamic responses induced by direct laryngoscopy reach a maximum level within one minute and end within 5 to 10 minutes and are well tolerated by healthy individuals [32], but may be fatal in some clinical situations (patients with cardiopulmonary diseases or increased ICP).
Our data are not comparable to that of S. Singh et al who conducted a study with 75 patients under general anesthesia that reported the nasotracheal intubation had brisk presser effects on heart rate and mean arterial pressure (especially in nasopharyngeal and nasotracheal phases). These effects are likely to be reduced by using lidocaine in the nasal cavity and nasopharynx [33]. Alan C. Heffner et al performed a historical cohort study of 465 patients undergoing emergency tracheal intubation and reported that a quarter of patients suffered from post-intubation hypotension[34].
Hemodynamic changes after laryngoscopy and endotracheal intubation have been reported in various reports from other parts of the world. Sharma et al [35] and Honarmand et al [36] also emphasized the importance of reducing the stress response during laryngoscopy and tracheal intubation, especially in patients with cardiovascular diseases. Pernerstorfer et al [37] reported that hypertensive patients showed an exaggerated cardiovascular response to laryngoscopic and intubation stimulation, even when the endotracheal tube was removed. Hartigan et al [38] also revealed a remarkable hemodynamic reaction in blind nasal intubation. This study showed the advantage of 10% nasal lidocaine spray in eliminating the cardiovascular response to nasotracheal intubation suggested that the most harmful aspect of this procedure was the passage of the tube through the nose and pharynx.
This study showed the benefit of 10% lidocaine nasal spray in suppressing the cardiovascular response to nasotracheal intubation, the most harmful aspect of this procedure being the passage of the tube through the nose and pharynx. However, some studies did not report significant hemodynamic changes after endotracheal intubation [38-39]. Ovassapian et al [40] indicated that hemodynamic changes in intubation can be reduced with the help of a fiberoptic. Jitendra Singh

