

## RESPIRATION

### Paper No: 72.00

#### Evaluation of the costs and utilization of operating rooms in a public hospital in Trinidad

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**Introduction:** In Government funded healthcare sectors such as in Trinidad & Tobago, the expenditure for operating rooms (OR) is a key area to be evaluated. The objective of every public healthcare system is to make the service more cost-efficient, yet retain the standard of care. Most cost evaluation studies analyze the 'cost-effectiveness' of individual surgical treatments; there have been few attempts to study the 'cost-efficiency' of OR as a 'system'. This study evaluates this paradigm from the exchequer's perspective.

**Objectives:** To determine the cost of running OR in a public hospital and to relate to its efficient utilization.

**Methods:** A "cost-block" model which included capital expenditure, estate, non-clinical support services, clinical support services, consumables and staff was adapted to identify the costs of running OR in a public hospital during two time-periods: 2006 and 2009. Data were obtained from Human Resources, Administration, Finance, Pharmacy, Stores and Biomedical Engineering Departments. Total annual costs, cost per OR, cost per patient and cost per hour were calculated. OR utilization hours were also recorded for the two time-periods.

**Results:** Capital expenditure contributed to 70% of the costs. Consumables were the second expensive block followed by staff salary. The total annual costs of running 4 ORs for the years 2006 and 2009 were approximately US\$ 2.3 and 3.3 million respectively. The cost of running the four ORs per day was approximately US\$ 6350 in 2006 which increased to US\$ 9015 in 2009. Costs per patient were US\$ 1570 and 1650, cost of one hour of OR time was approximately US\$ 70 and 98 in 2006 and 2009. The total number of elective surgery hours unutilized was 4588 in 2006 and 2145 in 2009. The cost of this underutilization was US\$ 316,000 during 2006 and US\$ 200,000 during 2009.

**Conclusions:** The adapted "Cost-Block" model was useful to evaluate the costs of running ORs in a Public Hospital in Trinidad. This analysis may assist policy makers to optimize the functioning of the operating room services from the Government's perspective.

### References

1. Overdyk FJ, Harvey SC, Fishman RL, Shippey F. Successful strategies for improving operating room efficiency at academic institutions. *Anesth Analg* 1998; **86**(4):896-906
2. Mazzei W J. Maximizing operating room utilization: A landmark study. *Anesth Analg* 1999; **89**(1):1-2
3. Hariharan S, Chen D, Merritt-Charles L. Cost evaluation in the intensive care units of Trinidad applying the cost-blocks method—an international comparison. *Anaesthesia* 2007; **62**: 244–249

### Paper No: 150.00

#### Advanced airway management by anesthesiologists during the FIS Alpine Ski World Championship 2011 in Germany

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**Introduction:** The Bavarian Mountain Rescue Services "Bergwacht" (MRS) was responsible for rescue services in mountain areas during the 11th FIS Alpine Ski World Championship 2011 in Garmisch-Partenkirchen, Germany. According to the FIS medical guide any critically injured athlete along the course has to be reached by a trauma teams trained in Advanced Cardiac or Trauma Life Support and advanced airway management within 4 minutes after the incident.

**Objectives:** Together with 18 first responders of the MRS eight emergency physicians were on duty along the race course during every training and race for injured athletes using rescue-sledges together with air-rescue-bags for hoist evacuation. At least four anesthesia consultants also holding Diploma in Mountain Medicine and Mountain Emergency Medicine were positioned at risky hazard spots,

equipped with ski, crampons and climbing harness. For transportation to accident scenes further afield they used a skidoo as well as rescue helicopter equipped with a rescue winch. They were equipped with special emergency backpacks containing oxygen cylinders, face masks and ventilation bags, emergency respirator, fluids and medication to support circulation and airway management equipment. Airways could be managed by endotracheal intubation, supraglottic airway devices or by cricothyroidotomy, facilitated with intravenous anesthetics, opioids and muscle relaxants. For monitoring pulse oximetry and automated external defibrillators with ECG-monitoring screen were used.

**Plan of actions:** In case of an accident on the slope a first evaluation was performed by the MRS member nearby. Together with the emergency physician the injured athlete was stabilized for transportation by MRS with the rescue-sledge and accompanied by the physician. Patients with severe head-injuries, multiple trauma, etc. should be intubated if mandatory at the scene. To handle possible problems during airway management, the anesthetists could help themselves using their advanced equipment. After establishing a secure airway the patient should be evacuated from the scene under assisted ventilation accompanied by the anesthetist with the rescue winch from the helicopter. Severely injured patients should be directly transferred to the next trauma center by rescue helicopter.

**Results:** During the FIS World Championship 2011 six athletes suffered distortions of the thumb or ankle joint, cruciate ligament ruptures or contusions of the cervical spine. Fortunately, no severe accident happened and no athlete needed to be intubated by the anesthetists.

**Discussion:** Based on our experience and regardless of the fact that no major accident happened during the FIS World Championship 2011, organizers of forthcoming alpine speed competitions should establish MRS teams in combination with specially trained airway experts.

## Paper No: 157.00

### A Novel Airway Management Technique for Bearded and Edentulous Patients

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**Introduction:** Airway management techniques are of paramount importance whenever encountering difficult airway situations such as those found in edentulous or bearded patients. We illustrate an innovative technique using commonly found anesthesia equipment.

**Objectives:** Describe a distinct mask ventilation technique with slight variations for edentulous or bearded patients that can be used globally.

**Methods:** After pre-oxygenation and induction of anesthesia, an appropriate size nasal airway is inserted in the patient's

nostril and a toddler size mask is used to ventilate the patient. The mask extends from the bridge of the nose to the alveolar ridge. The ventilation is totally accomplished through the nostrils.

