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Problems of endotracheal intubation in obese patient

Layth Masood Saleh, Kirkuk Health Authority, Maternity and Children Hospital, Email:leith71z@yahoo.com, ORCID: https://orcid.org/0009-0007-5930-6425, Kirkuk, Iraq.
Hazim Faisal Mohammed, Kirkuk Second Health Care Centre, Kirkuk Health Authority, Kirkuk, Iraq. Email: hhfma1999@gmail.com,
ORCID: https://orcid.org/0009-0009-7113-3170
Ammar Noori Afat, Muayad Khalaf Khuder, Marwan Nawzad Asi, Al-Qalam University College, Kirkuk, Iraq.

Correspondence author: Laith Masoud Salih, Kirkuk Health Authority, Maternity and Children Hospital, Email: leith71z@yahoo.com, ORCID: https://orcid.org/0009-0007-5930-6425, Kirkuk, Iraq.
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Abstract
Background: Performing intubation in obese patients is a challenging problem both in the intensive care unit (ICU) and patients with a high BMI face various complication.
Methods: A prospective multiplex cohort study in Kirkuk governorate was conducted in obese patients (body mass index greater than 30 kg m2). The primary endpoint was the occurrence of difficulty intubation. Secondary endpoints were risk factors for difficult intubation, use of difficult airway management techniques, and serious, life-threatening complications related to intubation (cardiac problems, hypoxaemia, and severe cardiovascular collapse).
Results: Out of 100 patients, 48 patients had problems and complications as a result of intubation. These complications varied from simple to serious. 7 patients experienced hypoxia, 22 patients experienced difficulty in intubation, 5 patients experienced cardiac arrhythmias, and 2 patients had a dental injury that was. This complication is related to the body mass index.
Conclusions: In severely obese patients, the incidence of difficult intubation in the intensive care unit was related to BMI. Researchers did not encounter deaths resulting from intubation, perhaps due to the development of medicine and new tools.
Keywords: Intubation, Endotracheal intubation, Obesity, Preoperative complication.

Introduction

Obesity is a common health problem affecting more than a third of the world's population [1]. The obesity is the predominant chronic diseases risk factors and is linked to many health problems [2]. Certain sub-specialties such as emergency medicine and anesthesiology face common procedural challenges in obese individuals, including intravenous (IV) cannulation and endotracheal intubations [3]. Difficult tracheal intubation is a common mechanism of respiratory-related adverse outcome in anaesthetic practice. The incidences of difficult intubation are varied from 0.2-8.5% [4,5,6].

Intubation is associated with life-threatening complications both in intensive care unit (ICU)[7,8,9] and in operating theatres (Ots) [10,11].Difficult intubation increases the

risk of such complications [12]. thereby leading to the development of prediction models for difficult intubation both in the ICU10 and in the OT [13]. Up to 4% of patients admitted to ICU had been admitted for the management of a primary airway problem, and 6.3% were predicted to have a difficult airway [14].Although controversial results regarding the association of obesity with endotracheal intubation [15], BMI is considered as associated with difficult intubation, both in the ICUand in the OT. Obesity remains a challenging problem in perioperative medicine and has been increasing both in patients admitted to ICU and to OT [11]. Major airway complications occurring in ICU and OTinvolved obese patients in 47% and 40%, respectively [16].

Difficult endotracheal intubation definition is not uniform as the condition is an outcome of many factors interaction that involve clinical settings, medical personnel's skills and patient's factors. Benumof defined difficult endotracheal intubation as Cormack Lehane (CL) grade III with several attempts [17]. Difficult endotracheal intubation is defined by the American Society of Anesthesiologist (ASA) in 1993 as*three attempts at endotracheal intubation when an average laryngoscope is used or when endotracheal intubation takes 10 min or more* [18]. In the year 2013, ASA redefined difficult intubation as tracheal intubation requiring multiple attempts, in the presence or absence of tracheal pathology [19].

In 1997, Adnet et al. introduced the Intubation Difficulty Scale (IDS) [20] as an objectives scale for the assessment of difficult intubation. Juvin assessed the performance of IDS to predict difficult intubation in France [21]. Subjected to definition, preoperative evaluation is important in the detection of patients at risk for difficult airway management by noting anatomical landmarks and clinical factors associated with a difficult airway. Appropriate plan, proper equipment and experience hands will reduce or eliminate the severity of adverse events [21].

