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Effects of Preoxygenation and Positioning of Obese Patients During Intubation

Brandon M. Vesel

EFFECTS OF PREOXYGENATION AND POSITIONING OF OBESE PATIENTS DURING INTUBATION

By

Brandon M. Vesel

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Abstract

Title: Effects of Pre-oxygenation and Positioning of Obese Patients During Intubation.

Background: Obesity is an epidemic that continues to rise around the world, in the United States millions of Americans are considered severely obese. According to Nagelhout & Plaus (2013), approximately 34% of adults in the United States are classified as obese. Worldwide there is an estimated 300 million people who are considered obese. Patients with a body mass index (BMI) of 30 or more are considered obese. By the year 2025 the World Health Organization (WHO) foresees the number of severely overweight people to double. WHO states that obesity is responsible for 400,000 deaths per year. In the United States, the individuals who are considered obese have a 10% to 50% increase chance of dying from all causes. Pre-oxygenating an obese patient in the head-up position for a minimum of three minutes will give the anesthesia provider an extended margin of safety, until the airway is accessed.

Purpose: The purpose of this independent project is to investigate the benefits of pre-oxygenation, in the head up position, providing a safer anesthetic to the obese patient.

Process: A comprehensive review of literature was completed utilizing the Harley E. French library at the University of North Dakota. PubMed and CINAHL were the two databases used to conduct a literature search regarding the question. For a more thorough search, the librarian was utilized and interlibrary loan was accessed.

Results: This exhaustive literature review states that pre-oxygenating an obese patient for three minutes, in a head up position, will give the anesthesia provider an extended amount of time before desaturation occurs.

Implications: When anesthesia providers pre-oxygenate their obese patients for three minutes in a head up position, this extends the amount of time, to safely secure the airway.

Keywords: Obesity, Anesthesia, pre-oxygenation, patient positioning, head-up, supine

Approximately 34% of adults in the United States are considered obese. Obesity is defined as a BMI greater than 30 (Nagelhout & Plaus, 2013). Pre-oxygenation consists of 100% oxygen being delivered to a patient through a tightly sealed face mask. Proper positioning of a patient can enhance the amount of oxygen absorbed by the lungs. An obese patient being pre-oxygenated for three minutes in the 25 degree head up position will give the anesthesia professional more time to intubate before the onset of critical hypoxia (Sirian & Wills, 2009).

Definitions

Obesity: An excess amount of adipose on the body that has an adverse effect on health.

BMI: Body Mass Index. It is a weight to height ratio that is calculated by a person's weight in pounds multiplied by 703 and divided by height in inches.

Obesity Scale: Scale used to classify body mass index. Consists of eight classifications:

Underweight: Less than 18.5

Normal weight: 18.5-24.9

Overweight: 25-29.9

Obesity 1: 30-34.9

Obesity 2: 35-39.9

Morbid obesity: 40-49.9

Super obese: 50-59.9

Super super obese: 60-69.9

Pre-oxygenation: The administration of 100% oxygen to a patient pre-operatively through a tight fitting mask. This extends the apneic period in which a practitioner has to intubate.

De-nitrogenation: The elimination of nitrogen from the lungs while inhaling oxygen.

Supine: Lying down position of the body with face positioned upward.

Reverse Trendelenburg: The position of the body where the head is elevated higher than the lower extremities.

Ramped position: When the patients external auditory meatus and sternal notch are in alignment perpendicularly. Achieved by putting blankets below the patient's upper body to elevate the neck and head.

Case Report

A 34 year old, 5'11", 125 kg female patient presents for an emergent laparoscopic cholecystectomy due to acute cholecystitis. She was determined to be a Class 2 on the obesity scale with a BMI of 38. She complained of pain in the upper right quadrant of her abdomen, nausea and vomiting and fever of 101 F for two days. The patient reported a medical history of GERD, asthma, hypertension, obstructive sleep apnea, anxiety and smoked 2 packs of cigarettes per day. The patient's past surgical history included appendectomy and right knee replacement. During her knee replacement surgery she reported severe nausea and vomiting during the post-operative period. It was noted that she had an allergy to sulfa. Although the patient seemed anxious in the pre-operative area; versed was not given due to the patient having severe obstructive sleep apnea and we did not want to suppress her respiratory drive due to a potential difficult airway. Airway exam revealed a Mallampati score of II, thyromental distance of less than three fingerbreadths and a small mouth opening of less than two fingerbreadths. The anesthetic plan was to perform a general anesthetic with a rapid sequence intubation (RSI) as the patients NPO status was uncertain and also due to her obesity. The patient was assisted onto the operating room table per OR staff. Non-invasive monitors such as ECG, blood pressure cuff and pulse oximetry were applied. Patient was pre-oxygenated for three minutes, with oxygen at 10L via face mask in the supine position. Induction medications, propofol 200 mg and

