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Research article

Anesthetic techniques and haemodynamic control for Endoscopic Sinus Surgery: A retrospective analysis and review of literature

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ABSTRACT

Introduction: Bleeding from mucosal edges is known to decrease surgical visibility and increase the risk of complications in Endoscopic sinus surgery (ESS). A variety of strategies, including modifying anesthetic techniques have been proposed to create a bloodless field. A recent survey in anesthesiologist revealed that a vast majority neither use controlled hypotension nor believe that modifying the anesthetic techniques will improve the outcome of ESS. This study investigates the different anesthetic techniques used for ESS and their effect on the haemodynamic variables achieved intra-operatively.

Methods: Data were retrospectively collected from an electronic anesthesia database on 233 consecutive adult patients who underwent endoscopic sinus surgery in a tertiary hospital in Singapore from January 2014 to August 2015 and statistical analysis was performed using SPSS.

Results: Inhaled anesthetics (IA) were used for 93% (49% with morphine or fentanyl, 42% with remifentanil) and total intravenous anesthesia (TIVA) for 7% of the cases respectively. The airway was secured with endotracheal tube in 94.6% and the rest were having LMA. Average Mean Arterial Pressure (MAP) lower than 70 mmHg was achieved in 74.4%. Antihypertensive drugs were used only in 5 cases (2.3%). Distribution of intra operative MAP and Heart rate (HR) were similar among different anesthetic techniques. Lowest MAP and HR achieved were significantly lower in IA with remifentanil use.

Conclusion: Inhaled anesthesia is the preferred maintenance technique used for ESS. The desired MAP range was achieved in about 75% of the cases without needing anti hypertensives. Use of remifentanil reduces the MAP and HR further which might potentially improve the quality of surgical field and the outcome.

1. Introduction

Endoscopic sinus surgery (ESS) is a widely used surgical intervention for treatment of various sinus pathologies [1]. Bleeding from mucosal edges is known to decrease surgical visibility and increase the risk of complications [2]. Optimized surgical field in ESS has been proven to improve surgical outcomes, reduce operating time and lessen blood loss [3]. A variety of strategies have been proposed to create a bloodless field: (a) patient positioning in reverse Trendelenburg to decrease venous congestion of the upper part of the body [4], (b)administration of topical vasoconstrictors to nasal mucosa to decrease capillary bleeding [5], (c) anesthetic modifications like the use of a laryngeal mask airway to decrease hemodynamic responses to endotracheal intubation [6], (d) "high-frequency" jet ventilation to improve venous return [7] and (e) manipulation of ventilator settings to avoid hypercarbia which is a potent vasodilator [8]. Controlled hypotension is another widely used method to reduce the surgical bleeding in otorhinolaryngology, vascular, orthopedic and orthognathic surgeries. Controlled hypotension is defined as a fall in systolic blood pressure (SBP) to 80–90 mmHg, or mean arterial pressure (MAP) to 50–65 mmHg in normotensive patients, or a fall of 30% of MAP in patients with hypertension [9]. The state of hypotension is achieved by reducing the systemic vascular resistance or cardiac output, which is determined by stroke volume and heart rate.

A recent questionnaire survey done in Singapore found that almost 65% do not routinely employ controlled hypotension for ESS and 47% opined that anesthetic technique made no substantial divergence in outcomes of endoscopic sinus surgery [10]. This

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deviation of practice from the recommendation may be due to the ability to achieve MAP within the ranges that minimize surgical bleeding just by being under general anesthesia (GA). Alternatively, the surgeons may be able to achieve good visual fields under normotensive range by non anesthetic techniques. This retrospective study aims to investigate the hemodynamic parameters achieved during surgery, the various anesthetic techniques used for ESS and the outcome of those techniques along the intra operative hemodynamic variables.

2. Methods

This study protocol was developed in accordance to the STROBE (Strengthening the Reporting of Observational studies in Epidemiology) guidelines for reporting cross sectional studies and was approved by the Sing health Centralized Institutional Review Board with the waiver of informed consent (CIRB No 2015/2864).

A total of 233 patients who had general anesthesia for ESS in major operating theatre from January 2014 to August 2015 were identified from an electronic surgical data base. All the patients' electronic pre-anesthetic documents and intra-operative anesthesia charts were reviewed by study members. We searched the following information from the pre-operative anesthetic document; Height, weight, BMI, age, gender, ASA status and history of hypertension and base line mean arterial pressure (MAP) at pre-operative evaluation clinic or at wards during anesthetic review. Electronic anesthesia chart was reviewed in detail to obtain (1) type of anesthesia used for maintenance (Inhalational or TIVA), (2) choice of airway technique used (type of endotracheal tube or Supra glottis airway), (3) drugs used for controlled hypotension (remifentanil, anti-hypertensive), (4) opioids administered and dose, (5) highest/lowest and average MAP and Heart rate (HR) achieved during surgery (excluding hemodynamic changes during induction and emergence of anesthesia), (6) mode of ventilation, (7) average ETCO2 range, (8) duration of anesthesia and (9) duration of surgery.