Chahar et al conducted a randomized control trial to compare changes in Hemodynamic Parameters caused by orotracheal versus nasotracheal fiberoptic intubation in Patients with Anticipated Difficult Airway.
Furthermore, in a study of mechanically ventilated patients undergoing cardiac surgery, Fletcher et al [41] reported no changes in blood pressure and heart rate following nasotracheal or oral intubation. the absence of hemodynamic changes in endotracheal intubation in some studies may be related to the type of drugs used before laryngoscopy and intubation.
In our research, pulmonary function was significantly suppressed during tracheal intubation as well as 5 minutes after (P=0.001) so that three patients had severe bradycardia and finally cardiac arrest. CPR was successful in two patients after discontinuation of laryngoscopy, mask ventilation, successful intubation, and intravenous adrenaline only, and unfortunately, the last patient died despite successful intubation with video laryngoscopy and long-term cardiopulmonary resuscitation.
Tracheal intubation in emergency situations is a lifesaving and time-sensitive procedure, whose failure occurs up to 40 times more frequently than in standard conditions [42]. Hypoxemia is the most common complication of tracheal intubation in the ICU, which usually leads to cardiac arrest [43-45]. Approximately one-third of patients who experience oxygen saturation less than 90% are at risk of severe hypoxia and cardiac arrest[46].
After hypoxemia was identified as a serious threat during intubation, several studies were designed to reduce it. Some of them have focused on knowing the risk factors associated with this condition, and some have focused on finding effective preventive measures.
Andrew C. McKown et al predicted severe hypoxemia during intubation with the use of a six-point score: age< 50 years, operator with fewer than 100 prior intubations, race other than black, hypoxemic respiratory failure as indication for intubation, preintubation SpO2 less than 94, and BMI greater than 35 (AT RISK score). They reported oxygen saturation before laryngoscopy and acute hypoxemic respiratory failure as the strongest risk factors associated with lower oxygen saturation during intubation[46].
Guitton et al suggested that ICU patients with non-severe hypoxemia are at risk for adverse events during intubation and may benefit from high-flow nasal oxygen (HFNO) [47].
Several studies have evaluated measures to optimize endotracheal intubation in ICU patients, including peroxygenation, apneic oxygenation, appropriate devices, use of airway management algorithm, hemodynamic optimization, drug selection, and intubation timing. Papazian L et al reported that in prolonged direct laryngoscopy in patients with airway problems, HFNO would be an effective method to oxygenate apnea and reduce hypoxemia[47].
Also, several studies have investigated the relationship between drugs and duration of laryngoscopy with respiratory instability and hemodynamics. Ritesh Sharma et al conducted a randomized clinical trial comparing intravenous lignocaine (1.5 mg/kg) and fentanyl (3 µg/kg) 3 minutes before intubation and concluded that fentanyl was superior[48].
Changlin Chen et al showed that topical airway anesthesia effectively controls the cardiovascular response during direct laryngoscopy [49]. The main objective of our study was to use a less invasive method (blind nasotracheal intubation) in emergency airway management of difficult airways. Patients with acute burns and inhalation injury suffer from a wide range of problems such as airway problems, fluid and electrolyte disturbances, respiratory failure, hemodynamic instability, increased sensitivity to sedative side effects, recent food intake, and cardiovascular disease. Despite all the advances that have occurred in the updated implementation of the airway management algorithm and the use of more sophisticated facilities (fiberoptics, video laryngoscope, more effective drugs with fewer complications, etc.), emergency oral intubation remains a dangerous procedure. For this reason, the use of tracheal intubation as a simple minimally invasive procedure would be valuable in individual situations such as difficult airway management in inhalation injuries. The strength of our study is the revival of a forgotten method and the optimal use of its advantages in difficult airway management in patients with critical conditions. Especially in case of failure, other methods will be possible. In addition, there is no need for direct laryngoscopy, intravenous drug injection, and as a result, the possibility of side effects is unlikely. However, there are important issues that need to be addressed in the future. Because the sample size was insufficient, we cannot determine whether the cardiac arrest was related to hypoxia or hemodynamic instability caused by intravenous drug administration or prolonged direct laryngoscopy. Due to the small sample size, the obtained information does not have the necessary power to draw definitive conclusions about complications such as bleeding, vomiting, pulmonary aspiration. Although several studies have shown that the right

nostril and the left bevelled tube pass through the nose more easily, our study did not investigate it[50]. Finally, blind nasotracheal intubation is an essential procedure that can replace orotracheal intubation in emergency situations. By learning and acquiring blind nasopharyngeal intubation techniques, there is an added opportunity for safe airway management. This also allows for quick handling of unexpected intubation problems and prevention of side effects and complications from orotracheal intubation.

