
Is asthma still a risk factor for general anesthesia

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Abstract: Objective: To assess the incidence of anaesthetic complications in a cohort of patients with asthma undergoing anaesthesia and surgery. Design, Setting and Patients: 79 patients (who underwent a total of 80 anaesthetics) who were admitted for elective surgery at a major tertiary referral hospital, during a seven month period were enrolled. Data on asthma control and severity were collected prior to surgery, and information on the incidence of intra and post-operative complications were recorded, as well as any alterations to their asthma control following discharge. Results: Perioperative complications occurred in 5 patients (6%), 4 of which developed post-induction bronchospasm, successfully treated in 3 with the fourth having the surgery abandoned. The fifth patient had post-extubation coughing, also successfully managed. The patient who developed severe bronchospasm had poorly controlled asthma. Following discharge 18 patients (24%), reported an increase in severity of their asthma symptoms. This was seen more commonly in patients with poor preoperative asthma control and a higher asthma severity. Conclusions: The incidence of intraoperative complications attributable to asthma was low and generally easily managed. Most asthmatic patients undergo anesthesia without respiratory incident. The low rate of intraoperative respiratory complications does not lead to significant morbidity. However, anaesthetists should focus on optimising their patient's asthma control as poorly controlled asthma can lead to both intraoperative and postoperative respiratory complications.

Keywords: General Anesthesia, Asthma, Bronchospasm, Complications

1. Introduction

It has been estimated that asthma affects about 1 in 9 adults depending on geographic location [1]. Although there have been a number of literature reviews [2-4] written with guidelines on the preoperative and intraoperative management for the patient with asthma undergoing anesthesia, many of these studies are over twenty years old, and undertaken on the basis of retrospective medical record reviews. The patient with asthma has historically been presumed to experience a higher rate of perioperative respiratory complications [5]. However with improvements in asthma control, and a clear change in direction from treatment to prevention, the conclusions reached in many of these early studies may no longer be applicable.

The aim of this study was primarily to undertake a prospective study of a cohort of adult patients with asthma undergoing surgery and anesthesia during three phases, pre-operatively, intra-operatively and following discharge.

2. Methods

Approval to conduct the study was provided by Harbour Human Research Ethics Committee (HREC) of Northern Sydney Central Coast Area Health service.

Patients who were enrolled in the study were followed through three phases.

2.1. Preoperative Assessment

Patients for elective surgery who presented to the Pre-admissions clinic (PAC) at the Royal North Shore Hospital during the seven months study period were screened by the PAC pharmacists to ascertain if they had answered "yes" to the question of whether they suffered from asthma on the patient health questionnaire. Patients were included in the study if they satisfied the following criteria: a) were 18 years or older, b) had asthma which was currently treated, c) were scheduled to have an elective surgery, and d) could provide informed consent to the study.

During the interview with the pharmacist, the following data were also collected: demographic data (age, sex), the nature and date of proposed surgery, the current asthma medications taken, patients' smoking status and recent emergency department presentations for asthma. Each patient was also graded to determine both the severity and the degree of control of the patients' asthma using an adapted tool from the Asthma Management Handbook [1] by the National Asthma Council of Australia (Table 1). They were not given any further specific instructions apart from that to continue taking their regular asthma medications and to treat any symptoms as they would normally.

2.2. Intraoperative Monitoring

Questionnaires were attached to the patients' anaesthetic records for the attending anaesthetist to complete intraoperatively.

The purpose of the intraoperative data collection was to obtain information from the attending anaesthetist with respect to the type of anaesthetic given to the patient, the medications used and whether any intra, or immediate postoperative complications, that could be attributable to the patients' asthma were observed. In cases where this form was incomplete, details were obtained from the patients' medical record and anesthetic charts.

2.3. Postoperative Follow Up

After discharge from hospital, patients enrolled in the study were contacted by telephone generally within two to four weeks. The purpose of this follow up was to ascertain whether the patients felt that their asthma had been influenced by their recent anaesthetic – specifically whether they felt it was worse, unchanged or better as compared to before the surgery.

