Review Article

Anaesthetic Considerations in an Obese Patient with Obstructive Sleep Apnoea

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Abstract

Obstructive sleep apnoea (OSA) is a sleep disorder which is increasing in prevalence in India[1]. Obesity is the most common cause for OSA. Obesity is associated with a host of other comorbid illness due to the associated pathophysiologic abnormalities. The main victims of OSA and obesity are body metabolism, cardiovascular system (CVS), respiratory system (RS) and airway anatomy. Involvement of CVS and RS along with host of metabolic derangements and airway changes, and logistic of dealing with big patient makes anaesthetic management of morbidly obese patients different and difficult from non obese patients. As the association of OSA with obesity is common, it is difficult to dissociate the peri operative management of OSA and Morbidly obese (MO).

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Obesity and OSA

Definition and classification:

The imbalance in the calorie intake and expense leads to increase in fat deposits. This excess fat deposit leads to obvious increase in the total body weight which is measured to diagnose and quantify obesity. The direct measurement of body fat deposition can be done by imaging studies like CT scan.[2,3] But they are expensive and not useful for routine clinical or epidemiological measurement of obesity. Body Mass Index (BMI) is simple and robust measure used to define and classify obesity (Table 1).[4] (BMI is Weight /Height in kg /m2). The distribution of the excess fat is either truncal (android or central) or peripheral which is not identified by BMI measurement.[5] Waist – Hip ratio or waist circumference is a better predictor of this abnormality which is used for measuring central obesity. The central or abdominal fat is associated with many of pathological changes and illness associated with obesity.[6,7]

Obstructive Sleep Apnoea is a sleep disorder associated with frequent dynamic obstruction of airflow into lung due to partial or complete obstruction of upper airway. The salient feature that differentiates OSA from central cause of apnoea is the continued presence of respiratory effort against the obstructed airway. Deposition of fat in the upper airway along with nocturnal loss of pharyngeal dilator muscle tone makes obesity a leading cause of OSA.[8] The etiology, mechanism and patho physiologic changes associated with OSA has been described elsewhere in this issue. The medical management of OSA including role of nasal CPAP has been dealt separately. Hence subsequent part of this article deal with the anesthesia management of these patients when they present for surgeries.

Table 1: Obesity classification

BMI (kg /m^2)	Class
18.5-24.99	Normal weight
≥ 25	Overweight
25-29.99	Pre obese
≥ 30	Obese
30-34.99	Class I
35-39.99	Class II
≥ 40	Class III

Source: World health Organisation. Media centre obesity and overweight fact sheet.Updated March 2011. Available at http:// www.who.int/mediacentre/fact-sheet /fs311/en/index/html

Table 2: Obesity and OSA associated illness

System	Co morbidity
CVS	Hypertension, Arrythmias, Coronary artery disease, Congestive Cardiac failure, Pulmonary hypertension, Cor pulmonale
RS	Obesity Hypoventilation sysndrome
Metabolic disorders	Metabolic syndrome

Anaesthesia management

Pre operative evaluation

History: Pre operative clinical history taking should be focussed to identify the obesity related co morbid illness. (Table 2) History suggestive of Gastro Esophageal reflex Disorder (GERD) will influence the airway management technique. Obese patients have restricted physical activity and might be asymptomatic despite underlying cardio respiratory illness. Presence of shortness of breath and pedal edema if demonstrated can be a sign of right heart failure. The clinical predictors of OSA which suggests increased risk of perioperative complications has been identified by ASA task force.[9] This should be elicited to rule out any OSA in obese individuals even if there is no polysomnography (PSG). History to elicit or rule out diabetes and hypertension should be a routine in all OSA patients who are obese. The pre operative visit should be done well before surgery to optimise OSA as they might need Continuous positive airway pressure (CPAP) therapy. Uncontrolled diabetes and hypertension should be adequately controlled prior to surgery.

Investigation

Haemogram, RFT, LFT should be done prior to surgery. ECG signs of RBBB, LVH are common and need no further evaluation.[10] Further cardiac evaluation is based on associated co morbid illness and type of surgery and not based on increasing BMI and presence or absence of OSA. In patients suspected to have OHS echocardiogram to detect PHT and right heart failure is warranted.[11] Other investigations include PSG, lipid profile, stress testing, to confirm or refute clinically suspected OSA, metabolic syndrome, coronary artery disease. The array of investigations should be based on the clinical history and the type of the proposed surgery. Morbid obesity or OSA alone is not an indication for extensive cardiac or pulmonary evaluation. The cardiac workup can be done based on ACC/ AHA guidelines for non cardiac surgeries.

Airway assessment

Obesity and OSA is suggested as difficult airway predictor.[12] The increase in posterior cervical fat deposit will limit neck mobility. While this might be true, the fact is not all obese patients have difficulty in Back Mask Ventilation and/or intubation. Increasing BMI, OSA, GERD do not correlate with difficult airway.[13,14] The airway assessment tools like Mallampatti (MMP) score, Patil's test (Thyromental distance) do not identify all difficult airways. But MMP ≥3, abnormal thyromental distance and restricted jaw mobility have commonly lead to difficult airway in obese patients. [13] Neck circumference (NC) measured at the level of superior border of cricoid cartilage is useful in identifying difficult airway in obese patients. Increasing NC and mallampatti score ≥ 3 suggests possible difficult intubation.[14,15] Ultrasound detection of pretracheal soft tissue at the level of vocal cord along with neck circumference correlated with difficulty in laryngoscopy.[16] Neck circumference should be measured in addition to other airway assessment parameters to increase the chance of predicting difficult airway in obese patients. The airway management in obese patients should be tailored to the individual. The choice of technique can be anything ranging from RSI to awake intubation depending on the presence or absence of difficult airway predictor.