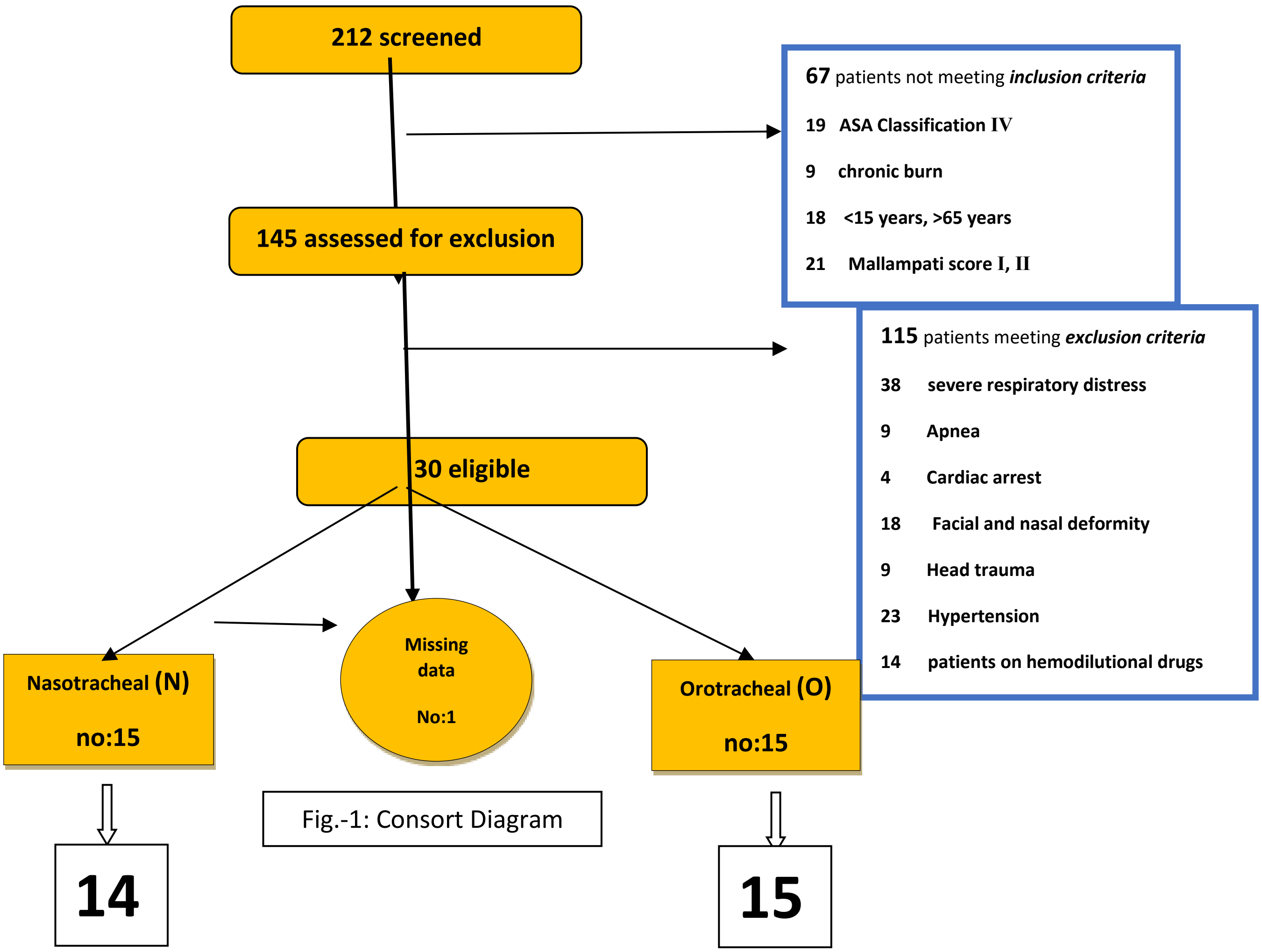


Fig.-1: Consort Diagram

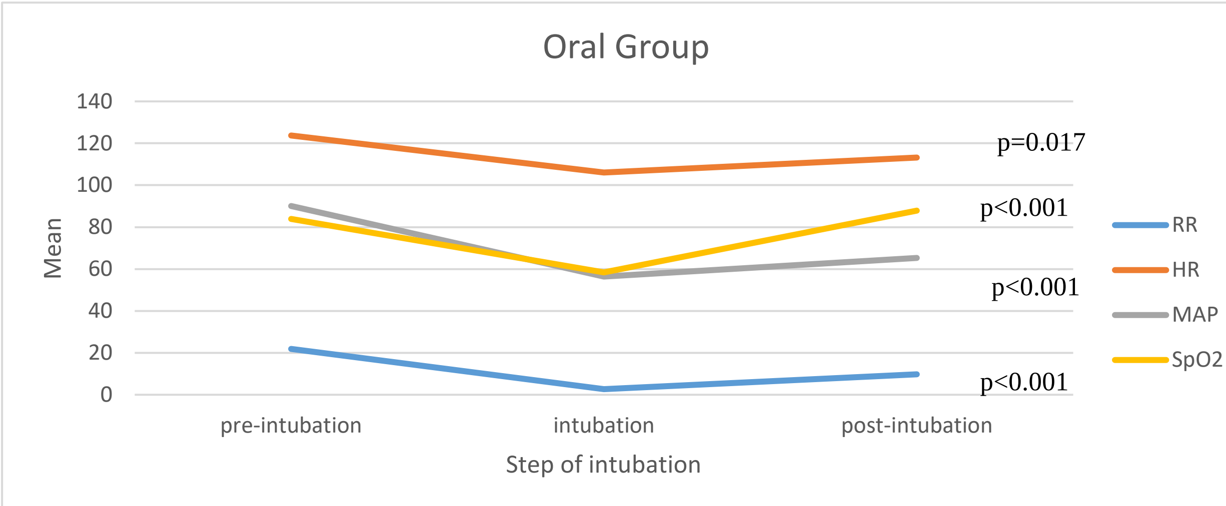
Table-1: Comparison of intubation techniques			
	Nasotracheal Intubation Group (N): 14	orotracheal Intubation Group (O): 15	P Value
Male	11 (78.57%)	11 (73.33%)	1.00
Age (Yr.)	32.5±11.54	34.80±10.87	0.677
Weight (Kg)	67.57±13.21	77.40±19.71	0.294
ASA (III) - only	14 (100%)	15 (100%)	1.00
GCS	12.57±1.50	13.80±1.69	0.025
TBS (%)	58.07±24.31	52.60±23.46	0.569