Obesity is a complex, multifactorial, and largely preventable disease [22], affecting, along with overweight, over a third of the world's population today [23,24]. If secular trends continue, by 2030 an estimated 38% of the world's adult population will be overweight and another 20% will be obese [25]. In the USA, the mostdirection projections based on earlier secular trends point to over 85% of adults being overweight or obese by 2030 [26]. While growth trends in overall obesity in most developed countries seem to have leveled of morbid obesity in many of these countries continues to climb, including among children. In addition, obesity prevalence in developing countries continues to trend upwards toward US levels [26]. Obesity is defined as body weight excess in relation to height [27].Obesity is a risk factors for many chronic diseases.Childhood obesity results in the same conditions, with premature onset, or with greater likelihood in adulthood [28]. Thus, the economic and psychosocial costs of obesity alone, as well as when coupled with these comorbidities and sequelae, are striking.

The current most widely used criteria for classifying obesity is the body mass index (BMI; body weight in kilograms, divided by height in meters squared), which ranges from underweight or wasting (<18.5 kg/m2) to severe or morbid obesity (≥40 kg/m2). In both clinical and research settings, waist circumference, a measure of abdominal adiposity, has become an increasingly important and discriminating measure of overweight/obesity[27]. Abdominal adiposity is thought to be primarily visceral, metabolically active fat surrounding the organs, and is associated with metabolic dysregulation, predisposing individuals to cardiovascular disease and related conditions[29]. Thus, obesity is linked to a syndrome called metabolic syndrome [29,30], which a common global health problem.

Oxygenation decreases with increase in weight, mostly because oxygen consumption and work of breathing are increased in obese patients [31]. At rest, oxygen

consumption is 1.5 times higher in obese patients than in none obese patients [31]. Obese patients have an excess production of carbon dioxide (CO2), because of their increased oxygen consumption and increased work of breathing, especially when there is an associated obesity hypoventilation syndrome, including a decreased respiratory drive [32]. Previous studies indicated that subjects with BMI of more than 40 kg/m^{2}was with breath rate of 15-21 in obese subjects, while it was 10-12 in none obese individuals [33]. Diposition of adipose tissue in viscera and abdomen lead to increase in abdominal pressure. The capacity of the chest is reduced compared to none obese individuals, because the diaphragm is passively pushed cranially. Obese patients have decreased pulmonary and thoracic compliance, a reduction in forced residual capacity (FRC), and an increased work of breathing, compared to none obese patients [34]. The main change remains the decreased FRC, leading to more frequent atelectasis in obese than in noneobese patients after ventilation. In addition, obesity is a major risk factor for obstructive apnea syndrome.

Difficult intubation was defined as three or more laryngoscopic attempts to place the tracheal tube into the trachea, as lasting >10 min using conventional laryngoscopy, or both [35]. Severe life-threatening complications[7]were defined as severe hypoxaemia (decrease in SpO2 Level to <80% during attempts), severe cardiovascular collapse (systolic arterial pressure <65 mm Hg recorded at least one time, <90 mm Hg lasting 30 min despite 500–1000 ml of crystalloids/or colloids solutions loading and/or requiring introduction of vasoactive support), cardiac arrest, and death. Mild to moderate complications[36]were defined as oesophageal intubation, supraventricular, ventricular arrhythmia, or all (without a pulseless rhythm) requiring therapy, dental injury, aspiration, or dangerous agitation (Richmond agitation sedation scale score>3)[37]. Etiology of difficult intubation is the combination of multiple factors related to patients and the skill of the individual who perform the intubation. Thus, this study was conducted to illustrate the frequency of endotracheal intubation difficulty in sample of Iraqi population.

Aim of the study.

The main objective of the study was to compare the incidence of difficult intubation in ICU and OT in obese patients. The secondary aims were to assess risk factors of difficult intubation, to compare the use of difficult airway management techniques and severe life-threatening complications related to intubation in obese patients admitted to ICU and OT.