succinylcholine 200 mg were administered intravenously (IV). Cricoid pressure was applied per the anesthesiologist until confirmation of the endotracheal tube was validated with bilateral breath sounds. During direct laryngoscopy the patient's oxygen saturations rapidly declined from 97% to 86%. A laryngospasm was the first complication the anesthesia team expected, nevertheless this was ruled out when the patient was able to be mask ventilated. De-Saturation continued to 66% during laryngoscopy with a miller 2 without view of the cords. A glidescope was accessed and the patient was successfully intubated without further incident. The patient was manually ventilated until oxygen saturation was restored to 100%.

Analyzing this case, the patient exhibited difficult airway traits: BMI greater than 35, limited jaw protrusion, and a Mallampati class 3. Pre-oxygenating at a 25 degree head-up position would have maximized this patient's oxygen stores providing the anesthesia team more time to safely intubate, without a decrease in oxygen saturation.

Literature Search

PubMed was the first search engine used. It is the best choice for beginning exploratory searches because it has the largest biomedical database available and is one of the most comprehensive healthcare databases made up of millions of medical science articles (Mateo & Foreman, 2014). The advanced search builder was used with the words "pre-oxygenation" and "head up" and "supine" which revealed seven articles. Three of which were relevant to the research question. A second search was conducted with the keywords "patient positioning" and "intubation" and "obese". This resulted in twenty nine articles. Four articles were analyzed in detail and two were found to be appropriate in regards to this independent project.

The CINAHL search engine was the second search engine used. CINAHL is a comprehensive source for nursing and allied health journals (Mateo & Foreman, 2014).

CINAHL keywords were used to narrow the search. The keywords used first were "patient positioning" and "pre-oxygenation" and "intubate". This resulted in zero articles. This search was altered using "pre-oxygenation" and "head up" and "supine", which had three articles. Two of which were relevant to this topic. The search was changed using the headings "pre-oxygenation" and "obesity". This revealed five articles. Two of which were relevant. The Peer Reviewed and English limit were applied, which still produced five articles. Out of these five articles, four were thoroughly analyzed and three applied to this independent project.

When full text articles were not available in PubMed, the "Find it @ UND" button was utilized then the "Free Full Text at Minerva" button was used. For a more thorough search, the librarian was utilized and interlibrary loan was employed through the University of North Dakota. The literature search generated nine articles related to this independent project.

Review of Literature

There were several studies addressing the obese patient during induction and intubation. The studies in this independent project researched the effects of pre-oxygenation and positioning alone and then looked at them simultaneously in the obese population.

Obesity

Obesity is an overabundance of body fat that has a negative impact on health. The obese population presents many challenges to the anesthesia provider. Some physical challenges that anesthesia providers encounter are thicker neck, limited mouth opening and a diminished range of neck motion (Sirian & Wills, 2009). The physiological challenges include decreased functional residual capacity (FRC) or the amount of air in the lungs after passive expiration, increased metabolic rate and lower alveolar concentration of oxygen (Sirian & Wills, 2009). FRC plays an important role in oxygen reserve in which the greater the FRC, the greater amount

of time a patient can be apneic prior to becoming hypoxic (Sirian & Wills, 2009). The increased mass of an obese patient requires an increased metabolic demand. This requires increased oxygen consumption with carbon dioxide production secondary to fat metabolism (Nagelhout & Plaus, 2013). The alveolar oxygen concentration in the obese population is lower due to adipose retention of carbon dioxide. During apneic periods, the obese patient will consume their oxygen reserve much more quickly and become hypoxic due to their decreased chest wall compliance and diminished lung compliance causing an even greater reduction in functional residual capacity (FRC).

Pre-Oxygenation

Pre-oxygenation plays a vital role to help prevent hypoxia prior to induction of anesthesia by building up the oxygen reserve in the lungs. Pre-oxygenation involves delivering 100% oxygen through a tightly sealed mask which aids to replace nitrogen in the lungs with oxygen which is known as de-nitrogenation. This is a critical step to provide anesthesia practitioners with an increased amount of time to intubate prior to the patient becoming hypoxic.

