Perioperative management in adults with bronchial asthma by monitoring of peak expiratory flow

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Abstract

Patients with bronchial asthma who undergo surgery are at increased risk for perioperative complications. We prospectively studied perioperative complications by monitoring peak expiratory flow (PEF) daily in patients with bronchial asthma who underwent anesthesia and surgery. Fifteen consecutive patients referred to us by surgical services were enrolled.

Their mean age was 54.3 years old. Operation had to be delayed in 6 patients because of poor respiratory condition. Two of these patients had severe, nearly fatal bronchial asthma attacks before receiving surgery. With treatment, PEF increased and the diurnal variation of PEF decreased, subsequently permitting surgery without pulmonary complications. No bronchial asthma attacks occurred during surgery. One patient who was treated for several bronchial asthma attacks before surgery had localized atelectasis and bronchial asthma attacks after the operation. Wheezing developed after surgery in one patient who had a respiratory tract infection before surgery. In the 2 patients with respiratory complications, PEF was sometimes lower than 80% of the best personal value or lower than 60% of the predicted value during 2 weeks prior to surgery despite preoperative treatment for bronchial asthma.

Monitoring of PEF and sufficient perioperative management are needed in patients who show low PEF and frequent bronchial asthmatic attacks or develop respiratory tract infections before surgery.

Introduction

Many patients with bronchial asthma require surgery during their lifetime. Most studies of surgery and related complications in asthmatic patients have been retrospective; few have been prospective¹². Retrospective studies of patient records or case reports have important limitations with respect to the sensitivity and specificity of diagnostic criteria and the definition of complications. Several studies have focused on severe adverse complications, such as bronchospasm; less severe events, such as mild, transient wheezing, have been largely disregarded.

Although recommended in current bronchial asthma guidelines³, peak expiratory flow (PEF) is often not monitored in patients with bronchial asthma who are scheduled to undergo surgery. We prospectively monitored PEF and studied the incidence of perioperative complications in asthmatic patients requiring surgical procedures under tracheal intubation and general anesthesia.
Patients and Methods

The study design was prospective. We enrolled 15 patients undergoing 17 procedures who were consecutively referred by surgical services to the Third Department of Internal Medicine, Tokyo Medical University Hospital for the management of bronchial asthma from March 1998 through June 2000. This study did not include patients who had not suffered bronchial asthma attacks for several years.

Preoperative examinations included physical examinations, chest radiography, electrocardiography, and laboratory studies. Respiratory status was assessed by blood gas analysis while the patients were breathing room air, spirometry, and measurement of PEF. Patients were instructed how to use a portable Assess Peak Flow Meter (Health Scan Products Inc. a division of Healthdyne Technologies, Inc. Cedar Grove, NJ, USA) and were provided with diaries for daily recording of morning and evening PEF. Predicted PEF was determined as previously described. Diurnal variation was calculated by the following formula:

\[
(\text{PEF evening/PEF morning})/\left(1/2 \times (\text{PEF evening} + \text{PEF morning})\right) \times 100
\]

All patients kept a diary of their asthmatic clinical scores, assessed according to the criteria of the Japanese Society of Allergology, for at least 2 weeks before surgery.

Patients were allowed to receive their usual medication for bronchial asthma. During the follow-up period including 2 preoperative weeks, poor-risk patients were additionally given preoperative and postoperative treatments to improve their respiratory status. All patients were instructed to stop smoking.

Wheezing during the operation was determined by auscultation. Oxygen saturation, airway pressure, and systemic blood pressure were monitored. Postoperatively, all patients were observed physically daily.

Results

The mean age of the 15 subjects was 54.3 years (range, 15 to 77). Nine patients had atopic bronchial asthma, and 6 had non-atopic bronchial asthma. The clinical characteristics of the patients are shown in Table 1. The percent changes in PEF 2 weeks prior to surgery are summarized in Table 2. Respiratory function is shown in Fig. 1. The relations among FEV_{1,0}, FEV_{1,0}/% predicted, and mean percent change in PEF from the predicted or personal best value 2 weeks prior to surgical procedures are shown in Fig. 2.

