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KEY WORDS: Gastric calibration tube (GCT), Endotracheal tube (ETT) cuff pressure, Bariatric surgery, Morbidly Obese

"THE EFFECT OF GASTRIC CALIBRATION TUBE ON ENDOTRACHEAL TUBE CUFF PRESSURE DURING LAPAROSCOPIC BARIATRIC SURGERY "

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ABSTRACT

At present, laparoscopic bariatric surgery represents a modern and most efficient method of weight loss .[1] During surgery, a gastric calibration tube (G.C.T.) is routinely placed into the oesophagus after tracheal intubation which may affect endotracheal tube pressure. This study evaluated the potential effect of GCT insertion on endotracheal cuff pressure in patients undergoing laparoscopic bariatric surgery. Morbidly obese patients, undergoing bariatric surgery were assessed for eligibility for this study. After successful tracheal intubation, the tracheal tube with a high-volume, low-pressure cuff was adjusted to 28 cmH2O (Baseline) using a manometer. The change of endotracheal cuff pressure was recorded after the GCT had been left in situ for 1 min. This study has shown that the mean tracheal cuff pressure increased signi□cantly from the baseline value of 28 ± 0.00 to 36.28 ± 7.29 cmH2O (P<0.000) after G.C.T. insertion . We found that clinically significant increase in cuff pressure (>35 cmH2O) was observed in 55 of 120 patients (45 %). Our results suggest that the endotracheal cuff pressure should be routinely monitored in patients undergoing laparoscopic bariatric surgery requiring insertion of a calibrating orogastric tube.

INTRODUCTION–

At present, laparoscopic bariatric surgery represents a modern and most efficient method of weight loss in patients with BMI >35 kg/m2 associated with severe co-morbidities (diabetes, OSA, HTN and serum lipid abnormalities), as well as in those with BMI > 40 kg/m2.[1] Laparoscopic surgery is performed under general anesthesia with mechanical ventilation. A high volume, low pressure cuffed endotracheal tube with a sealing cuff pressure of about 20 to 30 cmH2O commonly used for proper seal and avoidance of over-inflation. During surgery, a gastric calibration tube (G.C.T.) is routinely placed into the oesophagus after tracheal intubation. This is to facilitate gastric pouch formation. However, this device may not be used without concern.[2] As the posterior membranous tracheal wall is in contact with the oesophagus, there is a possibility that the insertion and removal of this medical instrument into the oesophagus may affect tracheal tube cuff pressure._ Excess pressure on the lateral wall of the trachea reduces tracheal capillary blood flow, causing tracheal ischemia. Maintenance of adequate endotracheal tube cuff pressure in a range is important to avoid ventilator leak during mechanical ventilation and to prevent aspiration of secretions accumulated above the cuff without compromising tracheal perfusion. Mean capillary pressure in the tracheal wall is only about 30 cmH2O. Several postoperative complications such as cough, sore throat, hoarseness are seen above this value.[3,4] Minimal pressure of 20 cmH2O is recommended to prevent aspiration and ventilator associated pneumonia.[5]

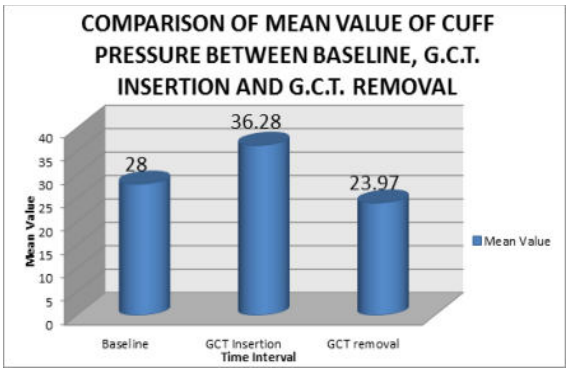
AIM: To study the endotracheal tube cuff pressure alteration at G.C.T. insertion in the morbidly obese patient presenting for laparoscopic bariatric surgery.

OBJECTIVES: To observe cuff pressure changes following G.C.T. insertion, To observe cuff pressure changes following Gastric calibration tube removal & To observe immediate postoperative complications for first 24 hours like sore throat, cough, hoarseness and aspiration pneumonia due to cuff pressure variations.