When assessing pre-oxygenation of different weight groups, they can be separated into normal, obese, and morbidly obese. Pre-oxygenating each group for a specific amount of time while measuring the time to desaturation; it has shown that, obese patients have a substantially higher chance of becoming hypoxemic when apneic. Jense, Dubin, Silverstein and O'Leary-Escolas (1991), showed that three groups were pre-oxygenated for 5 minutes or de-nitrogenated to < 5%. Once they were induced with anesthetic agents and given paralytics they were allowed to remain apneic until they de-saturated to 90% oxygen saturation (Jense et al., 1991). It was found that the normal group de-saturated in 24 seconds (Jense et al., 1991). The obese group de-saturated in 21 seconds and the morbidly obese group de-saturated in 15 seconds (Jense et al.,

1991). In general, obese patients have a lower functional residual capacity with a diminished oxygen reserve during episodes of apnea. Allowing adequate time for pre-oxygenation in a head-up position will provide the additional time needed to safely access the airway.

Pre-oxygenation using continuous positive airway pressure (CPAP) at 5 cm H2O, with pressure support ventilation (PSV) at 5 cm H2O, has been studied to determine if it improves oxygenation pre-induction. Forty four patients were split into two groups of twenty-two. Both groups were pre-oxygenated with 80% oxygen for two minutes. The first group had CPAP 5 cm H20 and PSV 5 cm H2O applied. The second group of twenty-two patients performed normal breathing without any assistance. The post-intubation PaO2 was increased in the CPAP/PSV group at 32.2, as opposed to the normal breathing group whose PaO2 was 23.8. This concluded that using CPAP 5 cm H2O and PSV 5 cm H2O together provided superior oxygenation and interrupted desaturation episodes as compared with normal breathing. Proper pre-oxygenation with a CPAP device and PSV built up the oxygen stores in the lungs, giving the provider a safer window to manage the airway (Harbut, Gozdzik, Stjernfalt, Marsk and Hesselvik, 2014).
De Jong et al., (2014) found that maximizing pre-oxygenation and positioning of the obese patient allows enhanced intubation security. Positioning the bed in reverse Trendelenburg would allow more oxygen to be taken up into the lungs before induction (De Jong et al., 2014).

Recently three hundred morbidly obese patients who were having bariatric laparoscopic surgery were examined in the perioperative anesthetic management of cases. Eighty percent of these patients were women with a BMI over 46. It was concluded that pre-oxygenating the patient, before an RSI, while using a McCoy laryngoscope provided an intubation success rate of 98.6%. Navarro, Pindado, Pax, Caro, Mariscal and Ruiz (2011) found that the McCoy laryngoscope offers an improved view of the cords in the presence of a difficult intubation. Pre-

oxygenating and then using a McCoy laryngoscope gives the anesthesia provider extra time to secure the airway before the patient becomes hypoxic (Navarro et al., 2011).

Research by Langeron, Birenbaum, Le Sache, and Raux (2014) shows that pre-oxygenation in the 25 degree head up position should be a requirement, because it helps in obtaining greater gas exchange than in the supine position. This was especially true if they exhibit traits that could lead to a difficult mask ventilation. These traits being, BMI greater than 35, age greater than 55 years, limited jaw protrusion, lack of teeth, beard, and Mallampati class 3 or 4 (Langeron et al., 2014).

Studies have shown that pre-oxygenation should be mandatory in morbidly obese patients to counteract atelectasis development. There is also a debate about how to decide when to use a certain intubation technique such as RSI, standard induction with hypnotics or awake intubation and to not base your decision on their morbid obesity. Kristensen (2010) discovered that this should only be decided after a thorough airway evaluation and assessment of co-morbidities. Pre-oxygenating an obese patient is critical, prior to induction. This will allow an anesthesia provider the added time to secure a potentially difficult airway (Kristensen, 2010).

Sirian & Wills (2009) discovered that pre-oxygenation can impede the onset of critical hypoxia by optimizing pre-oxygenation. This can be done by just applying 100% oxygen over an open airway an allowing oxygen to passively flow into the lungs. The benefits of pre-oxygenation continue to happen even when the face mask is placed over the patient's mouth without delivering any breaths and building up functional residual capacity (Sirian et al., 2009).

There is increased importance in pre-oxygenating and the different pre-oxygenating techniques used in practice. Tanoubi, Pierre and Francois (2009) found that pre-oxygenation enhances oxygen stores and duration of apnea without desaturation (DAWD). There are three

different techniques. The first technique is the 3 minute tidal volume breathing (TVB) technique. The second technique is four deep breaths in 30 seconds. The third technique is eight deep breaths in 60 seconds. It was found that the TVB technique and eight deep breaths in 60 seconds techniques, are recommended for anyone going under general anesthesia. The most useful indicators of the completeness of pre-oxygenation are end-tidal nitrogen fraction (FEN2) and end-tidal oxygen fraction (FEO2). Having an FEO2 greater than 90% is the most accurate end point to pre-oxygenation (Tanoubi et al., 2009).