Table 1. Asthma severity and control tool modified from the Asthma Management Handbook

Asthma control score*	Clinical features	No ICS	Low-dose ICS	Low-to-medium-dose ICS and LABA	High-dose ICS + LABA ± other agents
1	Any of Daytime symptoms occur less than once per week Night-time symptoms occur less than twice per month Exacerbations are brief	Intermittent	Mild persistent	Moderate persistent	Severe persistent
2	Any of Daytime symptoms more than once per week but not everyday Night-time symptoms more than twice per month but not weekly	Mild persistent	Moderate persistent	Severe persistent	Severe persistent
3	Any of Daytime symptoms daily Night-time symptoms at least weekly Exacerbations affect sleep/activity SABA use daily	Moderate persistent	Moderate persistent	Severe persistent	Severe persistent
4	Any of Daytime symptoms everyday and restrict physical activity Night-time symptoms frequent Exacerbations are frequent	Severe persistent	Severe persistent	Severe persistent	Severe persistent

ICS=inhaled corticosteroid. LABA=long acting β -agonist. SABA=short acting β -agonist. * Score of asthma control: 1=well controlled, 2=relatively well controlled, 3=relatively poorly controlled, 4=poorly controlled

3. Results

In the study period, 79 patients were enrolled in the project through the PAC for a total of 80 anaesthetic events (one patient had two separate procedures). Of the study population, 4 medical files could not be located and were lost to follow up, while 2 patients had their surgeries indefinitely postponed at the time of write up.

3.1. Preoperative Assessment

3.1.1. Patient Population

Patients in the study had a mean age of 58(\pm 16) years and had a female propensity (64%). Table 2 also shows the type of surgery for which the patients were admitted. Five of the 79 patients (6%) had presented to an emergency department with acute asthma within the previous 12 months, while 13 (16%) of the patients identified as current smokers.

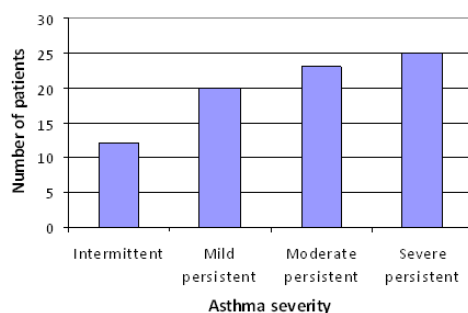
3.1.2. Asthma Severity and Control

With regard to asthma severity classification, almost a third of the patients (31%) were identified as having severe persistent asthma according to the criteria in the Asthma Management Handbook (Table 1), 23 (29%) were scored as having moderate persistent asthma, 20 (25%) as mild persistent asthma, and 12 (15%) as intermittent asthma (Fig. 1). The same tool was also used to provide information on the level of asthma control, namely the frequency of their asthma symptoms, by using the Asthma control score. This is scored from 1 to 4, with 1 indicating well controlled and 4 indicating poorly controlled asthma was used. Forty patients (50%) had well controlled asthma, being symptomatic less than once per week while only 5 (6%) patients reported having poorly controlled asthma, experiencing daily symptoms limiting function as well as frequent night-time symptoms (Fig. 2).

Table 2. Patient demographics

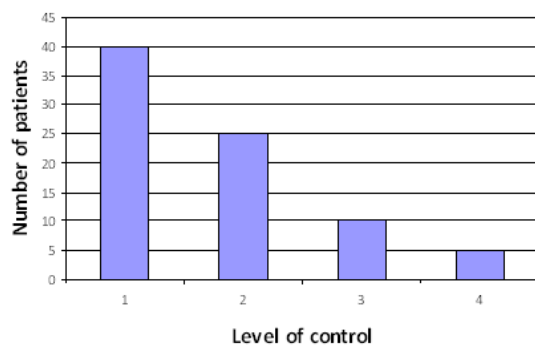
	Number (%)
Age (n=80)	
18-30	6 (8%)
31-50	17 (21%)
51-70	38 (48%)
>70	19 (24%)
Sex (n=80)	
Female	52 (65%)
Male	28 (35%)
Type of surgery (n=80)	
Urological/Gynaecological	16 (20%)
Neurological	14 (18%)
Abdominal	11 (14%)
ENT/Ophthalmology	11 (14%)
Endocrine	10 (13%)
Orthopaedic	10 (13%)
Cardiothoracic	5 (6%)
Plastics	2 (3%)
Vascular	1 (1%)
ED presentation for asthma in last 12 months (n=80)	5 (6%)
Currently smoking (n=80)	13 (16%)

n value is the number of patients that the information was available from. Percentages may not add up to 100% due to rounding.

**Figure 1.** Distribution of the number of patients in the asthma severity tool (n=80)

3.1.3. Asthma Medications

There were a wide range of medications used by the patients in the group, with salbutamol and fluticasone/salmeterol combination used most commonly (89% and 57%, respectively), there were also 5 individuals who were taking oral corticosteroids when they attended the PAC (Table 3).