METHOD:

After approval from institutional ethics committee 120 morbidly obese patients (BMI > 40 kg/m2) posted for laparoscopic bariatric surgery over a period of 1 yr were recruited after written informed consent was given. Morbidly obese patients, undergoing bariatric surgery were assessed for inclusion criteria (ASA grade II & III, Both males and females, BMI above 40, Patient posted for elective Bariatric surgery under GA) and exclusion criteria (Patient with tracheostomy/ difficult intubation, Contraindications for GCT insertion) for this study After shifting to operation theatre, all patients were administered GA following a standard protocol. Using a manometer, the cuff pressure of a high-volume, low-pressure tracheal tube was adjusted to 28cmH2O (baseline value) before G.C.T. insertion. After the mandible had been lifted and neck □exed slightly, the 38 Fr (12.7mm) Gastric Calibration Tube was inserted in slightly head up position. After insertion, maximum pressure attained was recorded after the patient's head and neck were placed in the neutral position and the occiput on a same type of pillow. Cuff pressure was then again stabilised at 28 cmH2O and maintained throughout the surgery. upon removal of G.C.T. cuff pressure was recorded again. In this study each measurement was made with the same manometer and this manometer was calibrated monthly. Data was recorded after 1 min of G.C.T. insertion and removal. The result obtained were analyzed by using paired t test and P value (probability value) <0.05 was considered significant.

OBSERVATION & RESULT:



***Graph : Bar diagram showing* comparison of mean value of cuff pressure between baseline, GCT insertion and removal**

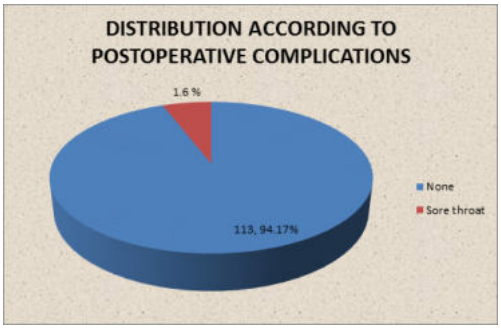
Table No. 1 Comparison of ETTcuff pressure between baseline and GCT insertion and final removal of GCT

Time Interval	No.	Mean ± SD	't' value	P value
Baseline	120	28.00 ± 0.00	-12.45, df=119	0.000*
GCT insertion	120	36.28 ± 7.29		
Baseline	120	28.00 ± 0.00	14.86, df=119	0.000*
GCT removal	120	23.97 ± 2.97		

Paired 't' test applied. P value < 0.05 was taken as statistically significant

Table No. 2 Distribution of patients according to postoperative complications

Complications	No.	Percentage
None	113	94.2
Sore throat	7	5.8
Total	120	100.00



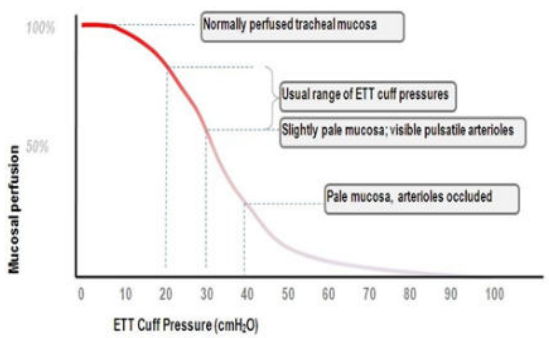
Graph 2 : Pie diagram showing distribution according to postoperative complications

The comparison of E.T.T. cuff pressure at baseline and just after G.C.T. insertion was found to be statistically significant ***(P<0.05),*** with comparatively higher value after G.C.T. insertion and the Comparison of E.T.T. cuff pressure between baseline and G.C.T. removal was also found to be statistically significant ***(P<0.05),*** with a comparatively higher value at the baseline in comparison to the G.C.T. removal. No complications were seen in 113 (94.17 %) patients, while sore throat were seen in 7 (1.6 %) patients.