Can nasopharnyngeal oxygen supplementation, following pre-oxygenation, in the obese population give the anesthesia practitioner additional time for intubation? Baraka, Taha, Siddik-Sayyid, Knazi El-Khatib, Chehade, Abdallah and Hajj (2007) studied thirty-four patients with an average BMI of 41.8 who were split into two groups. The first group receiving pre-oxygenation alone, and the second group receiving nasopharyngeal oxygen supplementation following pre-oxygenation. The time was measured from the beginning of apnea to where the oxygen saturation fell to 95% with a cut-off time of 4 minutes. The first group fell from 100% oxygen saturation to 95% in 27 seconds. The second group had 16 out of 17 patients maintain their oxygen saturation at 100% for 4 minutes. They concluded that nasopharyngeal oxygen insufflation following pre-oxygenation in morbidly obese patients slows oxygen desaturation during apnea. More studies will have to be done to determine the best way to pre-oxygenate an obese patient (Baraka et al., 2007).

Positioning

In addition to pre-oxygenation, patient positioning has a tremendous impact on denitrogenation. Dixon et al., (2005) discovered when the obese patient is in a head up position they have less weight compressing their lungs, improving the FRC and allowing a greater time to

intubate before a hypoxic event. Currently, there are no guidelines regarding obese patient positioning during pre-oxygenation. This makes due diligence in positioning even more important. Positioning plays a key role in prolonging times to safely manage the airway before desaturation occurred. Management can be achieved in one of three ways. The first, by putting the patient in a "ramped" position by placing blankets under their upper body. The second, is adjusting the bed to a 25 or 30 degree reverse Trendelenburg position. The third, is placing the patient in a head up or near-sitting position. All of these positions allowed for better laryngoscopic views, prolonging times to safely manage the airway before desaturation occurs. Also using non-invasive positive pressure ventilation (NIPPV) for pre-oxygenation extended the time before desaturation were to occur. Harbut, Gozdzik, Stjernfalt, Marsk, and Hesselvik (2014) recommended placing the patient in a reverse trendelenburg position with the application of manual CPAP at 10 cm H20. This position also reduced the risk of reflux and aspiration by reducing the intra-abdominal pressure, displacing the adipose tissue downward. Roman (2011) found that pre-oxygenating in a head-up position proves beneficial by allowing adipose tissue to drop down from the lungs, allowing FRC to build up.

Differences have been noted between pre-oxygenation in the 25 degree head-up position vs. the supine position and allowing the practitioner more time to intubate before the patient becomes hypoxic. This article answered the key points to this independent project. In a randomized control trial it was shown that the 25 degree head up group had higher oxygen tensions before induction and a prolonged time, approximately 49 seconds before obtaining an oxygen saturation of 92%. It was found that the 25 degree head-up position gave the practitioner more time to manage the airway vs. supine (Dixon, Dixon, Carden, Burn, Schachter, Playfair, Laurie and O'Brien, 2005).

In 2013 a study showed that pre-oxygenating obese patients in a head-up or reverse Trendelenburg position with continuous positive airway pressure (CPAP) allowed optimization of oxygen stores in the lungs. Murphy & Wong (2013) found that due to the accelerated decline in oxygen saturation of the obese patient, allowing adequate time for pre-oxygenation in the head-up position will improve oxygenation and extend the time before de-saturation. Currently, the use of CPAP machines before induction of anesthesia is not the standard in most facilities. Most obese people are prescribed and advised to use CPAP machines. Application of a CPAP machine in pre-op should be explored. More studies need to be done on the benefits it could potentially provide to obese patients (Murphy & Wong, 2013).

Another controlled trial without randomization took patients with a specified BMI of greater than 40 and measured the time until desaturation. The findings showed that when positioned in the 25 degree head up position it took 8 minutes of pre-oxygenation to an end tidal oxygen of greater than 90. They took 43 patients with a specified BMI of >40 and measuring the time to >90% end tidal O2. They were positioned in the 25 degree head up position and asked to breathe 8 L/min via tight face mask. Looking at the results of this study they recommend 8 minutes of pre-oxygenation to achieve an end tidal oxygen of >90 on morbidly obese patients. Pre-oxygenating in the head up position is optimal because longer pre-oxygenation equals better outcomes (Gaszynski, 2010).

Pre-oxygenation and Positioning

When both pre-oxygenation and positioning are used at the same time this has synergistic effects to the obese patient's oxygenation. There are several studies that assess the importance of using both of these with obese patients.