Drugs injection (iv)	0 (0%)	15 (100%)	0.001
Intubation Attempts	1.14±0.36	2.27±0.79	0.001
Time to intubation (S)	58.50±28.54	112.40±60.88	0.006
Apnea	0	7 (46.66%)	0.006
Cardiac Arrest	0 (0%)	3 (20%)	0.1
Obvious Bleeding	0	0	1.00
Vomiting	0	1 (6.66%)	0.677
Aspiration	0	1 (6.66%)	0.677

Table-2: Changes in hemodynamic and respiratory parameters at different time points.

Variable		Group				P-value
		Nasotracheal Intubation (N) no=14 (%)		Orotracheal Intubation (O) n=15(%)		
		Mean±SD	Median	Mean±SD	Median	
5 min before intubation	Respiratory Rate (RR)	23.07±6.86	21	21.86±4.21	21	0.947
	Heart Rate (HR)	120.93±15.21	121	123.73±16.32	126	0.637
	Mean Arterial Pressure (MAP)	81.43±24.13	84	90.07±18.74	85	0.289
	$Spao_2$	83.92±4.66	84	83.86±4.59	86	0.930
During intubation	Respiratory Rate (RR)	20.57±4.53	20	2.67±4.04	0	0.001
	Heart Rate (HR)	119.92±12.56	121	106.07±56.43	136	0.394
	Mean Arterial Pressure (MAP)	83.28±21.16	84	56.40±21.80	63	0.012
	$Spao_2$	87.35±3.81	87	58.40±21.50	60	0.001
5 min after intubation	Respiratory Rate (RR)	19.64±4.57	19	9.73±3.15	10	0.001
	Heart Rate (HR)	113.21±12.03	115	113.13±32.47	122	0.197
	Mean Arterial Pressure (MAP)	83.14±16.33	83	65.27±18.99	70	0.007
	$Spao_2$	96.92±1.77	97	87.86±22.98	93	0.001

Fig.-2: Linear graph comparing changes in hemodynamic and respiratory parameters at different time points between two