Premedications

Anti hypertensives, statins and anti diabetic medications should continued as in non obese patient. Antiplatelet therapy should be followed as per America Society Regional of Anaesthesia guidelines if regional analgesia is considered to be strongly beneficial. Any discontinuation or modification of cardiac medication should be done after discussion with operating surgeon and cardiologist. Patients using CPAP machine can be advised to bring their machine to hospital and continue their use in perioperative period.

Prevalence of obese patients with residual gastric volume of more than 25 ml and pH< 2.5 is higher than non obese patients. Even though incidence of clinically significant aspiration is not high, it is prudent to give proton pump inhibitors (PPI) night before and morning of surgery. If these patients have symptomatic GERD then consider H2 blockers like ranitidine along with PPI. Anxiolysis with benzodiazepines are better avoided due to common occurrence of OSA in morbidly obese.

Intra operative management

Specially designed operation tables or two tables joined together may be needed in extremely obese patients. Adequate padding around the pressure poins are important as obese patients are prone to pressure sores and neural injuries.[17] Standards of monitoting should be adhered to. The addition of invasive monitoring depends on associated co morbid illness and type of surgery. Invasive arterial blood pressure is indicated if blood pressure(BP) cuff of appropriate size is not available. Central venous line is placed in case of difficulty in intravenous (IV) access even if there is no need for Central Venous Pressure (CVP) monitoring.

Pre oxygenation: Absolute increase in metabolic rate seen in obese patients demands increased oxygen consumption.[18] Assuming supine position and induction of anaesthesia reduces arterial oxygen saturation due to reduction in FRC which is exaggerated in obese patients.[19,20] Hence preoxygenation is vital before airway intervention in obese individuals. 25 degree head up, Non invasive positive pressure ventilation(NIPPV) and CPAP/Positive End, Expiratory Pressure (PEEP) Present during preoxygenation increases the apnoea interval during laryngoscopy attemps.[21-23] 25 degree head up, and CPAP/PEEP during preoxygenation improves arterial oxygen tension by altering the cephalad position of diaphragm leading to reduction in basal atelectasis and intrapulmonary shunts. Nasopharyngeal insufflations of oxygen following preoxygenation further prolongs the time to desaturate during period of apnoea .[24]

Airway management

History of GERD and presence of predictors of difficult airway are two that will influence choice of airway technique. Considering the possibility of relatively high incidence of difficult airway in obese and/or OSA patients, it is prudent to keep difficult airway cart and help of a trained assistant available during airway management.

Not all obese patients have GERD and difficult airway. Some studies suggest the incidence of GERD is no different in obese individuals compared to non obese. The clinical relevance of increased gastric residual volume with low pH is questionable as the incidence of pulmonary aspiration is not higher than in non obese patients. Hence

1. RSI is not indicated in all obese patients
2. RSI is not contraindicated if the patient is obese and has history of GERD
3. Obese patient with H/O GERD itself is not an indication for awake intubation technique.

If there are no predictors of difficult intubation conventional laryngoscopy can be used as primary technique of airway management. Guedels airway is better used during Bag and Mask Ventilation (BMV) as better opening of airway minimises chance of gastric insufflations and improves ventilation. If still BMV is difficult to achieve adequate ventilation, then Laryngeal mask Airway (LMA), Proseal LMA (PLMA) and laryngeal tube(LT) can be temporarily used to ventilate before attempting intubation if general anaesthesia with paralysis is used as airway management technique.[25,26] Probably other supraglottic device may be used in this scenario. LMA can be used for minor surgeries as primary airway device.[27] RAMP/Head Elevated Laryngoscopy Position (HELP) position was initially described for intubation using laryngoscopy in morbidly obese patients.28 Recent study has reaffirmed, RAMP position instead of sniffing position will improve the chance of successful intubation by conventional laryngoscopy .[29] RAMP position is achieved by head and shoulder elevation to bring sternum in horizontal plane with the external auditory meatus. This can be done by either adjusting the operating table, using blankets or commercial devices.[30-33] RAMP position helps align the laryngoscopic axes in line aiding laryngoscopy guided intubation. The head up reverse trendelenberg position used for preoxygenation can be maintained during laryngoscopy.

The success rate using video laryngoscopes is better than conventional laryngoscopy in obese patients.[34,35] Different kind of video laryngoscope has been successfully used in morbid obese patients.[36] RAMP position can be used even with video laryngoscope if conventional laryngoscopy is the initial choice and proved unsuccessful. Morbidly obese patients have good success rate of intubation using intubating LMA (ILMA) and Ctrach LMA.[37,38] ILMA has been used even in emergency awake intubation in trauma setting.[39] Hence the choice of technique using alternate methods of securing airway depends on the availability of equipment and expertise of the individual practitioner.