Patients with a BMI of > 40 who were pre-oxygenated for 3 minutes in the 25 degree head-up position vs. the supine position and it was noted whether this would allow the practitioner more time to intubate before the patient becomes hypoxic. Blood gases were taken before and after pre-oxygenation and 90 seconds after induction. The patients were allowed to de-saturate to 92% while their oxygen tensions and time to de-saturation were marked down. This increased the pre-induction oxygen tensions to 442 with the head up position as compared to 360 with supine position. The time before desaturation to 92% for the head up position was 201 seconds compared to 86 seconds in the supine position (Dixon et al., 2005).

In one of the most confined of all the studies stating the 25 degree table-ramp approach to patient positioning was equal to the 25 degree blanket approach, in measuring the amount of time to intubate. This article specifically looked at positioning of patients with a BMI > 30. It showed obese patients positioned in the table ramp group took 71 seconds to intubate while patients in the blanket group took 66 seconds to intubate (Rao, Kunselman, Schuler and DesHarnais, 2008).

There is a correlation of pre-oxygenation and body positioning in the sitting vs supine position of obese patients. The time to desaturation of 90% was considerably longer in the sitting group compared to the supine group. This showing that positioning plays a key role in helping oxygen absorption in the lungs (Altermatt, Munoz, Delfino and Cortinez, 2005).

Another option is pre-oxygenating with 100% oxygen and non-invasive positive pressure ventilation with PEEP, while in the reverse trendelenberg position. Pre-oxygenation and positioning seem to enhance safety gained through this technique

Overall providing maximum pre-oxygenation in the head-up or "ramped" position, along with having an array of other airway management instruments like video laryngoscopes

significantly improves the visualization of the larynx and provides the greatest chance of success with intubation. Pre-oxygenating in a head up position allows for better uptake of oxygen into the lungs. This is improved by having the proper equipment like a Glidescope giving all providers a view of the airway (Aceto et al., 2013).

Positioning and pre-oxygenating an obese patient, will provide added time to secure the airway. Another beneficial position is the 25 degree reverse Trendelenburg position which achieved a 23% improvement in mean arterial oxygen tension. Different pre-oxygenating techniques, along with their benefits were discussed. When CPAP at 7.5 cm H2O, was applied to obese women an additional 37 seconds of time to de-saturate to 90% was seen. In a study CPAP at 10 cm H2O for five minutes with oxygen was sufficient in enhancing oxygenation and diminishing atelectasis when observed on the CT scan. Pre-oxygenating in the head-up position is starting to be seen on CT scan (Ali, 2009).

In the most confined of all the studies, the 25 degree table-ramp approach to patient positioning was equal to the 25 degree blanket approach, in measuring the amount of time to intubate. When looking at obese patients with a BMI of > 30 kg/m (2), 85 adults that were scheduled for elective surgeries. All of the patients were positioned by the same anesthesia practitioner, but intubated by anesthesia providers of different skill level. Rao, Kunselman, Schuler and DesHarnais (2008) found that to accomplish a head-elevated position the patient's external auditory meatus and sternal notch had to be in the same horizontal plane. It was a randomized control trial which made its evidence more meaningful. Using the table ramp position can provide added safety to the patient. Maximizing visualization of the vocal cords by lining up the oral, pharyngeal and laryngeal axes, enhances intubation success. Proper

positioning not only plays a key role in visualization of the vocal cords, but also maximizes oxygen delivery (Rao et al., 2008).

Research by Altermatt, Munoz, Delfino and Cortinez (2005) looked at assessing the correlation of pre-oxygenation and body positioning in the sitting vs supine position of obese patients, forty patients with a BMI of 35 or higher who were having surgery were divided into two groups of 20. One group was the sitting group and the other was the supine group. They were pre-oxygenated with 8 deep breaths in one minute, with an oxygen flow of 10 liters. An RSI was performed and after intubation the breathing circuit was disconnected until the oxygen saturation dropped to 90%. The time to desaturation of 90% was considerably longer in the sitting group 3 minutes and 34 seconds, compared to the supine group of 2 minutes and 42 seconds. This study shows that the anesthesia team delivering four vital capacity breaths in under thirty seconds in the twenty five degree head up position, could have provided more time to intubate before a decline in oxygen saturation.