**Figure 2.** Distribution of the number of patients in the asthma control scale (n=80). (1 – High level of control, 4– Poor control)**Table 3.** Asthma medications used and the number of patients using them (n=80)

Drug	Number (%)
Salbutamol	71 (89%)
Fluticasone/salmeterol*	46 (57%)
Budesonide/formoterol**	14 (17%)
Tiotropium	13 (16%)
Steroid inhaler alone†	8 (10%)
Formoterol	1 (1%)
Salmeterol	1 (1%)
Nedocromil	1 (1%)
Theophylline	1 (1%)
Oral corticosteroids	4 (5%)

*Seratide. **Symbicort. †includes budesonide, beclomethasone and ciclesonide

3.2. Intraoperative Complications

Of the 74 anaesthetics, 5 patients (7%) developed an intraoperative complication thought to be related to their asthma. Four (5%) of the complications were the development of post-induction bronchospasm. This was successfully managed in 3 cases, using salbutamol delivered via the anaesthetic breathing circuit, but in the fourth case, the response was severe enough to result in the surgical procedure being abandoned. One complication was an episode of post-extubation bronchospasm successfully treated with nebulised salbutamol. More details of these cases are provided in Table 6 (at the end of paper). In terms of the type of airway employed, 57 (77%) of patients were intubated and mechanically ventilated, while in 17 (23%) patients, including 2 out of the 4 who developed bronchospasm, anesthesia was administered using a spontaneously breathing approach a Laryngeal Mask Airway (LMA) (Table 4).

3.3. Postoperative Follow Up

Following surgery, 50 (66%) of the patients had a hospital stay of 4 or less days, with only 2 (3%) spending more than 2 weeks in hospital. Patients were contacted two weeks after hospital discharge. Eleven (15%) patients resumed cigarette smoking. In assessing how asthma may have changed following return from hospital, 45 (61%) reported their asthma to be the same as compared to before while 18 (24%) reported a worsening of symptoms (Table 5).

Table 4. Intra-operative airway management

Airway management (n=74)	Number (%)
Endotracheal intubation/mechanical ventilation	57 (77%)
Laryngeal mask airway/spontaneously breathing	17 (23%)
No airway management	1 (1%)

n value is the number of patients that the data was available from. Percentages do not add up to 100% due to rounding

Table 5. Postoperative follow-up of patients with the lengths of hospital stay, changes in asthma control and smoking status (n=74)

	Number (%)
Hospital stay (days)	
0-4	50 (66%)
5-9	17 (23%)
10-14	5 (7%)
>14	2 (3%)
Asthma control in the first 2 wks postop	
Worse	18 (24%)
Same	45 (61%)
Better	11 (15%)
Cigarette smoking within 2 wks postop	11 (15%)

n value is the number of patients that the data was available from.
Percentages may not add up to 100% due to rounding

4. Discussion

This prospective observational study found the incidence of intraoperative complications relating to asthma in an adult population undergoing elective surgery to be low but significant (7%). In previous anaesthetic literature, there had been a general consensus that asthma was universally worsened by general anesthesia, although direct evidence for this was lacking. Indeed most of the early studies that were performed were largely retrospective reviews, comparing the incidence of bronchospasm in asthmatic patients against that seen in the non-asthmatic population. Attempting to ascertain the incidence of bronchospasm in the non-asthmatic population is problematic, although the usually quoted figure is in the order of 0.2% [5].

In a large retrospective study, Olsson [6] analysed the computer anaesthetic records of 136,929 patients and found the overall incidence of bronchospasm to be 0.17%, although patients with a history of obstructive lung disease had an increased incidence of bronchospasm (0.8%). Warner *et al* [7] analysed the anaesthetic records of 706 surgical patients at the Mayo Clinic who had been diagnosed as having asthma and similarly also found the incidence of bronchospasm to be low (1.7%). This is further supported by a prospective series undertaken more than fifty years ago by Gold and Helrich [8] where 296 patients (196 asthmatics, 100 non-asthmatics) were followed through surgery. They found patients with asthma had a higher rate of respiratory

complications (commonly intraoperative bronchospasm) compared to non-asthmatics, but there was no clear relationship to asthma severity.

The precipitants of intraoperative bronchospasm are numerous and include inadequate anesthesia, cold inspired gasses, inhaled irritants, procedures such as tracheal intubation, drugs (such as beta adrenergic blocking agents and thiopentone [9]), pulmonary oedema and anaphylactic reactions.