Awake intubation using LMA CTrach can accomplished after adequate airway anaesthesia with lidocaine spray.[40] For facilitating awake fiberoptic technique in adult morbidly obese patients 40ml of atomised 2% lidocaine spray can be used.[41,42] Nerve blocks like translaryngeal nerve block with or without ultrasound guidance and dexmedetomidine infusion can be used along with lignocaine spray to facilitate awake fiberoptic bronchoscopy.[43,44]

Pharmacokinetics

The implications of drug dosing in OSA but non obese patient are minimal whereas considerable in obese patients. Induction of General anaesthesia causes decrease in the upper airway muscle tone. The implication in OSA patient is they are possibly more prone to airway obstruction following sedative and anaesthetic drug administration. The residual effects of the anaesthetic drugs might lead to more adverse respiratory events in post operative period. Pharmacokinetic studies for drug dosing are generally based on body weight in non obese patients.[45] The total blood volume, volume of distribution and cardiac output in obese patients is increased.[46] This will affect the peak plasma concentration following a bolus dose. This implies the induction dose of lipophilic drugs like propofol might be based on total body weight.[47] In obese person the volume of distribution is varied considerably due to change in body composition and along with possible co morbidities like steatohepatitis of organs of elimination makes this issue more complex.[48]

The minimal lipid solubility of sevoflurane and desflurane suggests faster onset and emergence from anaesthesia.[49,50] Onset time is not different between sevoflurane or desflurane based induction of anesthesia in obese patients.[51] The MAC of sevoflurane or isoflurane in obese is not different from non obese individuals based on a rodent model of metabolic syndrome.[52] Recovery profile in neurosurgical patients is better with desflurane compared to sevoflurane.[53] While in obese patients undergoing laparascopic surgery the difference was not seen between these two agents in their recovery profile.[54,55] But the recovery from sevoflurane is faster compared to Isoflurane in laparoscopic surgeries[56] Dexmedetomidine at dose of 0.2 to 0.8mcg/kg reduces the requirement of intraoperative inhalational agent and fentanyl. The recovery profile is positively influenced while minimising cardiovascular side effects.[57] Whether this reduction in drug requirement leads to reduced post operative respiratory complications in OSA patients needs to be studied.

Different 'body weight' used for drug dose calculation are: 1. Total body weight (TBW, Actual measured body weight) 2. Ideal body weight (IBW) 3. Lean body mass (LBM). In non obese subjects all these weights corresponds with each other hence dose calculation based on any of these weight is acceptable (In fact they will be same for all calculation). In morbidly obese, drug dose calculation based on TBW is higher than IBW whereas dose based on LBM (Best correlates with cardiac output in non cardiac patients) lies in between. Different body weight scalar has been suggested for

different drug. Some authors have suggested the initial dose based on LBM and titrate based on the individuals response[58] Table 3 below gives a guidance for dosing intravenous drug use in obese patients.

IBW	LBM	TBW
Non depolariser	Fentanyl, remifentanil and induction dose of propofol and thiopentone	Succinylcholine and maintenance dose of propofol

Source:Ingrande J and Lemmenens HJM. Dose adjustment of anaesthetics in the morbidly obese. Br J Anaesth 2010;105(S1)

In theory rapid recovery from remifentanil has advantage over other opioids in obese patients especially when associated with OSA. In morbid obese patients Target Control Infusion (TCI) sufentanil (0.3ng/ml) compared to TCI remifentanil(3 ng/ml) had delay in the immediate awakening but compensated with good quality of recovery and no difference in the duration of PACU stay.[59] Intraoperative TCI remifentanil usage needs higher morphine dose for postoperative pain management.[60] Intraoperatively fentanyl has been administered as bolus of 0.5mcg followed by 1mcg/kg/hr along with desflurane anaesthesia.[61]

The pharmacokinetic and clinical studies of anaesthetic drugs in morbidly obese patients and OSA are sparse. Even in this fewer studies the dosing and results are conflicting to suggest one drug over another in any class of anaesthesia drugs. The various choice of drug described and their dosing can at the best be considered expert opinion rather than based on consensus of evidence based medicine.

Hence pharmacodynamic end points can be used to titrate the drug dose. While neuro muscular (NM) monitoring is a good end point for titrating muscle relaxant dose, consider anaesthetic depth monitors when available.[62] Intraoperative opioids can be titrated based on haemodynamic response. Drugs with rapid onset and short acting are easy to titrate. Hence drugs like remifentanil, propofol, desflurane are considered choice by some of the authors. Opioid antagonist like naloxane and benzodiazepine antagonist flumazenil should be readily available to treat any respiratory depression that might occur with use of this group of drugs.

Regional anaesthesia and analgesia

Regional analgesia provides good pain relief and reduces parenteral opioid use in postoperative period. The advantage of catheter based technique is it provides continuous pain relief in the post operative period. Good pain relief is essential in upper abdominal and thoracic surgeries to minimise postoperative atelectasis. The concerns with regional anaesthesia technique in obese patients are identification of landmark, variation in drug dosing in central neuraxial block, positioning for block and appropriate equipment availability.