Fat distribution and body composition can play a role in the reduction of lung volumes. Both abdominal fat, measured by waist circumference, waist-to-hip ratio, abdominal height, thoracic and upper body fat, subscapular skin fold thickness, and bicep skin fold thickness are all associated with reductions in lung volumes (Salome, King, and Berend, 2011). The two main lung volumes affected are the functional residual capacity (FRC) and the expiratory reserve volume (ERV). This reduction reflects a shift in the balance of inflationary and deflationary pressures of the lung due to the accumulation of adipose tissue around the rib cage, abdomen and in the visceral cavity (Salome et al., 2011). By positioning these patients in a 25 degree head up or reverse trendelenburg position allows this adipose to displace downward. This in turn allows the oxygen stores in the lungs to build up. By keying in on the minute details an anesthesia

provider can greatly enhance the safety, of the anesthetic plan for the obese patient (Salome, King and Berend, 2010).

Pre-oxygenating obese patients in the 25 degree head up position, shifts all the adipose downward, allowing the lungs to absorb more oxygen, delaying desaturation. This is done by placing towels, bed blankets or adjusting the bed to obtain into this position. Practice recommendations suggest two options for pre-oxygenation. One is four vital capacity breaths in under 30 seconds. The other is three minutes of 100% pre-oxygenation. During this case, the anesthesia team chose to pre-oxygenate her at 100% for three minutes which seemed like the best option at the time. In retrospect four vital capacity breaths in under 30 seconds and this could have provided more time before desaturation occurred.

Discussion

The purpose of this independent project is to prove that pre-oxygenation for three minutes in a 25 degree head up position extends the amount of time for the anesthesia practitioner to safely secure the airway, before hypoxia occurs. With proper pre-oxygenation, enhanced by the head up position, this provides a safer anesthetic to the patient.

The outcome of these studies imply that the obese patient should be pre-oxygenated for a minimum of three minutes in a head up position, prolonging the time the anesthesia practitioner has before hypoxia ensues. Currently there are no guidelines on how to properly pre-oxygenate an obese patient, to provide the safest delivery of anesthesia.

Preoxygenation

The research provides solid evidence that the longer an anesthesia practitioner can pre-oxygenate an obese patient the more FRC is built up and the more de-nitrogenation occurs. The best choice for pre-oxygenation is a tight fitting mask with 100% oxygen. Using this technique

builds up the end tidal oxygen and increases the oxygen content of FRC. The obese patient has a low FRC, this influx of oxygen into their lungs improves their oxygen stores, allowing more time before desaturation.

The second best technique is using low pressure CPAP with low pressure PSV. Not all operating rooms are equipped with CPAP machines. With the pressure of quick room turnovers, driven by the hospitals budget, the amount of time to set up a CPAP machine pre-operatively could prove costly.

There are elevated risks, for not pre-oxygenating an obese patient. This population of patients has a diminished FRC reserve in their lungs. This FRC without pre-oxygenation has mostly nitrogen contained in it. This carries a higher risk of airway closure and expiratory flow restriction. Oxygen desaturation happens quickly, which does not allow the anesthesia provider enough time to secure the airway before hypoxia sets in. This can prove disastrous in an unanticipated difficult airway.

Positioning

The literature states that positioning an obese patient in a head-up position where the adipose tissue is displaced downward from the lungs, increases oxygen uptake. The best way to position a patient is in the 25 to 30 degree reverse trendelenburg position. This position shifts the adipose tissue downward while lowering the intra-abdominal pressure, decreasing the risk of reflux and possible aspiration.

The second best position, according to the literature was "ramping" the patient up with blankets or wedge positioner. This also provides the downward displacement of adipose tissue, while improving the view to the cords for the anesthesia provider.

There are increased risks associated with the supine position. When an obese patient is supine all of their adipose tissue is compressing their chest diminishing chest wall and lung compliance, causing airway closure and subsequent hypoxia. This population's body mass puts them at a greater risk of acid reflux and ensuing aspiration. This is because most obese patients have a gastric content of greater than 0.25ml/kg and a ph of less than 2.5 which is known as Mendelson's syndrome. Slowed gastric empting occurs frequently in this population due to the enlarged abdominal mass.

Preoxygenation and Positioning

The recommendation for the best practice regarding the obese patient is to pre-oxygenate for three minutes via face mask that is applied to the face, with no leaks, in the head up position achieved by placing the bed in a 25-30 degree reverse trendelenburg position. This would provide optimal safety to the patient.

Practice Recommendations

Research is consistent stating that pre-oxygenating an obese patient in the head up position was most beneficial.

First, it is recommended that anesthesia care providers pre-oxygenate patients, with a BMI over 30, in the 25 degree head raised position. All of the studies (Dixon et al., 2005; Gaszynski, 2010; Altermatt et al., 2005; Jense et al., 1991; Rao et al., 2008) showed a safer anesthetic course for the patients implementing this intervention, allowing more time to intubate. The implications to employing this practice recommendation have to take into account a couple of factors.