DISCUSSION:

This study has shown that the mean endotracheal cuff pressure increased signi□cantly from the baseline value of 28 ± 0.00 to 36.28 ± 7.29 cmH2O (P<0.000) after G.C.T. insertion with adjusted cuff pressure to 28 cmH2O (Baseline) .We found that clinically significant increase in cuff pressure (>35 cmH2O) was observed in 55 of 120 patients (45 %). Approximately two fold increase was observed in 3 out of 120 patients (2.5%), suggest that G.C.T. insertion can signi□cantly increase the tracheal cuff pressure and may compromise tracheal blood flow. A BMJ article from 1984 reports the direct observations of the tracheal mucosa with different pressure levels. As the cuff pressure rises up to 30cmH2O, the mucosa becomes somewhat blanched, indicating that the capillary perfusion is impaired. As the cuff pressure increases, so the capillary perfusion decreases. At a pressure of 40cmH2O even mucosal arterioles are no longer visible.

Graph 3: showing tracheal mucosal perfusion at different pressure level



Hung (2013) found that after insertion of the calibrating orogastric tube, the median tracheal cuff pressure increased from 28 to 36 cmH2O (P<0.001) and was greater than 35 cmH2O in 30 of 60 patients (50 %) with body mass index (BMI) greater than 35 kg/m2, posted for laparoscopic bariatric surgery. [6] Our □ndings that only 45 % of patients had a tracheal cuff pressure greater than 35 cmH2O is consistent with their reports (50 %).The posterior membranous tracheal wall is in contact with the oesophagus. This explains how the placement of a G.C.T. into the oesophagus may exert an external force and compress the posterior tracheal wall resulting in the increased cuff pressure that we have demonstrated. High-volume, low-pressure cuffs are commonly over-in□ated (40–80%) in patients under GA and a pressure greater than 30 cmH2O for 15 min has been reported to induce histological tracheal mucosal lesions [8,9]. In a clinical study, **Liu et al.** demonstrated that an over-in□ated cuff could lead to tracheal mucosa damage for patients even in procedures of short duration (1–3 h). **Saad Nseir et al.** concluded that continuous control of Pcuff in ICU patients is associated with reduced micro-aspiration of gastric contents and reduced incidence of VAP.[12] Our study has shown that E.T.T. cuff pressure frequently drops from the baseline after G.C.T. removal. Clinically significant decrease in cuff pressure (<20cmH2O) was observed in 2 of 120 patients (1.6 %). This drop in ETT cuff pressure observed in present study can be explained by removal of an external force on the posterior membranous tracheal wall exerted by GCT in the oesophagus. These period of insufficient pressure leave the patient susceptible to microaspiration (1st step in pathophysiology of VAP). Secretions pooled on top of the E.T.T. cuff or hemorrhagic acidic gastric content dripping from G.C.T. may move past it and trickle down into the lungs. **Rello et al (1996**) performed an observational cohort study in 81 critically ill patients. They have demonstrated that under inflation of the tracheal cuff as an independent risk factor for VAP.[13] **Hung (2013)** recommended further studies to evaluate whether laryngo-tracheal complications can be reduced effectively by monitoring the tracheal cuff pressure in obese patients.[6] In our study only postoperative sore throat were seen in 2 out of 120 patients. This was probably due to readjustment of cuff pressure to 28 cmH2O every time the cuff pressure deviated from normalcy. Therefore we can conclude that continuous monitoring and control of endotracheal cuff pressure using a pneumatic device would allow effective reduction of postoperative laryngotracheal complications in this patient population. Estimation of cuff pressure by clinical judgment alone may not be accurate and often leads to over inflation of cuff and tracheal mucosal damage, which can predispose the patient to postoperative complications. Cuff pressure monitoring with hand held aneroid manometer is a simple & cost effective method to prevent postoperative complications, even for short duration surgeries.

LIMITATIONS:

First, the investigator recording the data was not blinded. However, because objective numerical data were recorded, this may not have biased the results. Second, we have observed patient for first 24 hrs only for postoperative airway complications. THIRD, the assessment was subjective as evaluation of complications was based on patient's symptomatology alone, objective parameters like examination by fibreoptic bronchoscopy or histological study of tracheal mucosa were not used to confirm & grade the severity of tracheal mucosal injury.

