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# Anaesthesia and peri-interventional morbidity of rigid bronchoscopy: A retrospective analysis

Jerry Tan [a,*], Dinoo Kirthinanda [b], Dawen Esther Yu [c], Ruban Poopalalingam [a], Harikrishnan Kothandan [a]

[a] Department of Anaesthesia, Outram Road, Singapore General Hospital, Singapore 169608, Singapore
[b] Singhealth Residency Program, Ministry of Health Holdings, Singapore 099253, Singapore
[c] Duke-National University of Singapore Graduate Medical School, Singapore

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ABSTRACT

*Background:* Rigid bronchoscopy is an invasive procedure that requires general anaesthesia with different ventilation strategies. Various mechanical and systemic complications can arise from the procedure and anaesthetic technique employed. The aim of this study is to evaluate the two common anaesthetic techniques and the peri-interventional morbidity of rigid bronchoscopy.

*Methods:* We retrospectively analysed all the rigid bronchoscopies conducted in Singapore General Hospital between 1999 and 2014. Patient characteristics, type of procedures, type of anaesthesia, duration of procedure, ventilation strategies, various intra-operative medications, pre-operative and post-operative arterial blood gas, oxygen saturation and pulmonary function test, and peri-interventional complications were collected. Continuous data were reported as mean and categorical data were reported as percentages.

*Results:* Majority of patients that underwent rigid bronchoscopy received total intravenous anaesthesia (81%). A significantly higher proportion of patients in the volatile groups were scheduled for biopsy (29.4%) using rigid bronchoscopy. Choice of ventilation strategies were largely similar in both groups. A higher complication rate of hypertension (11.8%), acute myocardial infarction (11.8%) and pneumothorax (17.6%) was seen in the volatile group.

*Conclusion:* The choice of anaesthetic technique possibly affects the complication of patients undergoing rigid bronchoscopy. Volatile anaesthetics appeared to be driven by presumably shorter procedure, but was associated with higher systemic complication.



## 1. Introduction

The rigid bronchoscopy defined by the as the passage of rigid instruments trans-orally or trans-tracheostomy for diagnostic or therapeutic purposes, aided by various light sources, telescopes and accessory instruments [1]. Although the use of rigid bronchoscope was largely replaced by the use of flexible bronchoscopes for most therapeutic and diagnostic purposes in adults, it maintains its value for better control of the compromised airway, massive haemoptysis, airway stent placement and removal of large foreign bodies [2]. The indications and contraindications for rigid bronchoscopy are listed in Table 1.

Mechanical complications associated with rigid bronchoscopy include those arising from the underlying pathology as well those associated with the procedure. The requirement for general anaesthesia for rigid bronchoscopy predisposes patients to various peri-interventional morbidity that may be attributed to the choice of anaesthetic and airway management.

## 2. Methods

We carried out a retrospective observational study at Singapore General Hospital to assess the perioperative outcomes of the rigid bronchoscopy after obtaining Institutional Review Board (IRB) approval.

Patients who required bronchoscopy at the Singapore General Hospital between 1999 and 2014 was retrieved through Operating Theatre records and Online Operating Theatre Listing Software (OTM). A total of one hundred and twenty-two cases were identified and individual medical records were physically retrieved from

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* Corresponding author at: Blk 5 Level 2, Anaesthesia Office Outram Road, Singapore 169608, Singapore.
*E-mail address:* tan.jerry@outlook.com (J. Tan).

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**Table 1**
Indication and contraindications for rigid bronchoscopy.

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|---|
| **Indications for rigid bronchoscopy** |
| • Management of massive haemoptysis |
| • Treatment of tracheobronchial stenosis |
| • Foreign body removal |
| • Tumour resection |
| • Deep bronchial wall biopsy |
| **Contraindications for rigid bronchoscopy** |
| • Unstable cervical spine |
| • Severe maxillofacial trauma or deformity |
| • Obstructing oral or laryngeal disease |

Adapted from ERS/ATS statement on interventional pulmonology, 2002 [1].

the Singapore General Hospital Medical Records Office (MRO). Ninety patients were included in the final analysis after exclusion criteria was applied. These exclusion criteria include flexible bronchoscopy and missing medical records. Data were collected by the investigators using a prefabricated data collection form.