Obesity reduces the success rate and possibly increases incidence of vascular puncture in upper limb blocks using nerve stimulator.[63,64] Nerve stimulator guided paravertebral block has successfully been used as sole anaesthetic technique for breast surgeries in morbidly obese patients with a success rate of 76.9%.[65]

To improve the success rate ultrasound gram (USG) and fluoroscopy has been used in obese patients. Intraoperative fluoroscopy has been used for spinal needle placement.[66] USG use in obese patient has been described for various blocks including epidural[67]. The success rate of interscalene block using USG is high and is as good as in non obese patients.[68] The insertion of perineural catheter using ultrasound is more successful and the time for insertion is not different from non obese patients.[69]

Limitations of regional analgesia and USG in obese patients need to be considered while contemplating this technique. In general increasing BMI is a predictor of incomplete analgesia requiring frequent intra operative opioid supplementation. This occurs whether landmark based or USG guided technique is used.[70-71] Ultrasound guided technique has its limitation while using in obese patients as sound wave has to travel deep through fat tissue. [72] Another issue is complications specific to obese patients. Phrenic nerve paralysis is a common side effect of interscalene block which might become symptomatic in obese patients due to the pre existing pulmonary pathophysiologic alterations.[73]

The spinal CSF volume is reduced in obese patients. [74] The dose requirement of local anaesthetic in central neuraxial block is reduced in obese parturient.[75] The same can be true for non parturient obese patients too. But recent evidence suggests otherwise. The spinal dose needed to produce adequate block is not different in obese and non obese parturient as low dose produces inadequate sensory block with possibility of conversion to general anaesthesia.[76] The intrathecal bupivacine less than 10mg is not effective for caesarean section.[77] Similarly in non parturients the local anaesthetic dose is unaltered.[78] Considering the technical difficulties in surgery and possibility of prolonged duration of surgery, some authors suggests possibility of increase in need for combined spinal epidural (CSE) in caesarean section. [79]

Intra operative ventilation and extubation

Inadequate intraoperative ventilation might affect respiratory mechanics in obese patients undergoing surgery. Neither changing head up or down position or changing repiratory rate/tidal volume has any effect on oxygenation in patients undergoing laparoscopic surgery.[80] Intraoperatively mechanical ventilation using pressure controlled ventilation improves oxygenation by improving ventilation perfusion mismatch.[81] Pressure support ventilation improves intraoperative oxygenation which is maintained in moderately overweight patients undergoing minor procedures.[82] Morbidly obese patient are sensitive to the respiratory depressant effects of sedatives. The pulmonary mechanics suggests any decrease in neuro muscular function will lead to adverse respiratory

event. Hence extubation should be done after complete recovery when the patient is awake. NM monitoring can be used to ensure adequate reversal of residual muscle block.

Post operative period

Reduction in FRC during supine anaesthetised obese patients makes them prone to pulmonary complications. Postoperatively sleep pattern is disturbed in the initial 24-48 hours and OSA aggravates respiratory events in this period. Magnitude of pulmonary atelectasis with loss of lung volume is significantly higher and persists for longer period in morbidly obese patients.[83] Prophylactic early breathing exercise, incentive spirometry and coughing improves postoperative recovery of lung functions[84] Obesity is a risk factors for postoperative desaturaion following upper abdominal surgery in the first 48 hours.`[85] Episodes of postoperative hypoxaemia occurs in MO patients even in absence of OSA despite supplemental oxygen.[86] Association of OSA probably will increase such events. Prophylactic CPAP (10cmH2O) immediately after extubation maintains lung function better in patients undergoing bariatric surgery.[87] Vigilant monitoring of saturation by pulse oximetry in high dependency unit or ICU is warranted in the 24-48 hours of post operative period.

Adequate postoperative analgesia is another important aspect in preventing postoperative pulmonary complications. Regional analgesia should be used when ever feasible. PCA with morphine (1-2 mg bolus with 8 min lock out) can provide satisfactory analgesia similar to epidural analgesia.[88] Multi modal analgesia with ketorolac (30mg 6th hourly) along with PCA morphine provides better pain relief when used with surgical wound infiltration.[89] Continuous spinal anaesthesia using bupivaciane and fentanyl and intraperitoneal continuous infusion of bupivacaine (7.5mg/hr) has been described to be effective for postoperative bariatric surgery and allowed early ambulation. [90,91] Preemptive analgesia with ketamine and clonidine has reduced postoperative opioid use in morbidly obese patients.[92] Thus there are various effective options for postoperative pain management of obese patients. The technique and choice of drug depends on availability, type of surgery and individual patient. Whatever method is used the end point should be adequate analgesia.

Deep vein thrombosis (DVT)

Obesity is considered to be one of high risk factor for postoperative DVT.[93] Hence various preventive strategies have been described to decrease the incidence of DVT and fatal pulmonary embolism (PE). LMWH at dose of 30-60 mg sc is safe and effective in reducing the incidence of DVT.[94] Rather than considering obesity alone combination of venous stasis disease, BMI >/= 60, truncal obesity, OHS/Sleep apnea syndrome represents a high risk for DVT and fatal PE. In such group consider prophylactic IVC filter placement.[95] Obesity alone do not constitute high risk for DVT or PE and the incidence is found to be too low until associated with other coagulation abnormality.[96] Hence routine use of prophylaxis in all obese patient or bariatric surgery patient is questionable when no other risk factor for DVT is present.