CONCLUSION:

This study demonstrates that G.C.T. insertion signi□cantly increases endotracheal cuff pressure, even though the cuff is not over in□ated and G.C.T. removal significantly decreases the cuff pressure. As more and more laparoscopic bariatric surgeries are being performed for weight loss, we recommend that the tracheal cuff pressure should be routinely monitored and readjusted in all kinds of surgeries and this should be made a part of the standard monitoring guidelines to minimize the possibility of postoperative pulmonary complications.

Individuals with PWS can safely undergo anaesthesia. Anaesthetic management of these patients includes a careful approach to difficulties with airway, strict control of intraoperative ventilation, management of metabolic disturbances and cardio circulatory support.

DISCUSSION:

CHALLENGES	COMPLICATIONS	MANAGEMENT
PWS Defective central control of ventilation	· hypoxia	· intra-opratively strict control of ventilator modality.
Temprature regulatory abnormalities	· hypothermia / hyperthermia	· warm air blanket. · warm fluid to prevent hypothermia.
Thick saliva	· airway obstruction, suction blockage	· avoid antisialagogue drugs.
Bronchospasm	· oxygen desaturation	· selection of sevoflurane for · inhalational anaesthesia · (less irritative, bronchodilator)
Metabolic disturbances	· hypoglycaemia	· monitor blood sugar intra & peri · operatively.
Aggressive personality	· desaturation / apnoea	· Avoid postop sedation and · benzodiazepine.
Food seeking behaviour	· increase risk of aspiration	· fasting must be verified by caregiver / put RT to assure empty stomach.
high pain threshold	· mask underlying problems	• other possible sign of underlying problems should be monitored
Hypotonia	· ineffective cough & inability to clear the airway after extubation.	· judicious use of muscle relaxant · proper suctioning
growth hormone deficiency	· may have smaller airway – · difficult mask ventilation · difficult intubation	· difficult airway management- · induction in head up position. · mask ventilation by 4 handed technique. · appropriate equipment to deal with the "cannot intubate/cannot ventilate" scenario
OBESITY: OSA	· apnoea / respiratory obstruction (sensitive to narcotic and sedative).	· Short acting narcotics intraoperatively · avoid tranquilizers postoperatively. · Naso-pharyngeal Airway.
low respiratory reserve volume (decrease FRC,FVC,TLC)	· respiratory insufficiency (difficulty in ventilation, faster desaturation)	· head up position · proper oxygenation
increase intra-abdominal pressure /GERD	· increase risk of aspiration	· put efficient suction device very close. · pre-op fasting, aspiration prophylaxsis.
SURGERY Alteration in E.T.T. cuff pressure at various steps of surgery	· increase cuff pressure-cough,sore throat, hoarseness of voice. · decrease cuff pressure- risk of aspiration	· monitor & keep adjusted by manometer
haemodynamic changes	· haemodynamic instability	· monitoring · proper fluid management · cardio-circulatory support