**Results:** A literature review has supported the uniqueness of this approach

**Conclusions:** Difficult mask ventilation has a reported prevalence of 5% and requires a wide range of interventions. As Benumof states regarding the degree of difficulty: "mask ventilation can range from zero to infinite"(1). Edentulous and bearded patients are high risk for difficult masking (1,4). Approaches to difficult mask ventilation involves modifications of anatomy, positioning, the use of specialized equipment, and even methods of circumventing this difficult task (1,2,3,5,6,7). Our approach affords advantages over a technique that Racine, et al. described(7). In our easy to teach technique the neck is not extended, one person conducts ventilation and the mask is not used to ventilate through the mouth. Based on established criteria of difficulty of mask ventilation, this technique provides easy ventilation despite increased risk factors (4).

## References

1. Benumof JL. 1991. "Management of the Difficult Adult Airway: With Special Emphasis on Awake Tracheal Intubation". *Anesthesiology*. **75**: p1087-1110.
2. Conlon NP, et al. 2007. "The effect of leaving dentures in place on bag-mask ventilation at induction of general anesthesia." *Anesth Analg*. **105**(2):370-3.
3. Heuer JF, et al. 2010. "Initial ventilation through laryngeal tube instead of face mask in out-of-hospital cardiopulmonary arrest is effective and safe." *Eur J Emerg Med*. **17**(1):10-5.
4. Langeron O, et al. 2000. "Prediction of Difficult Mask Ventilation". *Anesthesiology*. **92**: 1229-36.
5. Lanier WL. 1987. "Improving anesthesia mask fit in edentulous patients." *Anesth Analg*. **66**(10):1053.
6. Nakanishi K, et al. 2009. "[Successful oral fiberoptic intubation by a double-lumen tube under the ventilation only via nostrils with a child size mask in a patient with limited mouth opening]". *Masui - Japanese Journal of Anesthesiology*. **58**(5):616-619.
7. Racine SX, et al. 2010. "Face mask ventilation in edentulous patients: a comparison of mandibular groove and lower lip placement". *Anesthesiology*. **112**(5):1190-3.

## Paper No: 213.00

### Airway management with pentax airway scope (pentax-aws®). Complications and incidents

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**Introduction:** Maintaining patient airway is essential for adequate oxygenation and failure to do so, even for a brief period of time, can be life threatening.

**Objectives:** The aim of this study was to evaluate the use of Pentax-AWS® in the management of the airway, evaluating the indications, benefits and possible limitations of their employment.

**Methods:** The protocol was approved by the clinical research committee of each institution, and written informed consent was obtained from 61 patients scheduled for elective surgery, requiring general anaesthesia with tracheal intubation. Intubations were performed by 3 anesthesiologists with little experience in handling the device (less than 10 uses). Preoperatively, predictors of difficult airway (PDW) were considered: Body mass index (BMI) >35 kg/m<sup>2</sup>; Mallampati scale class III or IV; interincisor distance <3 cm; thyromental distance >6 cm; sterno-mental distance <12 cm; Atlanto occipital joint <15° and a class III in the bite test. In the operating room, it was collected the number of attempts to get the intubation, the degree of visualization of vocal cords with Pentax-AWS® (1: view of the glottis in the middle of viewfinder, 2: glottis not centered on the target mark, 3: view of the glottis and epiglottis; 4: Visualization of only epiglottis, 5: inability to see epiglottis) and complications encountered during use.

**Results:** Of 61 patients, 11 patients (18%) had 2 or more PDW. It was possible to insert the blade of the Pentax-AWS and to see a full view of the glottis on the first attempt in 93.5% (57 patients): the view was optimal (grade 1: 32 patients, 52.5%) or suboptimal (grade 2: 25 patients, 41%); in 4 patients (6.5%), the view was grade 4; we viewed always the epiglottis. Tracheal intubation was successful in all patients. The main complications encountered were failing to lift the epiglottis and advance into the vallecula (in 9 patients of 11 that had predictors of difficult airway).

**Conclusions:** In our experience, it was generally easy to insert the Pentax-AWS to obtain a full view of the glottis and to intubate the trachea, without major complications; it has great potential to become a standard technique of laryngoscopy for tracheal intubation

**Introduction:** In attempting to improve the preoperative diagnostic of difficult Endotracheal Intubation (ETI) in patients, different tests have been evaluated as predictors of difficult airway; Up until now, Upper Lip Bite Test (ULBT) has been studied in different countries: Iran<sup>1</sup>, Germany<sup>2</sup>, Venezuela<sup>3</sup>, and the USA<sup>4</sup> (Table 1). This test has to be evaluated in different populations to be approved. The ULBT has not been studied as a preoperative predictor of difficult endotracheal intubation in Spain; This study was performed to evaluate the ULBT in our population; We compared the ULBT's results against the results of the gold standard test for predicting difficult intubation, the Modified Mallampati Classification (MMC). In addition to this, we added both test results (ULBT + MMC) and compared them together against unique MMC test as predictors to detect the patients at a higher risk for difficult endotracheal intubation.

**Objectives:** To compare the Sensitivity, Specificity, Positive and Negative Predictive Values (PPV, NPV) of the MMC and of the ULBT separately and both tests linked together as predictors for difficult intubation.

**Methods:** This is a blind prospective study, we enrolled 174 adult patients who were scheduled for elective surgery undergoing general anesthesia and ETI. They were all subjected to the following assessments: 1. The MMC; 2. The new ULBT classification, defined class III as probable "difficult intubation"; 3. Laryngeal view grading according to Cormack's criteria, Grades 3 and 4 defined as "difficult intubation".

**Results:** The incidence of difficult ETI was 13.8% (n = 19). The specificity was similar on all the tests; The ULBT's specificity was the highest (99%). The sensibility of the combination of the ULBT with the MMC test was the highest. The PPV of the ULBT was higher than of the MMC. This means if the ULBT grades the patient as a "difficult intubation", it will probably be confirmed with a Cormack's stage III or IV (Table 2). However, the comparisons of the diagnostic values between the tests, did not reveal any significant differences (p > 0.05).

## Reference

1. Koyama J, Aoyama T et al. Description and first clinical application of AirWay Scope for tracheal intubation. *Journal of Neurosurgical Anesthesiology* 2006; **18**: 247–50.