1) Pre-oxygenation in a head up position can have a synergistic effect on safety for the patient allowing the anesthetist more time to safely administer anesthesia and decrease mortality.
2) The risks to patients is low due to the fact that their head has to be raised 25 degrees. This can be achieved by adjusting the bed or placing blankets underneath their shoulders, which will not cost the organization extra funds to implement.
3) Educating anesthesia practitioners through evidence based meetings would be optimal. These meetings would be short, taking into consideration time constraints of the anesthesia department.

The second practice recommendation is for anesthetists to participate in anesthesia research. Additional meta-analysis research should be done to obtain more advanced quality of evidence as it relates to this area. Larger sample sizes with more diversity would help substantiate the evidence in the studies (Dixon et al., 2005; Gaszynski, 2010; Altermatt et al., 2005; Jense et al., 1991; Rao et al., 2008) discussed in this paper. It could cost the organization some money to implement high quality research. Educating anesthetists how to properly research this topic would take a year to complete, but is definitely feasible. There is substantial evidence supporting the technique of pre-oxygenating an obese patient for three minutes in a head-up position, extending the amount of time an anesthesia professional can secure the airway, before hypoxia occurs, providing favorable patient outcomes.

Conclusion

The implications to implementing this practice recommendation would be accessing an appropriate funding source, time obligations for an extended study and experienced researchers. This recommendation is obtainable as all practitioners want to reach their fullest potential when it comes to safety of the patient, and these recommendations would enhance current practice.

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Pre-oxygenation and Positioning of Obese Patients

Brandon Vesel, SRNA

UND NURSE ANESTHESIA
UNIVERSITY OF NORTH DAKOTA

Introduction

- Obesity is an epidemic that continues to rise around the world.
- 300 million people worldwide are considered obese. The World Health Organization (WHO) predicts by the year 2025 the number of severely overweight people to double.
- Patient safety can be enhanced when anesthesia providers develop anesthesia care plans that take into account the specific needs of patients with obesity.

Introduction Cont'd

Obesity and Risk Factors in Anesthesia

- Patients with a body mass index (BMI) of 30 or more are considered obese.
- Risk Factors during Intubation
  - Thicker neck
  - Diminished Functional Reserve Capacity
  - Sleep Apnea – Airway obstruction
  - Limited mouth opening
  - Diminished range of neck motion
  - Increased metabolic rate
  - Lower alveolar concentration of oxygen

Introduction Cont'd

Pre-oxygenation and Positioning of Obese Patients

- An obese patient being pre-oxygenated for three minutes in the 25 degree head up positon will give the anesthesia professional more time to intubate before the onset of critical hypoxia, providing a safer anesthetic to the obese patient.

Case Information

- Emergent Laparoscopic Cholecystectomy
- 34 year old
- 125 kg
- BMI 38
- Female
- Mallampati III airway
- ASA 2
- Pre-op VS:
  - HR 96, BP 154/66, Oxygen saturation 97%
- Past Medical history
  - GERD
  - Asthma
  - HTN
  - Obstructive Sleep Apnea
  - Current smoker
  - Obesity
- Surgical history
  - Appendectomy
  - Right Knee Replacement (Patient reported severe nausea and vomiting post-op)

Anesthetic Management

- **Preoperative:**
  - Midazolam not administered, due to severe obstructive sleep apnea
- **Intraoperative:**
  - Standard monitors applied
  - Vital signs obtained: BP 150/62, HR 92, 96%
  - Induction: Propofol 200 mg, Succinylcholine 200 mg
  - RSI, due to NPO status uncertain, obese and history of GERD
  - Intubated with 7.0 ETT after 3 attempts
    - Placement confirmed with bilateral breath sounds and positive ETCO2

Anesthetic Management

- **Intraoperative Cont'd:**
  - Ventilator - volume mode
    - TV 600, rate 14, 50% FiO2
  - End tidal Sevoflurane maintained at 1.6% - 2.2%
  - End tidal CO2, 30-35 during maintenance phase
  - BIS 39-43
  - Antiemetic's given
    - Zofran 4 mg IV
    - Decadron 10 mg IV
  - MAP kept above 65mmHg throughout case

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Anesthetic Management

Intraoperative Issues:

- During direct laryngoscopy with a MAC 3 blade, oxygen saturation rapidly dropped from 97% to 86% within the first 5 seconds.
- The second DL attempt with a Miller 2 blade did not provide a view of the cords, with oxygen saturation dropping to 66%.
- The third DL attempt with Glidescope provided successful intubation, with patient manually ventilated to 100%.