REFERENCES

1. Livingston EH. Obesity and its surgical management. Am J Surg. 2002;184:103–13.
2. Sanchez BS, Safadi BY, Kieran JA, Hsu GP, Brodsky JB, Curet MJ, Morton JM. Orogastric tube complications in laparoscopic Roux-en-Y gastric bypass. Obes Surg. 2006;16:443–7.
3. Yildirim ZB, Uzunkoy A, Cigdem A, Ganidagli S, Ozgonul A. Changes in cuff pressure of endotracheal tube during laparoscopic and open abdominal surgery. Surg Endosc. 2012;26:398–401.
4. Seegobin RD, van Hasselt GL. Endotracheal cuff pressure and tracheal mucosal blood flow: endoscopic study of effects of four large volume cuffs. British Medical Journal 1984;288:965–8.
5. Young PJ, Rollinson M, Downward G, Henderson S: Leakage of fluid past the tracheal tube cuff in a benchtop model. Br J Anaesth. 1997,78 (5):557-562.
6. Hung, K.: changes of tracheal cuff pressure after a calibrating orogastric tube insertion. J Anesth. 2014;28:128
7. Campos JH. Update on tracheobronchial anatomy and flexible fiberoptic bronchoscopy in thoracic anesthesia. Curr Opin Anaesthesiol. 2009;22:4–10.
8. Nordin U. The trachea and cuff-induced tracheal injury. An experimental study on causative factors and prevention. Acta Otolaryngologica Supplementum 1977;345:1–71.
9. Sengupta P, Sessler DI, Maglinger P, et al. Endotracheal tube cuff pressure in three hospitals, and the volume required to produce an appropriate cuff pressure. BMC Anesthesiology 2004;4:8.
10. Liu J, Zhang X, Gong W, Li S, Wang F, Fu S, Zhang M, Hang Y. Correlations between controlled endotracheal tube cuff pressure and post-procedural complications: a multicenter study. Anesth Analg. 2010;111:1133–7.
11. Brimacombe J, Keller C, Giampalmo M, Sparr HJ, Berry A. Direct measurement of mucosal pressures exerted by cuff and non-cuff portions of tracheal tubes with different cuff volumes and head and neck positions. British Journal of Anaesthesia 1999;82:708–11.
12. Tu HN, Saidi N, Leiutaud T, Bensaid S, Menival V, Duvaldestin P. Nitrous oxide increases endotracheal cuff pressure and the incidence of tracheal lesions in anesthetized patients. Anesthesia and Analgesia 1999;89:187–90.
13. Rello J, Sonora R, Jubert P, Artigas A, Rue M, Valles J. Pneumonia in intubated patients: role of respiratory airway care. Am J Respir Crit Care Med. 1996;154:111–5.
14. V.A. Holm, S.B. Cassidy, M.G. Butler, J.M. Hanchett, L.R. Greenswag, B.Y. Whitman, et al.Prader–Willi syndrome: consensus diagnostic criteria Pediatrics, 91 (1993), pp. 398-402
15. E.C. Cho, S.E. Jee, Y. Jang, S.S. Park, J.T. Kim, H.K. SongPrader–Willi syndrome: a case report. Korean J Anesthesiol, 36 (1999), pp. 1091-1094
16. F. Cavaliere, S. Cormaci, M. Cormaci, A. Alberti, F. ColabucciGeneral anesthesia in Prader–Willi syndrome. Minerva Anestesiol, 62 (1996), pp. 327-332
17. J.F. Mayhew, B. TaylorAnaesthetic considerations in the Prader–Willi syndrome. Can Anaesth Soc J, 30 (1983), pp. 565-566
18. T.B. Sloan, C.I. KayeRumination risk of aspiration of gastric contents in the Prader–Willi syndrome. Anesth Analg, 73 (1991), pp. 492-495
19. Stumpel, L.M. Curfs, P. Sastrowijoto, S.B. Cassidy, J.J. Schrander, J.P. FrynsPrader–Willi syndrome: causes of death in an international series of 27 cases. Am J Med Genet A, 124 (2004), pp. 333-338
20. E. Oiglane, K. Ounap, O. Bartsch, R. Rein, T. TalvikSudden death of a girl with Prader–Willi syndrome. Genet Couns, 13 (2002), pp. 459-464
21. S.K. Palmer, J.L. AtleeAnesthetic management of the Prader–Willi syndrome Anesthesiology, 441 (1976), pp. 61-63
22. G.M. Nixon, R.T. BrouilletteSleep and breathing in Prader–Willi syndrome. Pediatr Pulmonol, 34 (2002), pp. 209-217
23. O. RittingerClinical aspects and genetics of Prader–Willi syndrome. Klin Padiatr, 213 (2001), pp. 91-98
24. H. Yukioka, E. Kitamura, N. Nagata, M. FujimoriPrader–Willi syndrome and anesthetic management. Jpn J Anesth, 28 (1979), pp. 518-521
25. I. Noguchi, M. Ebihara, R. Yamaya, T. Tsubo, A. Matsuki, T. OyamaExperience of anesthesia for a patient with Prader–Willi syndrome. J Jpn Dent Soc Anesth, 8 (1980), pp. 56-62