The rising incidence along with the associated surgical problems in OSA and MO population suggest the practising Anaesthetist in India is going to face these patients more frequently in their practise. Careful preoperative assessment along with meticulous planning reduces perioperative complication and improves outcome in this group of patients. At present, there are only limited studies to rely while decision making in this group of patients. In future more randomised control trials are needed to build an evidence based consensus.

References

1) Sharma SK, Kumpawat S, Banga A et al. Prevalence and risk factors of obstructive sleep apnoea syndrome in a population of Delhi, India. Chest 2006; 130: 149-56

2) Lukaski HD. Methods for the assessment of human body composition: Traditional and new. Am J Clin Nutr 1987; 46 : 537- 56

3) Lubura M, Hesse D, Neumann N, et al Non-invasive quantification of white and brown adipose tissues and liver fat content by computed tomography in mice. PLoS One. 2012;7(5):e37026.

4) World health Organisation. Media centre obesity and overweight fact sheet.Updated March 2011. Available at http://www.who.int/mediacentre/fact-sheet/fs311/en/index/html

5) Bouchard C, Bray GA, Hubbard VS. Basic and clinical aspects of regional fat distribution. Am J Clin Nutr 1990; 52: 946-50

6) Expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult treatment panel III) Executive summary of the third report of the national cholesterol educational program (NCEP). JAMA 2001;285: 2486-2497

7) Alberti KG, Zimmet P, Shaw J. Metabolic syndrome – a new world wide definition. A consensus statement from the international diabetic federation. Diabet Med 2006; 23:469-80

8) Lopez-Jimenez F, Sert Kuniyoshi FH, Gami A et al. Obstructive sleep apnea. Implications for cardiac and vascular disorder. Chest 2008;133;793-804

9) Gross JB, Bachenberg KL, Benumof JL et al. American society of Anesthesiologist task force on perioperative management.practice guidelines for the perioperative management of patients with obstructive sleep apnea: a report by the American Society of Anesthesiologist task force on perioperative management of patients with

obstructive sleep apnea. Anesthesiology 2006; 104: 1081-93

10) Ramaswamy A, Gonzalez R, Smith CD. Extensive pre operative testing is not necessary in morbidly obese patients undergoing gastric bypass. J Gastrointest Surg 2004; 8: 159-65

11) Chen Y, Horne SL, Dosman JA et al. Body weight and weight gain related to pulmonary function decline in adults. Six year follow up study. Thorax 1993;48: 375-80

12) Langeron O, Masso E, Huraux C, et al. Prediction of difficult mask ventilation. Anesthesiology 2000; 92: 1229-35.

13) Sheff SR, May MC, Carlisle SE et al. Predictors of a difficult intubation in the bariatric patient: does preoperative body mass index matter? Surg Obes Relat Dis. 2012 Mar 3

14) Brodsky JB, Lemmens HJM, Brock-Utne JG et al. Morbid obesity and tracheal intubation. Anesth Analg 2002; 94: 732-36

15) Gonzalez H, Minville V, Delanoue K et al. The importance of increased neck circumference to intubation difficulties in obese patients. Anesth Analg 2008; 106: 1132-36.

16) Ezri T, Gewürtz G, Sessler DI et al. Prediction of difficult laryngoscopy in obese patients by ultrasound quantification of anterior neck soft tissue. Anaesthesia 2003; 58: 1111-1114

17) Ogunnaike BO, Jones SB, Jones DB et al. Anesthetic consideration for bariatric surgery. Anesth Analg 2002;95:1793-1805

18) Huang KC, Kormas N, Steinbeck K, et al. Resting metabolic rate in severely obese diabetic and non diabetic subjects. Obes Res 2004;12: 840-45

19) Damia G, Mascheroni D, Croci M, Tarenzi L. Perioperative changes in functional residual capacity in morbidly obese patients. Br J of Anaesth1988; 60: 574–8.

20) Pelosi P, Croci M, Calappi M et al. Prone positioning improves respiratory mechanics and daytime oxygenation in obese patients with obstructive sleep apnea. Anesth Analg 1996; 83:578-83

21) Dixon BJ, Dixon JB, Carden JR et al. Preoxygenation is more effective in the 250 head up position than in the supine position in the severely obese patient. Anesthesiology 2005; 102:1110-15

22) Delay J, Sebbane M, Jung B et al. The effectiveness of noninvasive positive pressure ventilation to enhance preoxygenation in morbidly obese patients. A randomised control study. Anesth Analg 2008; 107:1707-13

23) Coussa M, Proietti S, Schnyder P et al. Prevention of atelectasis formation during the induction of general anesthesia in morbidly obese patients. Anesth Analg 2004; 98: 1491-95

24) Baraka AS, Taha SK, Saddik-Sayyid SM et al. Supplementation of preoxygenation in morbidly obese patients using nasopharyngeal oxygen insufflation. Anaesthesia 2007; 62:769-773.

25) Keller C, Brimacombe J, Kleinasser A et al. The laryngeal mask airway proseal as a temporary ventilatory device in grossly and morbidly obese patients before laryngoscope guided intubation. Anesth Analg 2002; 94: 737-40

26) Matiac AA, Olson J. Use of laryngeal tube in two unexpected difficult airway situations: lingual tonsil hyperplasia and morbid obesity. Can J Anesth 2004; 51(10): 1018-21

27) Zoremba M, Aust H, Eberhart L et al. Comparison between intubation and the laryngeal mask airway in moderately obese adults. Acta Anaesthesiol Scand. 2009; 53(4):436-42.