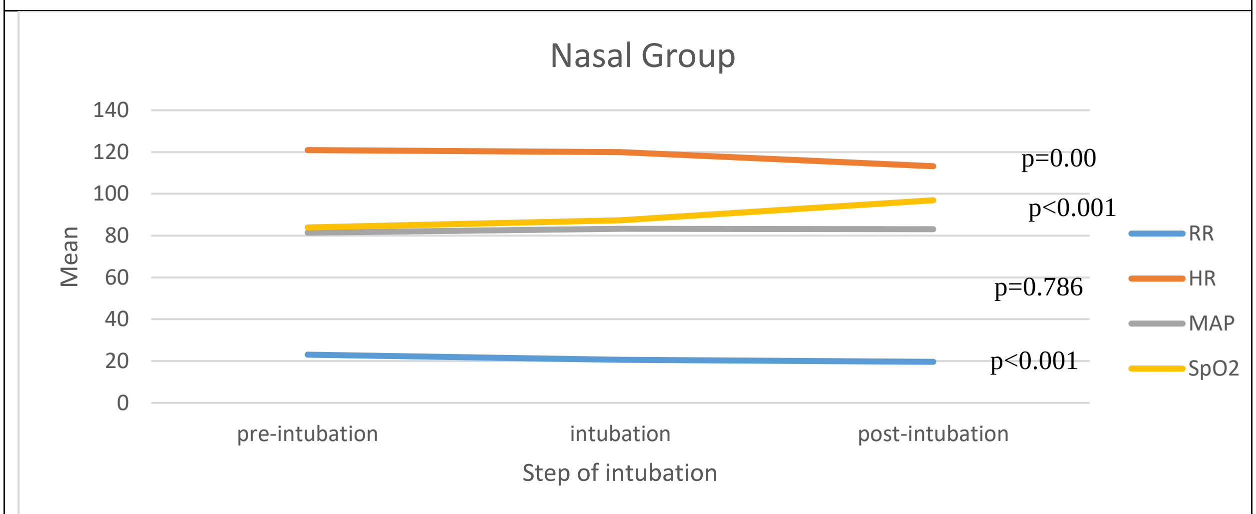


Figure (1): A 32-year-old male patient (suffered inhalation burns) with total surface burns (67% TBSA) under blind nasotracheal intubation

References

[1]. Sabri A, Dabbous H, Dowli A, Barazi A. The airway in inhalational injury: diagnosis and management. Ann Burn Fire Disasters 2017; 30:24–9.

[2]. Costa Santos D, Barros F, Frazão M, Maia M. Pre-burn centre management of the airway in patients with face burns. Ann Burns Fire Disasters 2015; 28:259–63.

[3]. Jones SW, Williams FN, Cairns BA, Cartotto R. Inhalation injury: pathophysiology, diagnosis, and treatment. Clin Plast Surg 2017; 44:505–11.

[4]. Cancio LC. Airway management and smoke inhalation injury in burn patient. Clin Plast Surg. 2009;36(4):555–567.

[5]. Goh CT, Jacobe S. Ventilation strategies in paediatric inhalation injury. Paediatr Respir Rev 2016; 20:3–9.

[6]. Toon MH, Maybauer MO, Greenwood JE, Maybauer DM, Fraser JF. Management of acute smoke inhalation injury. Crit Care Resusc 2010; 12: 267–7.

[7]. Graham CA, Ada HY, Chan SS, Rainer TH. Primary emergency surgical airway for trismus caused by electrical burn. Burns 2006; 32: 1062–3.

[8]. Fraser DJF, Venkatesh B. Recent advances in the management of burns. Australas Anaesth 2005. Available at: http://www.anzca.edu.au/documents/05_fraser.pdf (accessed 24 June 2016).

[9]. Mlcak RP, Suman OE, Herndon DN. Respiratory management of inhalation injury. Burns 2007; 33: 2–13.

[10]. Ching JA, Shah JL, Doran CJ, Chen H, Payne WG, Smith DJ. The evaluation of physical exam findings in patients assessed for suspected burn inhalation injury. J Burn Care Res 2015; 36:197– 202.

[11]. Divatia J. V, Bhowmick K. Complications of endotracheal intubation and other airway management procedures. Indian J Anaesth. 2005;49(4): 308-318.

[12]. Romanowski KS, Palmieri TL, Sen S, Greenhalgh DG. More than one third of intubations in patients transferred to burn centers are unnecessary: proposed guidelines for appropriate intubation of the burn patient. J Burn Care Res 2016;37: e409–14.

[13]. Jaber S, Amraoui J, Lefrant J-Y, Arich C, Cohendy R, Landreau L, et al. Clinical practice and risk factors for immediate complications of endotracheal intubation in the intensive care unit: a prospective, multiple-center study. Crit Care Med. 2006;34:2355–61.