**Paper No: 263.00**

## Upper lip bite test versus modified mallampati classification as predictors of difficult endotracheal intubation in Spanish population

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Table 1. Studies of ULBT in different countries

	Iran1	Germany2	Venezuela3	USA4
Sensitivity of the ULBT	76,5%	28,2%	20%	55%
Specificity of the ULBT	88,7%	92,5%	100%	97%

Table 2. Results from "Hospital Insular" of Spain.

	ULBT	MMC	ULBT + MMC
SENSIBILITY	21%	42%	54%
SPECIFICITY	99%	94%	93%
PPV	83%	53%	57%
NPV	89%	91%	93%

**Conclusions:** The findings of this study support those of a previous studies of the ULBT. The ULBT seems to be an acceptable option for predicting difficult ETI as a simple and single test. The ULBT and MMC combination enhances the chance to diagnose patients with difficult airway than of the tests employed separately. Because of the easy ULBT and the promising results of this small study we recommend further research with a larger sample.

## References

1. Khan ZH, Kashfi A, Ebrahimkhani E. A comparison of the upper lip bite test (a simple new technique) with modified Mallampati classification in predicting difficult in endotracheal intubation: a prospective blinded study. *Anesth Analg* 2003; **96**: 595–9.
2. Eberhart LH, Arndt C, Cierpka T, Schanekamp J, Wulf H, Putzke C. The reliability and validity of the upper lip bite test compared with the Mallampati classification to difficult laryngoscopy: an external prospective evaluation. *Anesth Analg* 2005; **101**: 284–9 Vol. 106, n°5, May 2008.
3. Rodriguez A, Rodriguez E. Prueba de la mordida del labio superior como método predictor de intubación orotraqueal difícil y su comparación con la prueba del Mallampati Modificado. *Rev. Venez Anestesiol*, 2008; **13**(1):47–50.
4. Hester CE, Dietrich SA, Secrest JA, Smith T. A comparison of pre-operative airway assessment techniques: The Modified Mallampati and the Upper Lip Bite Test. *AANA Journal*, June 2007; **75** (3): 177–182.

**Paper No: 373.00**

## Comparison of supportive high-frequency ventilation and t-piece for weaning from prolonged mechanical ventilation

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**Introduction:** Weaning from the respirator is a very important step in the complex of intensive care. On one hand extending the duration of mechanical ventilation (MV) leads to a significant increase in risks for the patient, on the other hand- early weaning can lead to decompensation of respiratory system, premature extubation, which may require reintubation [1]. According to the publications of some authors and our own observations, the use of supportive high-frequency ventilation (sHFV) is the most safe mode of respiratory support [2,3].

**Objectives:** To conduct comparative analysis of efficacy and safety of two methods of weaning from the respirator (sHFV and the use of T-piece) in patients who underwent prolonged mechanical ventilation.

**Methods:** Prospective observational multicenter study, which lasted from August 2007 to January 2010. The study included 99 patients with respiratory failure, who underwent MV, using CMV mode. The first group included 47 patients in the ICU

Hospital Nord (Marseille, France,) who underwent prolonged MV (more than 72 hours) and their weaning from the respirator was conducted using the T-piece. The second group included 52 patients in the department of anesthesiology and intensive care Kyiv hospital #17, in whom sHFV technique was used. These patients were conducted volume controlled ventilation, with a gradual transfer to sHFV and the subsequent transition to spontaneous breathing. The parameters sHFV mode were as follows: 150-180 ml tidal volume, respiratory rate 160 to 190 per minute,  $FiO_2 \geq 30\%$ ,  $TI/TE = 1$ .

**Results:** The incidence of successful weaning in patients of T-piece group was 53.2%, the need for reintubation and resumption of MV occurred in 31.9% patients. The incidence of successful weaning in sHFV group was substantially greater compared to T-piece group and equalled 73.1% ( $p = 0.038$ ). In six patients (11.5%) the efforts to continue MV and weaning were postponed. When using the technique of weaning through sHFV the incidence of VAP was significantly lower. It should be noted that this complication did not occur in any case after the use of weaning through sHFV. Mortality of patients in sHFV and T-Piece groups did not differ significantly and equalled 14.9% and 15.4% respectively ( $p = 0.716$ ). Failure to wean in the application of T-piece required reintubation and ventilation resumption, which led to an increase in the incidence of Ventilator-associated pneumonia (VAP) 4.3 fold.

**Conclusions:** The study showed greater efficacy and safety of sHFV for weaning from the respirator in patients who underwent prolonged MV compared with the use of T-piece.

## References

1. Boles J-M, Bion J, Connors A, Herridge M, Marsh B, Melot C, Pearl R, Silverman H, Stanchina M, Vieillard-Baron A, Welte T. Weaning from mechanical ventilation *Eur Respir J*. 2007; Vol. **29**: 1033–1056.
2. Klain M, Kala R, Sladen A High-frequency jet ventilation in weaning the ventilator depend patients// *Critical Care Med*. 1984; Vol. **12**No 9: 780–781.
3. Dubrov SO, Glumcher FS Influence of tracheostomy on duration of weaning from mechanical ventilation // *Critical Care* 2009; Vol. **13**, Suppl. 1. P. 7.

**Paper No: 439.00**

## Noninvasive Ventilation, in the Immediate Management of Negative Pressure Pulmonary Edema, a Choice for Ventilatory Support. Case Report

Martin Buffa and Enrique Scocco

**Introduction:** Negative pressure pulmonary edema (NPPE) is a rare but serious anaesthetic complication, arising as a



consequence of upper airway obstruction. Postoperative prevalence is 0.1%. We report a case of severe postoperative NPPE.