We defined hypotension as the reduction of mean arterial pressure (MAP) below 20% of the baseline and/or requirement of inotropic support to maintain MAP more than 65 mmHg, and hypertension as the elevation of MAP above 20% of baseline. Oxygen saturation less than 92% or partial pressure of oxygen less than 60 mmHg was considered as hypoxia. Dysrhythmias was defined as new onset of cardiac rhythm that differ from patient cardiac rhythm at baseline. Acute myocardial infarction (AMI) defines the new onset of ischaemic electrocardiogram (ECG) changes with elevated cardiac troponins. We take into account death that occurred during the admission for rigid bronchoscopy. We accepted diagnoses of various complications by principal clinicians at the time of discharge such as pulmonary oedema, pulmonary embolism, pneumothorax, pneumonia and delirium.

## 3. Statistics

Statistical analysis was performed using SPSS for Mac version 20.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were reported as mean ± SD. Categorical variables were reported as percentages. Normality for continuous variables in groups was determined by the Shapiro-Wilk test. Student's *t*-test was used for comparison of means of continuous variables between the studied groups. Pearson chi-square test was used for comparison of categorical variables among studied groups. A value of $P < 0.05$ was considered significant.

## 4. Results

The study was completed with 90 patients. Table 2 shows the demographic characteristics of the patients. Comparatively, the TIVA group has more hypertensive patients than the volatile group.

Table 3 depicts the various procedure performed using rigid bronchoscopy, type of anaesthesia, methods of ventilation and the various medications received intra-operatively. A larger proportion of patients who underwent biopsy received volatile agents (29.4% vs. 8.2%, $P = 0.016$). Of note, there was no significant difference in the method of ventilation between both groups. Remifentanil was used more often in the TIVA group (63.0% vs. 11.8%, $P < 0.001$) and fentanyl more so in the volatile group (41.2% vs. 15.1%, $P = 0.015$).

Table 4 summarises pre-operative and post-operative arterial blood gas, pulse oximetry and pulmonary function test data. Baseline pre-operative parameters were similar between both groups. Post-operatively, patients who received volatiles had a lower pH on arterial blood gas (7.30 ± 0.10 vs. 7.43 ± 0.09, $P = 0.021$). In addition, the volatile group was found to have a significantly higher forced vital capacity (2.73 ± 0.60 vs. 2.19 ± 0.62, $P = 0.034$) than the TIVA group after rigid bronchoscopy.

There were no significant differences in the mechanical complications between the two groups of patients in terms of stent dislodgement, laryngospasm, bleeding, tooth dislodgement or a need for switch to fibre-optic bronchoscopy due to failure to locate lesion. Patients who received volatiles had significantly higher systemic complications of hypertension (11.8% vs. 1.4%), myocardial infarction (11.8% vs. 0%) and pneumothorax (17.6% vs. 0%) as compared to patients who received TIVA (see Table 5).

## 5. Discussion

Our study puts into perspective the patient characteristics, interventions performed, ventilation strategies, intra-operative medications used and complications observed into two distinct groups based on the general anaesthetic technique for rigid bronchoscopy. Challenges unique to rigid bronchoscopy include effective attenuation of haemodynamic response to intubation and prevention of hypoxia in the setting of a shared airway compounded by the underlying disease pathology requiring rigid bronchoscopy.

Laryngeal and endotracheal intubation with the rigid bronchoscopy increases the sympathetic nervous system activity and adrenaomedullary catecholamine activity. Tachycardia is more pronounced when tracheal manipulation is involved [3]. The resulting hypertension, tachycardia and dysrhythmias increase the peri-operative risk for subgroup of patients with coronary artery disease, existing hypertension, preeclampsia and intracranial pathologies such as aneurysms [4]. Pharmacological agents such as intravenous or topical lignocaine, opioids such as remifentanil, nifidipine, clonidine, gabapentin, esmolol and magnesium sulphate had been described with variable success in ameliorating the haemodynamic response to tracheal intubation [5–11]. In a recent Cochrane review, the risk of dysrhythmias was reduced with administration of local anaesthetics, calcium channel blockers, beta blockers and narcotics as compared to placebo and showed reduced ECG evidence of myocardial ischaemia [12].

Remifentanil is an ultra-short acting opioid and works synergistically with both propofol and volatile agents such as sevoflurane in ablating the response to laryngoscopy [13,14]. With the myriad of other pharmacological agents to achieve the same haemodynamic suppression to laryngoscopy, the choice of remifentanil may be hindered by cost, need for specialised pumps and familiarity of use. As seen in our study, remifentanil was favoured in the TIVA as compared to volatile group (63% vs. 11.8% $P = 0.000$). We postulated that this was driven by a choice of a simpler anaesthetic by the primary anaesthetist, perceived by a possibly shorter operation time as majority of the cases in the volatile groups were for biopsies (29.4% vs. 8.2% $P = 0.016$). However, this did not translate to an actual shorter operation duration as compared to the TIVA group. Instead, the incidence of intra-operative hypertension was