[14]. De Jong A, Jung B, Jaber S. Intubation in the ICU: we could improve our practice. Crit Care. 2014; 18:209.

[15]. Jaber S, Jung B, Corne P, Sebbane M, Muller L, Chanques G, et al. An intervention to decrease complications related to endotracheal intubation in the intensive care unit: a prospective, multiple-center study. Intensive Care Med. 2010; 36:248–55.

[16]. Simpson GD, Ross MJ, McKeown DW, Ray DC. Tracheal intubation in the critically ill: a multi-centre national study of practice and complications. Br J Anaesth. 2012; 108:792–9.

[17]. Griesdale DEG, Bosma TL, Kurth T, Isac G, Chittock DR. Complications of endotracheal intubation in the critically ill. Intensive Care Med. 2008;34: 1835–42.

[18]. Cook TM, Woodall N, Harper J, Benger J. Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 2: intensive care and emergency departments. Br J Anaesth. 2011; 106:632–42.

[19]. Martin LD, Mhyre JM, Shanks AM, Tremper KK, Kheterpal S. 3,423 Emergency tracheal intubations at a university hospital. Anesthesiology. 2011; 114:42–8.

[20]. Mort TC. Emergency Tracheal intubation: complications associated with repeated laryngoscopic attempts. Anesth Analg. 2004; 99:607-613.

[21]. Anuradha Borle, Preet Mohinder Singh. Finding the way into the burnt airway! J Anaesthesiol Clin Pharmacol. 2015; 31(2): 242–243.

[22]. Luckhaupt H, Brusis T. [History of intubation]. Laryngol Rhinol Otol (Stuttg) 1986 65: 506-10. German.

[23]. Robinson DH, Toledo AH. Historical development of modern anesthesia. J Invest Surg 2012; 25: 141-9.

[24]. Magill IW. Blind nasal intubation. Anaesthesia 1975; 30:476–9.

[25]. Dong Ho Park, Chia An Lee, Chang Young Jeong, and Hong-Seuk Yang. Nasotracheal intubation for airway management during anesthesia. Anesth Pain Med 2021; 16:232-247

[26]. Depoix J. P., Malbezin S., Videciq M., Hazebroucq J., Barbier-Bohm G., Gauzit R., Desmonts J. M. Oral intubation v. nasal intubation in adult cardiac surgery. Br. J. Anaesth. 1987; 59: 167-169

[27]. Toon MH, Maybauer MO, Greenwood JE, Maybauer DM, Fraser JF. Management of acute smoke inhalation injury Crit Care Resusc 2010; 12: 267–7.

[28]. Mlcak RP, Suman OE, Herndon DN. Respiratory management of inhalation injury. Burns 2007; 33: 2–13.

[29]. Matthew B. Klein, MD, Avery B. Nathens, MD, PhD, MPH, Dominic Emerson, BS, David M. Heimbach, MD, Nicole S. Gibran, MD, An Analysis of the Long-Distance Transport of Burn Patients to a Regional Burn Center, Journal of Burn Care & Research. 2007; 28: 49–55

[30]. Derbyshire. Plasma concentration responses to tracheal intubation. Br. J. Anaesth. 1983; 55, 855–60.

[31]. Kovac, A. L. Controlling the hemodynamic response to laryngoscopy and endotracheal intubation. J. Clin. Anesth. 1996 8, 63–79.

[32]. Thompson JP, West KJ, Hill AJ. The cardiovascular responses to double lumen endobronchial intubation and the effect of esmolol. Anaesthesia. 1997;52(8):790–4.

[33]. Singh S. and Smith J. E. Cardiovascular changes after the three stages of nasotracheal intubation. British Journal of Anaesthesia 2003; 91 (5): 667-71

[34]. Heffner AC, Swords DS, Nussbaum ML, Kline JA, Jones AE. Predictors of the complication of postintubation hypotension during emergency airway management. Journal of critical care. 2012 Dec 1;27(6):587-93.