28) Brodsky JB, Lemmens HJM, Brock-Utne JG et al. Anesthetic consideration for bariatric surgery: proper positioning is important for laryngoscopy. Anesth Analg 2003; 96:1841-42

29) Lebowitz PW, Shay H, Straker T, et al. Shoulder and head elevation improves laryngoscopic view for tracheal intubation in nonobese as well as obese individuals. J Clin Anesth. 2012; 24(2):104-8

30) Rao SL, Kunselman AR, Schuler HG et al. Laryngoscopy and tracheal intubation in the head-elevated position in obese patients: a randomized, controlled, equivalence trial. Anesth Analg. 2008 ;107(6):1912-8

31) Rao SL, Kunselman AR, Schuler HG et al. Laryngoscopy and tracheal intubation in the head-elevated position in obese patients: a randomized, controlled, equivalence trial. Anesth Analg. 2008 ;107(6):1912-8

32) Cattano D, Melnikov V, Khalil Y et al. An evaluation of the rapid airway management positioner in obese patients undergoing gastric bypass or laparoscopic gastric banding surgery. Obes Surg. 2010; 20(10):1436-41

33) Rich JM. Use of an elevation pillow to produce the head elevated laryngoscopy position for airway management in morbidly obese patient and large framed patients. Anesth Analg 2004; 98:264-65

34) Ndoko SK, Amathieu R, Tual L et al. Tracheal intubation of morbidly obese patients: A randomised trial comparing performance of Macintosh and Airtraq laryngoscopes. Br J Anaesth 2008: 100; 263-68

35) Andersen LH, Rovsing L, Olsen KS. GlideScope videolaryngoscope vs. Macintosh direct laryngoscope for intubation of morbidly obese patients: a randomized trial. Acta Anaesthesiol Scand. 2011; 55 (9):1090-7

36) Massen R, Lee R, Hermans B et al. A comparison of three video laryngoscopes: The macIntosh laryngoscope blade reduces but does not replace routine stylet use for intubation morbidly obese patients. Anesth Analg 2009;109: 1560-65

37) Combes X, Sauvat S, Leroux B et al. Intubating laryngeal mask airway in morbidly obese and lean patient. Anesthesiology 2005; 102:1106-09

38) Dhonneur G, Ndoko SK, Yavchitz A et al. Tracheal intubation of morbidly obese: LMA C trach vs. Direct laryngoscopy. Br J Anaesth 2006; 97: 742-45

39) Bindra T, Nihalani SK, Bhodaria P et al. Use of intubating laryngeal mask airway in morbidly obese patient with chest trauma in an emergency setting. Journal of anesthesiology and clinical pharmacology. 2011; 27 (4): 544-46.

40) Wender R, Goldman AJAwake insertion of the fibreoptic intubating LMA CTrach in three morbidly obese patients with potentially difficult airways. Anaesthesia. 2007;62(9):948-51.

41) Woodruff C, Wieczorek PM, Schricker TAtomised lidocaine for airway topical anaesthesia in the morbidly obese: 1% compared with 2%. Anaesthesia. 2010;65(1):12-7

42) Wieczorek PM, Schricker T, Vinet BAirway topicalisation in morbidly obese patients using atomised lidocaine: 2% compared with 4%. Anaesthesia. 2007; 62(10):984-8

43) De-oliviera GS, Fitzgerald P,Kendall M.Ultrasound-assisted translaryngeal block for awake fiberoptic intubation.Can J Anesth 2011;58:664-65.

44) Nagashima M, Kunisawa T, Takahata O et al Dexmedetomidine infusion for sedation during awake intubation. Masui. 2008 ;57(6):731-4

45) De Baerdemaeker LEC, Mortier EP, Struys MMRF. Pharmacokinetics in obese patients. Br J Anaesth 2004; 5 (4): 152-55

46) Backman L, Freyschuss V, Hallberg D et al. Cardiovascular function in extreme obese. Acta Med Scand 1973; 193: 437-46.

47) Vallejo MC. Anesthetic management of the morbidly obese. Curr Opin Anaesthesiol 2007; 20:175-80

48) Bloulin RA, Kolpek JH, Mann HJ. Influence of obesity on drug disposition. Clin Pharma 1987; 6:706-14.

49) La Colla G, La Colla L, Turi S, Effect of morbid obesity on kinetic of desflurane: wash-in wash-out curves and recovery times. Minerva Anestesiol. 2007 ; 73(5):275-9.

50) La Colla L, Albertin A, La Colla G et al.Faster wash-out and recovery for desflurane vs sevoflurane in morbidly obese patients when no premedication is used. Br J Anaesth. 2007 ;99(3):353-8

51) Torri G, Casati A, Comotti LWash-in and wash-out curves of sevoflurane and isoflurane in morbidly obese patients. Minerva Anestesiol. 2002 ;68(6):523-7

52) Pal D, Walton ME, Lipinski WJ et al. Determination of minimum alveolar concentration for isoflurane and sevoflurane in a rodent model of human metabolic syndrome. Anesth Analg. 2012 Feb;114(2):297-302

53) Bilotta F, Doronzio A, Cuzzone V, et al. Early postoperative cognitive recovery and gas exchange patterns after balanced anesthesia with sevoflurane or desflurane in overweight and obese patients undergoing craniotomy: a prospective randomized trial. J Neurosurg Anesthesiol. 2009 Jul;21(3):207-13

54) Vallejo MC, Sah N, Phelps AL et al. Desflurane versus sevoflurane for laparoscopic gastroplasty in morbidly obese patients. J Clin Anesth. 2007 Feb;19(1):3-8.