Patients and methods

The protocol was approved by the Al Qalam Ethical Committee and informed consent was taken from each individual before their participation in the study. A100 consecutive obese patients undergoing elective surgery in Kirkuk governorate hospitals in 2023 for a period of three months agreed to be included the study. Morbid obesity was defined as a body mass index (BMI) >40 kg/m2. Before surgery, a complete medical history was obtained. Significant comorbidities were recorded, including snoring or a diagnosis of obstructive sleep apnea (OSA). Height and weight were used to calculate BMI.On the day of the surgery, the anesthesiologist in charge of the case asked the patient to stretch his neck, open his mouth, stick out his tongue, and speak by voice. The resulting display was recorded (4). Neck circumference (cm) was measured at the level of the thyroid cartilage and mouth opening width (cm). Thyroid distance (cm) and sternal distance (cm) were measured with the neck extended. No problems with the range of motion of the head and neck and the condition of the teeth were noted. Before surgery, patients received oral metoclopramide and sodium citrate. In the operating room, patients were placed with pillows or towels under their shoulders, with their heads raised and their necks open. Patients inhaled 100% oxygen with a face mask for at least 3 minutes or until their oxyhemoglobin saturation reached 100%.

Locular pressure was applied, followed by rapid-sequential induction of anesthesia using an intravenous induction drug (thiopental or propofol) and succinylcholine to facilitate tracheal intubation. Initial intubation attempts were performed by the resident anesthesiologist under the supervision of one of the authors. The blade of the laryngoscope (MacIntosh No. 3 or 4; Miller No. 2) was selected by the laryngoscopy specialist. Generally, a stylized 8.0 mm diameter endotracheal tube was used for men and a tube with an internal diameter of 7.0 mm for women.

Tracheal intubation was rated as easy if the output of graded laryngoscopy times the number of intubation attempts was less than 3 and was rated as problematic when it was 3. In no case was a bougie used to aid intubation. The SPSS program was used to analyze the recorded data.

Result.

In this study, data were collected from 100 patients who underwent surgery. Patients who did not require tracheal intubation were excluded. 78 women and 22 men, aged 44 years (interquartile range, 36-51 years) were studied. Weight was 137 kg (interquartile range, 124–156 kg), and BMI was 34.2 kg/m2 (interquartile range, 25.9–42.6 kg/m2). Forty-four patients had a history suggestive or diagnosed of obstructive sleep apnea. Fifty six had no evidence of OSA. The mean neck circumference was 46.0 cm (interdunal range, 42.0–49.0 cm).

In 30, 37, 32 and 1 patients, Malampati scores were 1, 2, 3 and 4, respectively. During initial laryngoscopy, the view of the larynx was grade I in 75 patients, grade II in 16 patients, and grade III in 9 patients. No patient had a grade 4 presentation. In 92, 5, and 2 patients, the trachea was intubated on the first, second, and third attempts, respectively. Intubation failure with direct laryngoscopy occurred in one patient. In 97 patients the trachea was intubated by an anesthesiologist. 3 patients required intubation by an anesthesiologist. In 12 patients, intubation was a problem.

Table 1.: Patient Characteristics (Continuous Variables) Stratified by Problematic and Easy Intubation

Variable		Number =100	Mean
Gender	Female	78	
	Male	22	
Age	Minimum	36	44
	Maximum	51	
Weight	Minimum	124	137
	Maximum	156	
BMI	Minimum	25.9	34.5
	Maximum	42.6	
Neck circumference	Minimum	42	46
	Maximum	49	
Obstructive Sleep Apnea	Yes	44	
	No	56	

Table .2. Patient characteristics.

Variable	Score	Number	Percent
Malampati scores	I	30	30
	II	37	37
	III	32	32
	IV	1	1
View of the larynx	Grade I	75	75
	Grade II	16	16
	Grade III	9	9
Number of intubation attempts	First attempt	92	92
	Second attempt	5	5
	Third attempt	2	2
	Intubation failure	1	1

Of the 100 patients who were obese, 48 had some problems, 22 of them had difficulty in intubation, 7 suffered from hypoxia, and in 12 there were minor complications that were remedied immediately, and 2 patients suffered a dental injury and 5 patients suffered a arrhythmia.

Table .3. Complications of intubation in ICU according to difficult intubation in obese patients. Values are number (%).