[35]. Sharma R, Singh S, Taank P. Comparison of lignocaine and fentanyl for attenuation of cardiovascular response during laryngoscopy and tracheal intubation in cardiac surgery patients. International Journal of Biomedical Research. 2018;9(10):342-5.

[36]. Honarmand A, Safavi M, Badiei S, Daftari-Fard N. Different doses of intravenous Magnesium sulfate on cardiovascular changes following the laryngoscopy and tracheal intubation: A double-blind randomized controlled trial. Journal of Research in Pharmacy Practice. 2015;4(2):79.

[37]. Pernerstorfer T, Krafft P, Fitzgerald R, Krenn C, Chiari A, Wagner O, et al. Stress response to tracheal intubation: direct laryngoscopy compared with blind oral intubation. Anaesthesia. 1995;50(1):17-22.

[38]. Hartigan ML, Cleary JL, Gross JB, Schaffer DW. A comparison of pretreatment regimens for minimizing the haemodynamic response to blind nasotracheal intubation. Canadian Anaesthetists' Society Journal. 1984;31(5):497-502.

[39]. Prys-Roberts C, Greene L, Meloche R, Foex P. Studies of anaesthesia in relation to hypertension II: haemodynamic consequences of induction and endotracheal intubation. British Journal of Anaesthesia. 1971;43(6):531-47.

[40]. Ovassapian A, Yelich SJ, Dykes MH, Brunner EE. Blood pressure and heart rate changes during awake fiberoptic nasotracheal intubation. Anesthesia & Analgesia. 1983;62(10):951-4.

[41]. Fletcher R, Olsson K, Helbo-Hansen S, Nihlson C, Hederstrom P. Oral or nasal intubation after cardiac surgery? A comparison of effects on heart rate, blood pressure and sedation requirements. Anaesthesia. 1984;39(4):376-8.

[42]. Cabrini L., Pallanch O., Pieri M., Zangrillo A. Preoxygenation for tracheal intubation in critically ill patients: one technique does not fit all. J Thorac Dis 2019;11: 1299-1303.

[43]. Simpson GD, Ross MJ, McKeown DW, Ray DC. Tracheal intubation in the critically ill: a multi-centre national study of practice and complications. Br J Anaesth 2012; 108:792–799.

[44]. Mort TC. The incidence and risk factors for cardiac arrest during emergency tracheal intubation: a justification for incorporating the ASA Guidelines in the remote location. J Clin Anesth 2004; 16:508–516.

[45]. De Jong A, Rolle A, Molinari N, Paugam-Burtz C, Constantin J-M, Lefrant J-Y, et al. Cardiac arrest and mortality related to intubation procedure in critically ill adult patients: a multicenter cohort study. Crit Care Med 2018; 46:532–539.

[46]. McKown AC, Casey JD, Russell DW, Joffe AM, Janz DR, Rice TW, Semler MW. Risk factors for and prediction of hypoxemia during tracheal intubation of critically ill adults. Annals of the American Thoracic Society. 2018 Nov;15(11):1320-7.

[47]. Guitton C, Ehrmann S, Volteau C, et al. Nasal high-flow preoxygenation for endotracheal intubation in the critically ill patient: a randomized clinical trial. Intensive Care Med 2019; 45:447-58.

[48]. Sharma R, Singh S, Taank P. Comparison of lignocaine and fentanyl for attenuation of cardiovascular response during laryngoscopy and tracheal intubation in cardiac surgery patients. International Journal of Biomedical Research. 2018;9(10):342-5.

[49]. Chen C, Wen D, Wang Y, Li H, Yu Q, Li M. A spray-as-you-go airway topical anesthesia attenuates cardiovascular responses for double-lumen tube tracheal intubation. BMC anesthesiology. 2022 Dec;22(1):1-9.

[50]. Arslan Zİ, Türkyılmaz N. Which nostril should be used for nasotracheal intubation with Airtraq NT®: the right or left? A randomized clinical trial. Turk J Med Sci. 2019 Feb 11;49(1):116-122. doi: 10.3906/sag-1803-177. PMID: 30762320; PMCID: PMC7350855.