**Methods & Results.** A 29-year-old male, underwent an appendectomy procedure under general anaesthesia. Obstruction of the airway occurred immediately after extubation, made forceful inspiratory efforts without breathing success. Patient became tachy-cardiac and hypoxaemic (SpO<sub>2</sub> 60–75%). Manual positive pressure mask ventilation with 100% inspired oxygen was made. When finally awake, he started to cough out bright red blood. Bilateral rhonchi were audible by auscultation. We continued treating with 100% oxygen via face mask and furosemide 40 mg., nevertheless, the patient remained hypoxemic. He was transferred to intensive care unit where he was supported overnight with continuous positive airway pressure (CPAP). Oxygen saturation immediately arise to 100%. Chest X-ray showed marked interstitial infiltrates bilaterally, compatible with pulmonary edema. He remained with intermittent CPAP ventilation for 3 days. Radiographic changes diminished gradually and the patient was discharged from the hospital after one week. We concluded that the patient's pulmonary edema was induced by negative intrathoracic pressure, resulting from strong inspiratory efforts in the setting of obstruction of the upper airway.

**Conclusions:** Facing acute hypoxemia after anaesthesia one should consider aspiration, anaphylaxis or cardiogenic pulmonary edema as origin. Simultaneously one should consider pulmonary edema due to airway obstruction. 1.2. Both, the diagnosis of pulmonary edema and an understanding of its underlying pathophysiology have important implications for treatment. NPPE is the result of acute increased transudation due to high negative airway pressure caused by forced inspiratory efforts against the closed glottis. An alternative to intubation is noninvasive respiratory support (NIV). 3. Evidence suggests that NIV is an effective strategy to improve oxygenation, and to reduce intubation rates, intensive care unit and hospital lengths of stay, and morbidity and mortality in postoperative patients. The aims of non-invasive respiratory support in the context of NPPE include: to partially compensate for the affected respiratory function by reducing the work of breathing; to improve alveolar recruitment with better gas exchange; and to reduce left ventricular afterload, increasing cardiac output and improving hemodynamics. Obstruction of the upper airway immediately after extubation and development of NPPE is a potentially fatal complication. Promptly diagnose. Treatment is a must. The use of non invasive ventilatory support, in the context of NPPE could be an alternative for postoperative management.

## References

1. Udeshi A, et al. Postobstructive pulmonary edema. *J Crit Care.* 2010 Sep; **25**(3):508. e1-5. Epub 2010 Apr 22.
2. Krodel DJ, et col. Case scenario: acute postoperative negative pressure pulmonary edema. *Anesthesiology.* 2010 Jul; **113**(1): 200-7.
3. Pelosi P, et col. Noninvasive respiratory support in the perioperative period. *Curr Opin Anaesthesiol.* 2010 Apr; **23**(2):233-8.

## Paper No: 513.00

### The using of high-frequency oscillatory ventilation in patients with brain injury

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**Introduction:** Negative effects of mode CMV are well-known. The objective of this study was to determine the intracranial, cardiovascular changes induced by conversion to high-frequency oscillator ventilation (HFOV) from conventional mechanical ventilation (CMV).

**Objectives:** In this study, 14 patients with severe head injury had cardiovascular and invasive intracranial monitors placed. Middle age has made  $36 \pm 6$  years, GCS 7-9 points; level ICP exceeded 15- 31 mm hg.

**Methods:** Cerebral haemodynamics was studied by a method of transcranial ultrasonography. We registered: cerebral blood flow velocity (Vm), resistance pial vessels (Pi) and a dilatation's reserve (Ri).

**Results:** The analysis of parameters central and system haemodynamics at various respiratory support has revealed significant distinctions. At mode CMV-ICP –  $23,6 \pm 0,7$  mm hg; Vm –  $51,1 \pm 1,4$  sm/s; Pi- $1,84 \pm 0,1$ ; Ri - $1,28 \pm 0,01$ ; CPP –  $67,4 \pm 1,3$  mm hg and at HFOV -ICP- $18,8 \pm 2,9$  mm hg; Vm  $57,8 \pm 7,1$  sm/s; Pi- $1,39 \pm 0,2$ ; Ri -  $1,36 \pm 0,01$ ; CPP -  $64,1 \pm 6,1$  mm hg. Arterial PaCO<sub>2</sub> increased significantly after converting from CMV to HFOV. Although the PaCO<sub>2</sub> significantly increased during periods of HFOV, there was no difference in ICP values for both modes of ventilation. The arteriovenous lactate difference (AVDL) was not affected by mode of ventilation; however, it did increase as mean airway pressure was increased. At HFOV authentically lower level of Pi, higher parameter of Ri and lower ICP is marked. That interferes with occurrence of the expressed spasm and an ischemia of a brain. Cerebral perfusion pressure was significantly lower during CMV than during HFOV (CMV:  $63,4 \pm 3,7$  mmHg vs. HFOV:  $75,1 \pm 5,8$  mmHg).

**Conclusions:** The using of ÍFOV as respiratory support at severe traumatic brain injury, on a background of an intracranial hypertension, has doubtless advantages before traditional methods of CMV. Its application provides preservation active autoregulation of brain blood circulation, promotes stabilization of intracranial pressure at lower level.

**Paper No: 549.00****Comparison of Propofol and Isoflurane effects on Intraocular Pressure in patients undergoing Lumbar Disc surgery**

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**Introduction:** Post operative blindness is a rare but devastating complication of surgeries, especially when performed in prone position, with the incidence of around 0.01% (1). There are some reports about post operative blindness mainly due to hemodynamic alterations affecting optic nerve perfusion rather than direct pressure on the eye globe (2). In prone position IOP is significantly higher than supine position (3).

**Objectives:** In our survey we studied the effects of Propofol and Isoflurane on IOP of patients in prone position which is to our knowledge the first study performed on the effects of these two drugs on IOP under prone position.

**Methods:** In this randomized clinical trial, 60 patients who were candidates for Lumbar disk surgery were randomly assigned to two groups: Propofol and Isoflurane. Intraocular Pressure was measured before and after induction of anesthesia in supine position, immediately after prone positioning of the patient and at the end of operation in prone position and also after turning the patients back to supine position. Mean arterial pressure, systolic and diastolic blood pressure and heart rates were all assessed. Finally, the data were evaluated using T test, Chi-square test and Generalized Estimating Equations.