	Number	BMI
There is no complication	52	25.9-30.2
Difficult intubation	22	32
Hypoxemia	7	36
Mild complication	12	39
Arrhythmia	5	42
Dental injury	2	31

Discussion

A difficult airway intubation has been defined as the clinical situation in which a conventionally trained anesthesiologist experiences problems with mask ventilation, with tracheal intubation, or with both [6]. The incidence of difficult laryngoscopy and tracheal intubation is unknown, but it may be as frequent as 7.5% in the normal surgical population [5,7]. The medical literature on this subject is confusing because poor laryngoscopic view does not always equate with difficult tracheal intubation. For example, seven of nine patients in our study with a Grade 3 laryngoscopy view had their trachea intubated on the first attempt. The tracheas of obese patients are believed to be more difficult to intubate than those of normal-weight patients [1–3]. In one study 9 (15%) of 68 morbidly obese patients were categorized preoperatively as difficult to intubate, and 4 underwent awake intubation because their preoperative evaluation predicted difficulty [8]. The criteria used to predict difficulty were not described.

Difficult intubation, defined as inadequate exposure of the glottis by direct laryngoscopy, was reported to increase with increasing BMI [2]. We found no association between increasing weight or BMI with problematic intubation. Only three patients qualified as having a difficult intubation with the criteria described by Karkouti et al. [9], that is, number of direct laryngoscopy attempts plus the grade of laryngoscopy view >4. In our study, this incidence was no more frequent than what might be expected in the normal surgical population [5].

There have been many attempts to develop a score to measure the complexity of endotracheal intubation. Most methods are quite complicated, involving numerous variables [10]. In this study a new category called ‘’problematic intubation’’ to describe patients in whom the potential for intubation difficulties was present, but in whom actual difficulty with establishing the airway may or may not have occurred. Other factors that have been associated with difficult laryngoscopy include short sternomental distance; short thyromental distance; large neck circumference; limited head, neck, and jaw movement; receding mandible; and prominent teeth [5,7]. Of these factors, only large neck circumference was associated with problematic intubation in our patient population. In this study, BMI was associated with several complications that were directly associated with high BMI.

Out of 100 patients, 52 had a BMI of 25.9 to 30.2 and no serious complications during intubation were observed, 22 patients with difficulty intubation had a BMI of 32, 7 patients with a BMI of 36 had hypoxia, and 5 patients had no cardiac arrhythmias had a BMI of 42, and 2 patients had a dental infection with BMI of 31. In 12 patients, there were some minor complications that were immediately resolved. In a previous study, Cook and colleagues [11] showed that life-threatening complications in obese patients were significantly over-represented in terms of major airway complications, compared to non-obese patients. In the current study, there were 48 patients who experienced complications from airway management in the intensive care unit. These complications were associated with obesity. These findings have been previously reported in non-obese patients in studies conducted separately in the ICU [7,12] and OT[11] and by Cook et al. [11] in the 4th National Audit Project of the Royal College of Physicians Anesthesia and community airway difficulty: a major complication of airway management in the UK (NAP4). Moreover, mild to moderate complications were more frequent. Cook et al.[11] reported that esophageal intubation and aspiration are important and often precursors to major complications. Difficult intubation and ICU preparation has been associated with severe, life-threatening complications. This study highlights the fact that the setting of patients with intubation complications is more likely to have a high BMI.

Conclusion

Obese patients admitted to the ICU are at risk of atelectasis, which is associated with pulmonary complications. NIV can be safely and efficiently used to prevent and/or treat acute respiratory failure, without delaying intubation if needed. HNFC enable continuously humidified and warmed oxygen to be delivered through nasal cannula, with an adjustable FiO2, with a flow reaching 60 l/min and providing a moderate level of PEEP. Because of the increased incidence of difficult mask ventilation and intubation in obese patients, a protocol of difficult airway management should be systematically applied to prevent the complications related to the intubation procedure (severe hypoxemia, arterial hypotension and cardiac arrest). Pre oxygenation should be optimized using positive pressure ventilation (CPAP or NIV) in a semi sitting position, eventually added to apneic oxygenation using HFNC in the more severely obese patients. After tracheal intubation, to avoid both baro volutrauma and atelecto biotrauma, association of low tidal volume, moderate to high PEEP and recruitment maneuvers (lung protective ventilation) should be applied. The height of the lung being correlated to the height of the patient, tidal volume should be set according to IBW and not actual body weight, between 6 and 8 ml/kg IBW. In patients with ARDS, prone position is a safe procedure which permits respiratory mechanic improvements and oxygenation. Obstructive apnea syndrome and obesity hypoventilation syndrome should be investigated to introduce appropriate treatment, including implementation of positive airway pressure at home.

Recommendations.

Large scale study conduction was warranted.

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