Two more recent studies have studied anesthesia and asthma. Kasaba *et al* [10] investigated the incidence of asthmatic attacks in 94 patients (1.5% with asthma) concluded that tracheal intubation, not the choice of anaesthetic is more important in the pathogenesis of bronchospasm. Kumeta *et al* [11] looked at the relationship between the intra and postoperative incidence of bronchospasm and the predisposing preoperative factors in 105 patients with reactive airway disease and found the incidence of intraoperative bronchospasm to be high with general anesthesia using endotracheal intubation compared to general anesthesia with mask and regional anesthesia. Our study did not find any clear association with tracheal intubation and bronchospasm. Two of the 4 patients (50%) who developed bronchospasm received LMA airway management, even though the numbers are too small to drawn any meaningful conclusions, LMA insertion is not without its risks.

When bronchospasm develops in the intraoperative setting, the immediate treatment is the administration of salbutamol via metered dose aerosol using a device designed to be incorporated in the anaesthetic breathing circuit. In three of the four cases in this series, this simple intervention alone was sufficient to result in amelioration of the symptoms and continuation of surgery.

In assessing asthma prior to surgery, it should be noted that asthma severity is not equivalent to asthma control. Even though 48 patients (60%) suffered from moderately persistent or severe persistent asthma, in the majority of these cases (81%), their asthma was well or relatively well controlled (Asthma severity scores 1 and 2), implying that a patient with asthma who has severe disease can still be relatively asymptomatic with the appropriate medical management (Figs 1 and 2). None of the previous studies on this topic have taken this into account.

Table 6. Features of patients who suffered anaesthetic complications related to asthma.

Patient	Age	Sex	Asthma Severity	Type of anaesthetic	Incident	Anaesthetic agents used
1	68	M	Mild persistent	Intubated ventilated	Post Extubation bronchospasm	P,Re,R,S
2	28	F	Intermittent	Intubated/ventilated	Post Induction bronchospasm	M,P,R,S
3	35	F	Severe Persistent	Intubated/ventilated	Post Induction bronchospasm	M,P,Re,S,V
4	39	F	Severe Persistent	Spontaneously breathing ProSeal LMA	Post Induction bronchospasm	M,P,S,F
5	28	M	Intermittent	Spontaneously breathing Classic LMA	Post Induction bronchospasm	M,P,S,F,O

(Drugs used: M=midazolam;F=fentanyl;R=rocuronium;Re=remifentanyl;S=sevoflurane;V=vecuronium)

The current study did not find a link between asthma severity or control with the occurrence of intraoperative respiratory complications. It is however exemplary that one patient (patient 5, Table 6) developed severe bronchospasm on the background of poorly controlled severe persistent asthma leading to cancelling of her surgery, only to return 6 months later with relatively well controlled severe persistent asthma and had an uneventful procedure with the identical anaesthetic.

This study appears to be the first in which patients were contacted post-discharge to ascertain whether their asthma had been influenced in any way as a result of their surgery and anesthesia.

Although obviously subjective, eighteen patients (24%) claimed to have had a worsening of their asthma symptoms on follow up, and interestingly 7 of those patients (39%) had poor or relatively poor preoperative asthma control (Asthma control scores 3 or 4). Furthermore, 13 of the 18 patients (72%) suffered from either moderate or severe persistent asthma. This would suggest that asthma severity and asthma control influence a patient's postoperative respiratory progress, but it can also be argued that their asthma control is possibly more important as it can be optimised before the anaesthetic procedure.

When patients with asthma are assessed by an anaesthetist prior to surgery, there needs to be a more detailed and systematic approach made to attempt to ascertain the degree of asthma severity and control. Asthma severity and control are different entities and should be considered separately.

In common with other chronic illnesses, elective surgical patients with poorly controlled asthma should have their asthma optimised prior to the anaesthetic to reduce the risk of respiratory complications.

5. Conclusions

It is unfortunate that certain constraints prevented us from extending the study period, and hence the total patient numbers enrolled in the study. Nevertheless despite this limitation, this survey represents one of the few prospective studies on asthma and anesthesia to be conducted during the last decade, and certainly the only one to examine possible post-anaesthetic asthma control in a population.

It has been encouraging to note that, in general, the level of asthma control in the population was high. This may have contributed to the finding that suggests that the majority of patients with asthma who undergo surgery and anesthesia are unlikely to encounter any significant intra-operative problems. Where intraoperative bronchospasm was

encountered it generally responded promptly to appropriate management. This is held true regardless of their age, the number of asthma medications used, their smoking status, the type of surgery and the anesthesia method. One interesting finding was that some patients found that in the postoperative period, asthma control, at least subjectively, seemed inferior than they had experienced prior to admission to hospital. It could be worthwhile warning patients of this possibility and suggest greater vigilance with post-operative asthma management.

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