**Result:** The baseline Mean Intraocular Pressure of awake patients in supine position in Isoflurane and Propofol groups were  $15.8 \pm 3.1$  and  $18.2 \pm 5.4$  mmHg respectively, and at the end of operation Intraocular Pressure in prone position was changed to  $18 \pm 5.8$  and  $17.2 \pm 4.9$  mmHg respectively. ( $P = 0.024$ ). According to mixed analysis, mean arterial pressure, systolic blood pressure, diastolic blood pressure, end tidal Co2 and heart rate did not show statistically significant changes between the two groups. ( $P < 0.05$ ).

**Conclusion:** Propofol better controls the Intraocular Pressure than Isoflurane in prone position with no significant difference in hemodynamic responses.

**References**

1. Warner ME, Warner MA, Garrity JA, et al. The frequency of post-operative vision loss. *Anesth Anal* .2001; **93**: 1417–21.
2. Cheng MA, Sigurdson W, Tempelhoff R, Laurysen C. Visual loss after spine surgery: a survey. *Neurosurgery* 2000 **46**: 625–31.

3. Hunt K, Bajekal R, Calder I, Meacher R, Eliahoo J, Acheson JF. Changes in intraocular pressure in anesthetized prone patients. *J Neurosurg Anesthesiol* 2004; **16** (4):287–90.

**Paper No: 660.00****Intraoperative comparison of continuous vs. intermittent subglottic suctioning with evac endotracheal tube**

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**Introduction:** Ventilator-associated pneumonia is a common complication in mechanically ventilated patients. The incidence in the intensive care unit is 5 to 10 cases per 1000 ventilator days. Subglottic secretion drainage has been shown to decrease the incidence of ventilator-associated pneumonia by nearly 50%.<sup>(1)</sup> Various suctioning regimens of these secretions have been found to decrease the incidence of nosocomial pneumonia by 9% to 13% as compared to no suctioning.<sup>(2,3)</sup> Neither optimal suction regimens nor the characterization of the content of subglottic secretions has been established in mechanically ventilated patients in an intraoperative setting. Endotracheal tubes may act as a conduit for bacteria to enter the lungs by pooling and leakage of secretions around the endotracheal tube cuff.<sup>(4)</sup> Developing a better understanding of the content of these secretions may help strengthen the relationship between intubation, pneumonia and other respiratory complications.

**Objectives:**

- To characterize the pH, volume, amylase, and micro-organism content of subglottic secretions collected on top of the cuff during intubation for surgery
- To determine the optimal timing interval for suctioning fluid from the cuff during surgery

**Methods.** After IRB approval and informed consent, 48 patients were intubated with the Taperguard EVAC TM endotracheal tube and randomized to either continuous (20 mmHg) or intermittent (100-150 mmHg for 15 seconds with an 8 second pause) suctioning schemes. The patients were randomized in a 1:1 ratio to the two suctioning schemes and equally distributed by gender (male, female) and age ( $< 50$  years,  $\geq 50$  years). Specimens were collected in a Lukens trap every 30 minutes for the duration of surgery. All intubation times were greater than two hours. Samples were analyzed for pH, volume, amylase, and microorganisms. **Results:** Thirty-five patients (73%) had secretions cultured, of which 48% of those patients had pathogenic microorganisms. Pathogenic microorganisms comprised 15% of all microorganisms cultured. All data were analyzed using a univariate ANOVA. No significant difference was found for pH, volume and amylase between the two different suctioning schemes, gender or age.

**Conclusions:** The Taperguard EVAC TM endotracheal tube allowed secretions to be collected independent of suction scheme, gender, and age in intraoperative patients. These secretions frequently contain pathogens that may contribute to postoperative pneumonia and other respiratory complications.

## References

1. Dezfulian C, Shojania K, Collard HR, Kim HM, Matthay MA, Saint S (2005). Subglottic secretion drainage for preventing ventilator-associated pneumonia: a meta-analysis. *Am J Med.* **118**(1):11–18.
2. Smulders K, van der Hoeven H, Weers-Pothoff I, Vandenbroucke-Grauls C (2002). A randomized clinical trial of intermittent subglottic secretion drainage in patients receiving mechanical ventilation. *Chest.* **121**(3):858–862.
3. Mahul P, Auboyer C, Jospe R, et al. (1992). Prevention of nosocomial pneumonia in intubated patients: respective role of mechanical subglottic secretions drainage and stress ulcer prophylaxis. *Intensive Care Med.* **18**(1):20–25.
4. Chastre J, Fagon JY (2002). Ventilator-associated pneumonia. *Am J Respir Crit Care Med.* **165**: 867–903.

## Paper No: 824.00

### Preservation of the Spontaneous Ventilation during a Bronchoscopic Resection of a Typical Bronchial Carcinoid Tumor: Case Report

Sergio Andres, Jaramillo Valencia, Fredy Ariza and Luis Angel Betancur

**Background:** Typical bronchial carcinoid tumors (TBCT) are infrequent malignancies corresponding to 1–2% of lung tumors. Typically, TBCT are not associated with smoking and affect big caliber bronchi with subsequent airway obstruction and atelectasia. Surgical treatment for these tumors is ideally done by an endobronchial approach. A wrong anesthetic management could trigger serious respiratory complications during procedure.

**Methods:** We describe the anesthetic management for a 42-year-old man with multiple polypoid tumors located in bronchia lumen who consult for respiratory failure. Image studies suggested TBCT. Additionally, we review the anesthetic considerations for these cases.

**Results:** A rigid bronchoscopy was initially done in this patient under a pure inhaled-based general anesthesia with sevoflurane (2 MACs) and preservation of spontaneous ventilation. Additional instilled 2% lidocaine with epinephrine and cold saline helped to control bleeding during the endoscopic resection of some of the polypoid masses. Suddenly, ventilation of the patient turned difficult due to a partial obstruction by pieces of the tumor and bleeding, forcing to change anesthetics administration to a TIVA technique until completion of the procedure without other incidents.