Average MAP was classified into MAP less than 50, 51–60, 61–70, 71–80 and above 80 mmHg. Average HR was categorized to HR under 40, 41–50, 51–60, 61–70 and 71–80 and above 80 beats per minute. Average ETCO2 was classified to ETCO2 under 30, 30–35, 36–40, 41–45 and above 45 mmHg. The ETCO2 was documented as a graph in the electronic anesthesia document. From the ETCO2 trace, tentative baseline ETCO2 was calculated for each 15-min time block, and the intra-operative average was derived from the values of 15 min blocks.

3. Statistical methods

Statistical analysis was performed using SPSS for Mac version 20.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were reported as mean values (SD). Categorical variables were reported as numbers (percentage). Normality for continuous variables into groups was determined by the Shapiro-Wilk test. One-way analysis of variance (ANOVA), Dunnett's test and student's *t*-test were applied for comparison of continuous variables between the examined groups. Pearson chi-square test was applied for comparison of categorical variables among studied groups. A p value below 0.05 was considered statistically significant.

4. Results

We reviewed 233 anesthetic documents and nine cases were excluded. Of those, eight cases were due to wrong surgical coding and one due to cancellation of surgery after induction of anesthesia. Data were obtained from 224 cases and used for the analysis.

The average age (SD) of our patient cohort was 49 (15) years with 56% males and remaining 44% patients were females. The majority of the patients (60.7%) belonged to the American Society of Anesthetists (ASA) 2 class, while 33.5% were ASA 1 and 5.8% ASA 3 respectively. Seventy (31.2%) patients were known to have hypertension with the mean (SD) MAP of 98.7 (12.2) mmHg at the time of pre-operative visit, while the rest (68.7%) of the normotensive patient had the mean (SD) MAP was 91.03 (12.1). Mean (SD) duration of anesthesia was 122.88 (51.4) min and the surgery was 91.03 (50.9) min (Table 1).

4.1. Anesthetic techniques

The airway was secured with endotracheal intubation in 212 (94.6%) patients, while the laryngeal mask airway was used in 12 (5.4%). The most popular choice of the endotracheal tube (ETT) used was armored tube, documented in 149 (66.5%) cases. RAE (Ring, Adair and Elwyn) preformed south tube and normal Portex ETT were used in 62 (27.7%) and one (0.45%) case respectively. Volume controlled ventilation was chosen in 214 (95.5%) patients, pressure control ventilation in six (2.7%) patients. Two (0.89%) patients each were ventilated using synchronized intermittent mandatory ventilation (SIMV) mode and spontaneous respiration. Anesthesia was maintained with inhaled anesthetic (IA) alone in 110 (49.1%) patients and a combination of IA and remifentanil (IA-R) in 94 (42%) patients. A combination of Total intravenous anesthesia (TIVA) with propofol and remifentanil was used in 16 (7.4%) and IA, propofol and remifentanil were administered to 4 (1.8%) patients. Almost all the patients (99.5%) received at least one opioid except one patient who didn't receive any (Table 2).

4.2. Intra-operative hemodynamic variables

The mean (SD) of lowest and highest MAP values were 55.57 (8.88) mmHg and 82.59 (13.7) mmHg respectively. The average MAP was 70 mmHg or below in 167 (74.55%) and above 70 mmHg in 57 (25.45%) cases (Fig. 1).

Table 1
Summary of patient demographic data and health status.

Characteristics	Mean (SD)
Age (years)	49.37 (15.14)
Height (m)	1.64 (0.10)
Weight (kg)	66.62 (14.08)
BMI (kg m^{-2})	24.65 (4.59)
Duration of anesthesia (min)	122.88 (51.4)
Duration of surgery (min)	96.48 (50.9)
Average baseline MAP (mmHg)	
Patients with known hypertension[a]	98.76 (12.26)
Patients without hypertension	91.03 (12.19)
Characteristics	**Number (%)**
ASA score	
1	75 (33.48%)
2	136 (60.71%)
3	13 (5.80%)
Gender	
Male	126 (56.25%)
Female	98 (43.75%)
History of hypertension	
Yes	70 (31.25%)
No	154 (68.75%)

Data is presented as mean (standard deviation) or number (Percentage).
BMI – body mass index, ASA score – American Society of Anaesthesiologists' classification of Physical Health, MAP – mean arterial pressure.
[a] Mean of baseline MAP (mmHg) in patents already diagnosed to have hypertension.