55) De Baerdemaeker LE, Jacobs S, Den Blauwen NM, Postoperative results after desflurane or sevoflurane combined with remifentanil in morbidly obese patients. Obes Surg. 2006;16(6):728-33.

56) Torri G, Casati A, Albertin A Randomized comparison of isoflurane and sevoflurane for laparoscopic gastric banding in morbidly obese patients. J Clin Anesth. 2001 ;13(8):565-70.

57) Tufanogullari B, White PF, Peixoto MP, Dexmedetomidine infusion during laparoscopic bariatric surgery: the effect on recovery outcome variables. Anesth Analg. 2008 ; 106(6):1741-8.

58) Schumann R, Jones SB, Ortiz VE et al. Best practice recommendations for anesthetic perioperative care and pain management in weight loss surgery. Obes Res 2005;13: 254-266

59) Bidgoli J, Delesalle S, De Hert SG, A randomised trial comparing sufentanil versus remifentanil for laparoscopic gastroplasty in the morbidly obese patient. Eur J Anaesthesiol. 2011 ; 28(2):120-4.

60) De Baerdemaeker LE, Jacobs S, Pattyn P et al. Influence of intraoperative opioid on postoperative pain and pulmonary function after laparoscopic gastric banding: remifentanil TCI vs sufentanil TCI in morbid obesity. Br J Anaesth. 2007 ;99(3):404-11.

61) Feld J, Hoffman WE, Paisansathan C Autonomic activity during dexmedetomidine or fentanyl infusion with desflurane anesthesia. J Clin Anesth. 2007 ;19(1):30-6..

62) Ibraheim O, Alshaer A, Mazen K, et al Effect of bispectral index (BIS) monitoring on postoperative recovery and sevoflurane consumption among morbidly obese patients undergoing laparoscopic gastric banding. Middle East J Anesthesiol. 2008 ;19(4):819-30

63) Hanouz J, Grandin W, Lesage A et al. Multiple injection axillary plexus block:Influence of obesity on failure rate and incidence of acute complications. Anesth Analg 2010;111:230-33

64) Franco CD, Gloss FJ, Voronov G et al. Supraclavicular block in obese patients: An analysis of 2020 block. Anesth Analg 2006;102: 1252-54

65) Naja ZM, Naccache N, Ziade F Multilevel nerve stimulator-guided paravertebral block as a sole anesthetic technique for breast cancer surgery in morbidly obese patients. J Anesth. 2011 ;25(5):760-4

66) Eidelman A, Shulman MS, Novak GM. Fluoroscopic imaging for technically difficult spinal anesthesia. J clini Anesth 2005; 17; 69-71.

67) Balki M, Lee Y, Halpern S et al. Ultrasound imaging of lumbar spine in transverse plane: the correlation between the estimated and actual depth to the epidural space in obese parturients. Anesth Analg 2009; 108: 1876-881

68) Schwemmer U, Papenfuss T, Greim CUltrasound-guided interscalene brachial plexus anaesthesia: differences in success between patients of normal and excessive weight. Ultraschall Med. 2006 ;27(3):245-50

69) Mariano ER, Brodsky JB. Comparison of procedural times for ultrasound-guided perineural catheter insertion in obese and nonobese patients. J Ultrasound Med. 2011 ;30(10):1357-61

70) Schroeder K, Andrei AC, Furlong MJ et al The perioperative effect of increased body mass index on peripheral nerve blockade: an analysis of 528 ultrasound guided interscalene blocks. Rev Bras Anestesiol. 2012;62(1):28-38

71) Nielsen KC, Guller U, Steele SM et al. Influence of obesity on surgical regional anesthesia in the ambulatory setting: An analysis of 9038 blocks. Anesthesiology 2005;102:181-87

72) Saranteas T. Limitations in ultrasound techniques in anesthesia: Obesity and muscle atrophy? Anesth Analg 2009;109(3):993

73) Rau RH, Chan YL, Chuang HI et al Dyspnea resulting from phrenic nerve paralysis after interscalene brachial plexus block in an obese male--a case report. Acta Anaesthesiol Sin. 1997;35(2):113-8

74) Hogan GH, Prost R, Kulier A et al. Magnetic resonance imaging of cerebrospinal volume and the influence of body habitus and abdominal pressure. Anesthesiology 1996;84: 134—49

75) Panni MK, Columb MO. Obese parturients have lower local anaesthetic requirements for analgesia in labor.Br J Anaesth 2006;96: 106-10

76) Emett A and Gowrie-Mohan S.standard dose of hyperbaric bupivacaine is safe and effective for CSE in morbidly obese patients. Int J of Obstet Anesth 2004;13(4): 298-99

77) Carvalho B, Collins J, Drover DR et al .ED(50) and ED(95) of intrathecal bupivacaine in morbidly obese patients undergoing cesarean delivery. Anesthesiology. 2011 ; 114(3):529-35

78) Kim WH, Lee JH, Ko JS et al. The effect of body mass index on spinal anaesthesia for total knee replacement arthroplasty: a dose-response study. Anaesth Intensive Care. 2012; 40(3):410-6.