**Conclusions:** Surgical resection of endobronchial tumors like TBCT requires an anesthetic management based in drugs

that preserve spontaneous ventilation, especially when risk of acute obstruction of the airway due to migration of the excised malignant tissue remains high. Additionally, neuro-vegetative and hemodynamic protection are permanent concerns during all the time of endoscopic resection. Rigid bronchoscopy ensures ideal conditions for the anesthetic delivery when an inhaled-based anesthesia is chosen although an intravenous technique is a valid alternative for these endoscopic procedures.

## Reference

1. Kulke MH, Mayer RJ. Carcinoid tumors. *N Engl J Med.* 1999; **340**: 858–868.
2. Erdoğan Cetinkaya, Gülfidan Aras. Treatment of endoluminal typical carcinoid tumor with bronchoscopic techniques. *Tüberküloz ve Toraks Dergisi* 2009; **57**(4):427–430
3. Roger Marks, Leigh Tanner. Management of a tumor in the distal trachea while maintaining spontaneous ventilation. *J Anesth* (2010) **24**:932–934.
4. Nick Antoniadis, Christopher Worsnop. Topical lidocaine through the bronchoscope reduces cough rate during bronchoscopy. *R Respirology* (2009) **14**:873–876.
5. Jeff Schnader, Jim Harrell. Clinical Conference on Management Dilemmas: Bronchiectasis and Endobronchial Polyps. *Chest* 2002; **121**:637–643.

## Paper No: 838.00

### Comparison of thiopentone and propofol for induction of ga in asthmatic patients on treatment and incidence of bronchospasm and laryngospasm

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**Introduction:** Asthma is a condition of increased sensitivity of bronchial tree. Asthmatics are more prone to bronchospasm under general anaesthesia than the general population. Even though on treatment, bronchospasm and laryngospasm may occur in some patients. Here the induction agent thiopentone is more prone for bronchospasm and laryngospasm. It is compared with propofol in this study

**Objectives:** The induction agent thiopentone is compared with propofol in this study. Asthmatic patients were kept on bronchodilator treatment. Incidence of bronchospasm and laryngospasm were observed.

**Methods:** Hospital ethics committee approval was taken and informed consent was obtained from patients. Both males and females were included. Age ranged from 25 to 73 years. Patients requiring elective surgery have undergone routine investigations and Lung function tests and were kept on bronchodilator therapy and improved effects were noted. They were divided into 2 groups of 65 each. After



improvement patient was taken to operating table, IV line was started and the following monitors were connected: pulse oxymeter, NIBP, ECG, ETCO<sub>2</sub>. They were randomly anaesthetized: group 1 with thiopentone, group 2 with propofol. When bronchospasm and laryngospasm occurred, they were treated adequately with IPPV, volatile anaesthetics, nebulisation with bronchodilators and muscle relaxants.

**Results:** In both groups male:female ratio was similar. Average age was similar. Average weight was similar. Incidence of bronchospasm and laryngospasm in thiopentone group was significantly higher than propofol group.

**Discussion:** Bronchospasm is one of the complications under general anaesthesia. Asthmatic patients are more prone to bronchospasm than general population. In this study, asthmatic patients requiring elective surgery were kept on bronchodilator therapy and symptoms controlled. They were divided into 2 groups. First group was given thiopentone and incidence of bronchospasm and laryngospasm was significantly higher than in second group, in which propofol gave some protection against bronchospasm.

**Conclusion:** Bronchodilator therapy in asthmatics mitigates or avoids bronchospasm. Propofol reduces the chances of bronchospasm when used as induction agent. With thiopentone there is increased incidence of bronchospasm which is statistically significant.

## Reference

1. McKeating K, Bali IM, Dundee JW. The effects of thiopentone and propofol on upper airway integrity. *Anaesthesia* 1988; **43**: p638-40.

## Paper No: 874.00

### Predictive value of airway assessments for difficult intubation in thyroid surgery

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**Introduction:** Anaesthesia for thyroid surgery is generally considered challenging, with potential difficulties in airway management and subsequent intubation posed by the presence of a neck mass and malignancy. Airway physical examination prior to anaesthesia has been recommended [1,2], although there is no clear evidence which of the assessments provide strongest predictive value, particularly for thyroid surgery.

**Objectives:** To ascertain the incidence of difficult airway and intubation in thyroid surgery, and the predictive value of preoperative airway assessment

**Methods:** A prospective observational study was conducted of all patients undergoing thyroid surgery at the Hammersmith Hospital in 2011 (approved by the Chair of the Local Clinical

Ethics Committee). The investigator obtained informed consent on the day of surgery. Data collected included a full airway assessment as well as patient demographic and clinically relevant data. The anaesthetising clinicians, who were blinded to these findings, documented difficulties in airway management and intubation, which was collected by the investigator along with size and pathology of goitre.

**Results:** A total of 67 consecutive patients were recruited. 35 patients had a hemithyroidectomy, and 32 patients had a total thyroidectomy. Laryngoscopy View: Grade I Grade II Grade III Number: 43 16 8 Malignancy: 7 5 3 Mallampati 1/2/3 29/10/4 6/6/4 4/4/0 Body Weight/kg (mean ± SD): 72.7 ± 13.4 78.5 ± 12.2 66 ± 25.0 Body Mass Index (mean ± SD): 27.6 ± 5.5 29.9 ± 4.0 30.1 ± 7.6 Neck Circumference (mean ± SD): 36.3 ± 3.2 39.3 ± 4.0 40.0 ± 8.0 Thyromental Distance: Height (mean ± SD): 5.31 ± 0.91 5.30 ± 1.294 56 ± 0.55 Goitre Weight/g (mean ± SD): 56.3 ± 56 71 ± 91.8 127.2 ± 135.2 Upper Lip Bite Test Class I/II/III: 13/30/0 4/8/0 1/6/1 Jaw Protrusion A/B/C: 38/6/0 14/2/0 8/0/0.