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Anesthetic Management

- **Emergence:**
  - Glycopyrrolate 1 mg IV and Neostigmine 5 mg IV given for paralytic reversal
  - Ventilator SIMV mode when RR dropped
  - Throat suctioned
  - Sevoflurane discontinued
  - Patient breathing on her own and following commands
  - Patient extubated without incident

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PACU

- **Postoperative:**
  - Patient was transported to PACU on 2L nasal cannula

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Discussion

- The review of literature looked at answering this question:
  - Does pre-oxygenating a patient, for three minutes in a 25 degree head up position extend the amount of time for the anesthesia practitioner to safely secure the airway, before hypoxia occurs.

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Discussion

Pre-oxygenation

- Delivering 100% oxygen through a tightly sealed mask, replaces nitrogen in the lungs with oxygen. This is called de-nitrogenation.
- This build up of oxygen in the lungs provides an increased amount of time to intubate before the patient becomes hypoxic.
- Recommended Techniques for Pre-oxygenation:
  - Three minute Tidal volume Breathing (TVB)
  - Eight deep breaths in 60 seconds

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Discussion

Pre-oxygenation Cont'd

- Indicator of the completeness of pre-oxygenation
  - End tidal oxygen fraction (FEO2)
    - Having an FEO2 greater than 90% is the most accurate end point of preoxygenation (Tanoubi et al., 2009)
- The research showed that by applying 100% oxygen over an open airway and allowing it to passively flow into the lungs built up FRC (Sirian and Wills, 2009).
  - Important for obese patients with GERD who need an RSI.
  - Decreased build up of air in the stomach

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Discussion

Pre-oxygenation Cont'd

- Pre-oxygenation becomes more important if patient exhibits traits that could lead to a difficult mask ventilation
  - BMI greater than 35
  - Age greater than 55 years
  - Limited jaw protrusion
  - Lack of teeth
  - Beard
  - Mallampati class 3 or 4

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Discussion

Positioning

- Plays a key role in prolonging time to safely manage the airway before desaturation occurs.
- The studies show that an obese patient in a head up position has less weight compressing their lungs, improving Functional Residual Capacity (FRC) (Dixon et al., 2005)

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Discussion

Positioning Cont'd

- Types of Positions
  - Ramped
    - Placing blankets under the upper body
  - 25 degree reverse Trendelenburg
    - Adjusting the entire bed where the upper body is higher then the lower body
  - Near-sitting
    - Moving the bed to a beach chair position

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Discussion

Positioning Cont'd

- Positioning the patient allowing downward displacement of the adipose tissue will
  - Reduced intra-abdominal pressure
  - Reduced risk of reflux
  - Reduced risk of aspiration
  - Increase FRC build up

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Discussion

Pre-oxygenation and Positioning

- Pre-oxygenation and positioning used together on an obese patient, have the greatest impact on extending the amount of time for an anesthesia provider to safely secure the airway before hypoxia occurs.

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Discussion

Pre-oxygenation and Positioning Cont'd

- Dixon et al. (2005) determined that patients with BMI's >40 who were pre-oxygenated in the 25 degree head up position for three minutes had:
  - Pre-induction oxygen tension of 442 compared to 360 in the supine position.
  - Time to desaturation of 92%
    - Head up position 201 seconds
    - Supine position 86 seconds

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Discussion

Pre-oxygenation and Positioning Cont'd

- Altermatt (2005) looked at the correlation of pre-oxygenation and body positioning in the sitting vs supine position of 40 patients with BMI's > 35.
  - Divided into two groups of 20
    - Pre-oxygenated with 8 deep breaths in one minute
    - Oxygen flow rate 10 liters
    - RSI performed
    - Breathing circuit disconnected
      - Time measured for oxygen saturation allowed to drop to 90%
  - Sitting group
    - Time to desaturation of 90% was 214 seconds
  - Supine group
    - Time to desaturation of 90% 162 seconds

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Conclusion

- Analyzing this case, the patient exhibited difficult airway traits:
  - Limited jaw protrusion
  - Mallampati class 3
  - Short neck
- Pre-oxygenating at a 25 degree head-up position would have maximized this patient's oxygen stores providing the anesthesia team more time to safely intubate, without a decrease in oxygen saturation.

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Conclusion Cont'd

- It is recommended that anesthesia care providers pre-oxygenate patients, with a BMI over 30, for three minutes in a 25 degree head raised position.
- This will allow more time to intubate before the onset of critical hypoxia, greatly enhancing the safety of the anesthetic for the obese patient.

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Thank You
Are There Any Questions?

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