Surgery had to be postponed in 6 patients (Nos. 2, 3,
Table 2 Perioperative peak flow

<table>
<thead>
<tr>
<th>Patient</th>
<th>PEF(L/min) mean±SD</th>
<th>PEF(L/min) range</th>
<th>% change from personal best (%) mean±SD</th>
<th>% change from predicted value (%) mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>514.4± 9.7</td>
<td>490~530</td>
<td>2.7± 1.3</td>
<td>97.1± 1.8</td>
</tr>
<tr>
<td>2</td>
<td>292.5± 9.7</td>
<td>280~310</td>
<td>2.2± 1.7</td>
<td>94.4± 3.1</td>
</tr>
<tr>
<td>3</td>
<td>422.6±27.2</td>
<td>380~470</td>
<td>2.6± 2.5</td>
<td>89.9± 5.8</td>
</tr>
<tr>
<td>4</td>
<td>244.3±12.0</td>
<td>210~260</td>
<td>4.2± 3.8</td>
<td>94.0± 4.6</td>
</tr>
<tr>
<td>5</td>
<td>396.3±23.1</td>
<td>350~440</td>
<td>5.9± 3.4</td>
<td>90.1± 5.3</td>
</tr>
<tr>
<td>6</td>
<td>461.1±27.7</td>
<td>410~520</td>
<td>4.2± 2.7</td>
<td>88.7± 5.3</td>
</tr>
<tr>
<td>7</td>
<td>210.0±20.4</td>
<td>175~225</td>
<td>8.9±10.5</td>
<td>93.3± 9.1</td>
</tr>
<tr>
<td>8</td>
<td>270.0±21.9</td>
<td>230~300</td>
<td>13.8± 5.1</td>
<td>90.0± 7.3</td>
</tr>
<tr>
<td>9</td>
<td>277.3±24.5</td>
<td>230~320</td>
<td>12.2± 6.3</td>
<td>86.6± 7.7</td>
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<tr>
<td>10</td>
<td>450.7±36.2</td>
<td>360~510</td>
<td>6.1± 5.3</td>
<td>88.4± 7.1</td>
</tr>
<tr>
<td>11</td>
<td>441.2±40.3</td>
<td>350~500</td>
<td>7.8± 5.0</td>
<td>88.2± 8.1</td>
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<tr>
<td>12</td>
<td>451.7±49.8</td>
<td>360~530</td>
<td>16.1± 8.4</td>
<td>85.2± 9.4</td>
</tr>
<tr>
<td>13</td>
<td>326.4±30.8</td>
<td>270~400</td>
<td>7.8± 6.8</td>
<td>81.6± 7.7</td>
</tr>
<tr>
<td>14</td>
<td>231.7±23.3</td>
<td>200~300</td>
<td>11.2± 6.2</td>
<td>77.2± 7.8</td>
</tr>
<tr>
<td>15</td>
<td>492.5±57.5</td>
<td>350~620</td>
<td>15.1±11.2</td>
<td>79.4± 9.3</td>
</tr>
</tbody>
</table>

5, 6, 7, 8) because of frequent bronchial asthma attacks or poor respiratory status, including low peak expiratory flow. Two (Nos. 6 and 15) had severe, nearly fatal bronchial asthma attacks before scheduling surgical treatment. With treatment, mean PEF increased and diurnal variation of PEF decreased 3-4 weeks later. Subsequently, surgery was successfully accomplished, with no pulmonary complications.

The mean duration of surgery was 3 hours 5 min (range, 1 hour 37 min to 7 hour 10 min). No attack occurred during surgery.

Patient No. 7, in whom surgery was postponed, had atelectasis after the operation. This patient had the lowest % vital capacity (%VC) (Fig. 1) and subsequently required emergency surgery later for ileus. Bronchial asthma attacks developed after the operation, and extubation required 4 days. Although the patient was prohibited from smoking, smoking was continued before surgery, and the general condition was poor.
Patients who have had frequent bronchial asthma attacks. Wheezing developed postoperatively in one patient (No. 11). This patient had an upper respiratory tract infection before the operation. Eleven patients had received additional preoperative treatment to improve respiratory status. Four of the 15 patients had been receiving oral Prednisolone as a controller of bronchial asthma, but 6 received it at 5 to 20 mg/day as supplementary preoperative treatment. ln 10 patients, inhalation steroids were given. However, inhalation steroids were not administered in 2 patients with respiratory complications. The steroids shown in Table 1 were administered intraoperatively before intubation. No patients developed adverse events due to steroid administration. Table 3 shows the frequency of postoperative complications.

In this study, peak expiratory flow was monitored to determine whether clinically significant respiratory dysfunction was present and, if so, its magnitude, to assess the effectiveness of perioperative therapy, and to determine the optimal date for operation. In the patients who underwent delayed surgery, especially in patients after major bronchial asthma attacks, preoperative peak expiratory flow measurement facilitated serial monitoring of improvement in the condition, and helped to determine the optimal timing for surgery.