**Conclusions:** The incidence of difficult intubation (defined as Cormack and Lehane Grade III on direct laryngoscopy) was 12%, similar to documented results from retrospective studies in thyroid surgery [3,4], but greater than that in "general anaesthesia" [5]. There were no grade IV laryngoscopies. Furthermore none of the patients were difficult "airways" with bag & mask ventilation described as easy in 82% and manageable in 18%. When comparing difficult (Grade III) and easy (Grade I) intubation grades, neck circumference (p value 0.028), thyromental distance: height ratio (p value 0.03) and goitre weight (p value 0.015) appeared stronger predictors of potential difficulty compared to the more commonly assessed Mallampati grade, presence of malignancy and relation of maxillary to mandibular incisors (upper lip bite test/jaw protrusion). In conclusion, although potentially challenging, there are predictive factors unique to airway management in thyroid surgery.

## References

1. Raising the Standard: A compendium of audit recipes (Second edition 2006). Royal College of Anaesthetists.
2. American Society of Anaesthesiologists Task Force on the Management of the Difficult Airway. Practice guidelines for the management of the difficult airway: an updated report by the American Society of Anaesthesiologists Task Force on the Management of the Difficult Airway. *Anaesthesiology* 2003; **98**: 1269–77.
3. Adnet F, Borron SW et al. The intubation difficulty scale (IDS): proposal and evaluation of a new score characterising the complexity of endotracheal intubation. *Anaesthesiology* 1997; **87**: 1290–7.
4. Amathieu R, Smail N et al. Difficult intubation in thyroid surgery: Myth or Reality? *Anaesthesia & Analgesia* 2006; **103**: 465–8.
5. Adnet F, Racine SX et al. A survey of tracheal intubation difficulty in the operating room: a prospective observational study. *Acta Anaesthesiol Scand* 2001; **45**: 327–32.



**Paper No: 994.00****Incidence of postoperative atelectasis or pneumonia according to anesthesia technique**

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**Introduction:** The postoperative atelectasis and pneumonia are most frequently observed after abdominal surgery with inhalatory general anesthesia increases DAaO<sub>2</sub> and Qs/Qt.

**Objectives:** To demonstrate that the incidence of postoperative pneumonia or atelectasis and DAaO<sub>2</sub> and Qs/Qt transoperative changes are less anesthesia with propofol than with halothane. **Methods:** It was designed a controlled clinical trial and prior authorization of the Local Committee for research and informed consent of patients, studied 114 subjects undergoing abdominal surgery, randomly divided into: grupo1 = Intravenous general anesthesia with Propofol and grupo2 = inhalatory general anesthesia with halothane. After oxygenation we took blood samples to determine the DAaO<sub>2</sub> and Qs/Qt. We assessed the preoperative pulmonary status with chest x-rays that are repeated 24/48/72 hours/sixth day, interpreted by two radiologists blinded experimental setting.

**Results:** The groups were similar in age, sex, weight, anesthetic time and type of surgery. Propofol group consisting of 36 women and 21 men, DAaO<sub>2</sub> in Basal Torr (B) =  $256.8 \pm 68.1$ , Transanesthetic (TA) =  $258.4 \pm 72.2$  and post-anesthetic (PA) =  $226.3 \pm 70.9$ . Qs/Qt: B =  $19.7 \pm 6.5$ , TA =  $19.0 \pm 5.4$  and PA =  $14.5 \pm 5.8$ . 28% Had pulmonary complication, 8 pneumonia and atelectasis 13. The halothane group with 31 mujeres and 26 men DAaO<sub>2</sub> B =  $271.8 \pm 74.6$ , TA =  $282 \pm 66.4$ , PA =  $249.2 \pm 73.7$ . Qs/Qt B =  $19.5 \pm 6.5$ , TA =  $22.6 \pm 8.6$ , PA =  $19.0 \pm 10.1$ . 60% Attended with pulmonary complication 20 pneumonias and 25 atelectasis. We calculated a relative risk = 3.3 (95% CI 1.2 to 9.3) to pneumonia and 2.6 (IC<sub>95%</sub> 1.17 a 6.5) for atelectasis.

**Conclusions:** The incidence of postoperative pneumonia and atelectasis was higher in the group managed with halothane.

**References**

1. Pedersen T, Eliassen K, Henriksen E. A prospective study of risk factors and cardiopulmonary complications associated with anaesthesia and surgery: risk indicators of cardiopulmonary morbidity. *Acta Anaesthesiol Scand* 1990; **34**: 144–55.
2. Hall CJ, Tarala AR, Hall LJ, Mander J. A Multivariate analysis of the risk of pulmonary complications after laparotomy. *Chest* 1991; **4**: 923–926.
3. Kimberly S, Ephgrave , Kleiman WR, Pharm D, Pfaller M Booth B, Werkmeister L, Young S. Postoperative pneumonia: A prospective study of risk factors and morbidity. *Surgery* 1993; **114**: 815–20.

**Paper No: 1163.0****Effects of superimposed high frequency jet ventilation on oxygenation and carbondioxide retention in rigid bronchoscopy**

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**Introduction:** Hypoxia and hypercapnia are important anesthetic problems during rigid bronchoscopy with the conventional ventilation. Carbondioxide retention can be prevented during Superimposed High Frequency Jet Ventilation (SHFJV), and therefore this ventilation mode can be applied for an extended period, while oxygenation is achieved through simultaneous use of normal and high frequency ventilation models (1-4).