79) Butwick A, Carvalho B, Danial C et al. Retrospective analysis of anesthetic interventions for obese patients undergoing elective caesarean delivery. J clin Anesth 2010;22:519-26

80) Sprung J, Whalley DG, Falcone T et al. The effects of tidal volume and respiratory rate on oxygenation and respiratory mechanics during laparoscopy in morbidly obese patients. Anesth Analg 2003; 97; 268-74.

81) Cadi P, Guenoun T, Journois D et al. Pressure-Controlled ventilation improves oxygenation during laparoscopic obesity surgery compared with volume controlled ventilation. Br J Anesth 2008;100:709-16

82) Zoremba M, Kalmus G, Dette F et al Effect of intra-operative pressure support vs pressure controlled ventilation on oxygenation and lung function in moderately obese adults. Anaesthesia. 2010 ; 65(2):124-9

83) Eichenberger AS, Proietti S, Wicky S et al Morbid obesity and postoperative pulmonary atelectasis: An under estimated problem. Anesth Analg 2002; 95:1788-92

84) Zoremba M, Dette F, Gerlach L et al. Short-term repiratory physical treatment in the PACU and the influence on the postoperative lung function in the obese adults. Obes Surg 2009;19:1346-54

85) Siriussawakul A, mandee S, Thonsontia J et al. Obesity, epidural and subcostal incision are risk factors for postoperative desaturation. Can J Anesth 2010; 57:415-22

86) Ahmad S, Nagle A, McCarthay RJ, et al. Postoperative hypoxemia in morbidly obese

without obstructive sleep apnea undergoing laparoscopic bariatric surgery. Anesth Analg 2008; 107:138-43

87) Nelligan PJ, Malhotra G, Fraser M et al. Continuous positive airway pressure via the boussignac systemimmediately after extubation improves lung function in morbidly obese patient with obstructive sleep apnea undergoing laparoscopic bariatric surgery. Anesthesiology 2009;110: 878-84

88) Charghi R, Backman S, Christou N et al. Patient controlled iv analgesia is an acceptable pain management strategy in morbidly obese patients undergoing gastric bypass surgery. A retrospective comparison with epidural analgesia. Can J Anesth 2003;50(7): 672-78

89) Schumann R, Sikora S, Weiss JM et al. A comparison of multimodal periopertive analgesia to epidural pain management after gastric bypass surgery. Anesth Analg 2003;96:469-74

90) Michaloudis D, Fraidakis O, Petrou A et al. Continuous spinal anesthesia /Analgesia for perioperative management of morbidly obese patients undergoing laparotomyfor gastroplastic surgeries. Obes Surg 2000;10:220-29.

91) Sherwinter DA, Ghaznavi AM, Spinner D et al. Continuous infusion of intraperitoneal bupivacaine after laparoscopic surgery: A randomised control trial. Obes Surg 2008; 18: 1581—86

92) Sollazi L, Modesti C, Vitale F et al. Preinductive use of clonidine and ketamine improves recovery and reduces postoperative pain after bariatric surgery. Surgery for Obesity and related diseases.2009;5(1):67-71

93) Kakkar VV,Howe CT, Nicholoides AN et al.Deep vein thrombosis of leg : is there a "high risk" group ?Am J Surg 1970;120:527-30

94) Singh K, Podolsky ER, Um S. Evaluating the safety and efficacy of BMI-based preoperative administration of low-molecular-weight heparin in morbidly obese patients undergoing Roux-en-Y gastric bypass surgery. Obes Surg. 2012 ;22(1):47-51

95) Sapala JA, Wood MH, Schuhknecht MP et al. Fatal pulmonary embolism after bariatric operations for morbid obesity: a 24-year retrospective analysis. Obes Surg. 2003; 13(6):819-25

96) Westling A, Bergqvist D, Boström A et al. Incidence of deep venous thrombosis in patients undergoing obesity surgery. World J Surg. 2002 ;26(4):470-3

Guilt Prone OR Scandal Prone?
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Not a day passes without eruption of some ethics-related scandal. The competition and the pressures of the modern world might force some to achieve their goals in an unethical manner. But many still appear to be bound by ethics. So, what actually predisposes individuals to ethical or non-ethical behavior? According to researchers, Taya Cohen and Nazli Turan of Carnegie Mellon University and A.T. Panter of the University of North Carolina, the answer could be the presence or absence of guilt-proneness. The persons who are guilt-prone anticipate a bad feeling even before they commit an unethical act (not the same thing as feeling guilty after the act) and their wide awake conscience acts as a deterrent. Guilt-proneness can be measured by Guilt and Shame Proneness Scale (GSPS). But, 30-40% of adults are likely to have a very low guilt-proneness. The latter are the ones likely to be involved in unethical business decisions, lying for monetary gain, or cheating during negotiations etc. The results of the study have been published in the latest edition of Current Directions in Psychological Science.

- Dr. K. Ramesh Rao