**Objective:** The aim of this study is to investigate the effects of tubeless superimposed high frequency jet ventilation (SHFJV) on oxygenation and carbondioxide retention in rigid bronchoscopy. **Methods:** Following Institutional Ethical Committee approval, 40 ASA I-II patients were randomly assigned to two equal groups. After anesthesia induction with lidocaine 1 mg/kg iv, propofol 2-2.5 mg/kg, rocuronium 0.6 mg/kg, remifentanyl 0.2 µg/kg/min, anesthesia was maintained using total intravenous anesthesia with propofol 4-10 mg/kg/h and remifentanyl 0.05-0.2 µg/kg/min. Group I was ventilated with conventional ventilation, and respiration was set at Vt: 8 ml/kg, 12 breath/min, I:E ratio = 1:2, FiO<sub>2</sub>: 0.6. Group II was ventilated with SHFJV, normal frequency unit was set at 12 breath/min, I:E ratio = 1:2, P:1 bar, and high frequency unit at 600 breath/min, I:E ratio = 1:2 and P:1 bar. Heart rate (HR), systolic arterial pressure (SAP), diastolic arterial pressure (DAP), mean arterial pressure, periphereic oxygen saturation (SpO<sub>2</sub>), end tidal carbondioxide (ETCO<sub>2</sub>) levels, PaO<sub>2</sub>, PaCO<sub>2</sub>, pH, SO<sub>2</sub> and HCO<sub>3</sub> values were recorded at onset (control), induction, before, during and after bronchoscopy and postoperative first hour. Data were analysed with Student's t, Chi Squared, paired t and repeated measurement two way variance analyses tests. Statistical significance was considered as p < 0.05.

**Results:** There was no significant difference in DAP, MAP and HR values between the two groups. SAP was higher at the 10th min in Group I (p < 0.05). SpO<sub>2</sub> displayed high values in SHFJV group at each recording, while no significant difference was observed for SpO<sub>2</sub> and PaO<sub>2</sub> between the two groups. ETCO<sub>2</sub> and PaCO<sub>2</sub> values were significantly lower in the SHFJV group between 5-30 mins of bronchoscopy and after bronchoscopy (p < 0.05). Although there was no significant difference in PaCO<sub>2</sub> values between the two groups, it displayed lower values in the SHFJV group at each recording. In Group I, ETCO<sub>2</sub> and PaCO<sub>2</sub> values increased continuously during bronchoscopy (p < 0.05), and reached their highest

values (ETCO<sub>2</sub>:  $41.10 \pm 8.32$  mmHg and PaCO<sub>2</sub>:  $63.80 \pm 10.59$  mmHg) after bronchoscopy ( $p < 0.05$ ).

**Conclusions:** SHFJV should be preferred during rigid bronchoscopy, due to the advantage of achieving more effective CO<sub>2</sub> elimination, as well as hemodynamic stability and sufficient oxygenation.

## References

1. Aloy A, Schachner M, Cancura W. Tubeless translaryngeal superimposed jet ventilation. *Eur Arch Otorhinolaryngol.* 1991; **248**: 475–8.
2. Aloy A, Schachner M, Spiss CK, Cancura W. Tube-free translaryngeal superimposed jet ventilation. *Anaesthesist.* 1990; **39**: 493–8.
3. Kraincuk P, Körmöcz G, Prokop M, Ihra G, Aloy A. Alveolar recruitment of atelectasis under combined high-frequency jet ventilation: a computed tomography study. *Intensive Care Med.* 2003; **29**: 1265–72.
4. Rezaie-Majd A, Bigenzahn W, Denk D-M, Burian M, Kornfehl J, Grasl M, et al. Superimposed high-frequency jet ventilation (SHFJV) for endoscopic laryngotracheal surgery in more than 1500 patient. *British Journal of Anaesthesia* 2006; **96**: 650–9.

## Paper No: 1262.0

### Preoperative pH predicts post-single lung transplant ventilation improvement in COPD patients

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**Introduction:** Patients with diagnosis of advanced chronic obstructive pulmonary disease (COPD) who undergo off-pump single lung transplantation (SLT) are at high risk of suffering volume or pressure related damage of the native lung during selective ventilation. Permissive hypercapnia (PaCO<sub>2</sub> between 50 and 100 mmHg, and pH  $\leq 7.20$ ) is a preventive alternative in selective lung ventilation, although it leads to transient alveolar hypoventilation.

**Objectives:** The aim was to identify intraoperative predictors in arterial blood gases (ABG) samples of post-transplant alveolar ventilation improvement in single lung transplant (SLT) COPD recipients.

**Material and Methods.** Between June/1994 and July/2011, 119 SLT were performed at our hospital. Of these, 64 COPD patients who received off-pump SLT were included in the study. All patients were in NYHA functional class IV. The ventilatory modality during the anaesthetic procedure was controlled volume with permissive hypercapnia. ABG samples were obtained after anaesthetic induction (baseline) and at the end of the procedure (final). Variables were compared using paired t test. A linear correlation was performed between baseline pH and  $\Delta$ PaCO<sub>2</sub> (PaCO<sub>2</sub> basal - PaCO<sub>2</sub> final). Results: Basal and Final measurements of ABG (mean  $\pm$  SD) were compared in the following table:

Baseline	Final	p value
PaCO <sub>2</sub> (mmHg)	60.5	
pH	11.6	50.6
pH	10.6	<0.01 pH 7.32
pH	0.06	7.34
pH	0.09	<0.05
HCO <sub>3</sub> (mM)	29.2	
pH	5.6	27.3
pH	5.3	<0.05
PaO <sub>2</sub> (mmHg)	370	
pH	131	391
pH	133	
NS BE (mM)	4.1	
pH	4.4	1.9
pH	4.1	<0.01

The following linear adjust was obtained:  $\Delta$ PaCO<sub>2</sub> =  $117 \cdot \text{pH baseline} - 866$  ( $p < 0.001$ ;  $r = 0.6$ ).

**Conclusions.** PaCO<sub>2</sub>, HCO<sub>3</sub> and base excess (BE) were immediately improved by the procedure. A linear correlation was identified between baseline pH and  $\Delta$ PaCO<sub>2</sub>. Pre transplant pH was an independent predictor of post-transplant alveolar ventilation improvement in this study.