Patients who had frequent bronchial asthma attacks or developed a respiratory tract infection before surgery and in patients in whom PEF sometimes decreased to 80% or less of the best personal value or 60% or less of the predicted value at routine monitoring despite good mean PEF values for 2 weeks prior to surgery may develop respiratory complications and need careful perioperative management.

**Discussion**

Major risk factors for perioperative pulmonary complications include the site of incision, chronic respiratory disease, obesity, an age of more than 70 years, a history of smoking, anesthesia lasting longer than 2 hours, a prolonged preoperative hospital stay, and perioperative protein depletion.

In particular, bronchial asthma can adversely affect the outcome of surgery. Many factors may precipitate asthmatic attacks and other complications related to surgical procedures. Intraoperative bronchospasm and postoperative atelectasis, pneumonia, bronchospasm, and asthmatic attacks occur significantly more frequently in patients with bronchial asthma than in the other patients. Respiratory complications comprised the most common complications in asthmatic patients. The incidence has been reported to be 2.2 to 25% (7, 12). The incidence of bronchospasm ranges from 0.84 to 1.7% (13, 15). Furthermore, cardiovascular complications have also been reported (8, 16-18).

Prediction of complications is often challenging. A history of bronchial asthma alone did not provide a sufficient basis for predicting severe respiratory events. Spirometric studies are more reliable than history alone in the preoperative detection of early obstructive lung disease (19-21).

PEF rate has greater intersubjective variability than FEV\(_{1.0}\). In patients with slight airway contraction, PEF is sensitive. However, in patients who exhibit remodeling, PEF is less sensitive. In the evaluation using percent changes from the personal best value, the condition of patients with stable low values before surgery may be underestimated. However, the goal of preoperative treatment must be established in accordance with the best value and diurnal variation in individual patients. In the evaluation using percent changes from the predicted PEF, the patient’s condition may be overestimated. FEV\(_{1.0}\) and FEV\(_{10}\) \% more strongly correlate with percent changes from predicted PEF than did the percent changes from the personal best value (Fig. 2). Therefore, dissociation should be supplemented by combined assessment of the two parameters.

FEV\(_{1.0}\) correlates with PEF rate (22), but these values are not interchangeable. On initial evaluation of patients with obstructive airway disease, FEV\(_{1.0}\) as measured by office-based equipment, and daily PEF, as measured by hand-held devices, should be monitored to avoid underestimation or overestimation of pulmonary impairment (23).

In patients recovering from an acute bronchial asthma attack, when the results of physical examination returned to normal, the mean FEV\(_{1.0}\) and PEF were only 63% and 54% of their predicted values, respectively (24). Since some patients have a blunted perception of dyspnea (25), monitoring peak expiratory flow is required to assess current status in numeric terms. Determination of the time of surgery by PEF monitoring is recommended in patients after major bronchial asthma attacks.
Poor-risk patients should be treated preoperatively. Recent asthmatic attacks can increase the risk of complications\(^{20-22}\). Bronchial hyperreactivity persists for 3 weeks after symptoms of infection resolve\(^{23}\). Patients recovering from upper respiratory tract infections who undergo surgery have increased pulmonary morbidity, including atelectasis, mucous plugging, and bronchospasm\(^{24,25}\). Smoking can decrease 1-second forced expiratory volume\(^{3i}\). Perioperative complications are frequent in children\(^{26}\) and elderly patients with bronchial asthma\(^{27}\).

Asthmatic patients who preoperatively receive corticosteroids can undergo surgical procedures, with a low incidence of complications\(^{11,43-49}\). The preoperative dose of steroids was lower in the two patients who showed complications than in the other patients. Especially in patients with low PEF and those with airway infection, appropriate steroid treatment is needed before and during surgery. However the other patients, especially in patients with low PEF and those with airway infection, appropriate steroid treatment is needed before and during surgery.

Recent advances in anesthesiology and surgical procedures have decreased the risk of surgery with general anesthesia in patients with bronchial asthma. However the risk is still appreciable\(^{20-49}\). Previously, preoperative management has been proposed as follows.

1. For elective surgery, asthmatic patients should be evaluated at least 1 week in advance, so that adequate treatment can be given to ensure optimal status\(^{49}\). All asthmatic symptoms should have been resolved, with normal respiratory function.

2. No asthmatic attack should have occurred within 2 weeks before surgery. If severe, nearly fatal attacks develop, the operation should be postponed for 4 weeks.

3. Surgery should also be postponed in patients who have respiratory tract infections within 3 weeks of the scheduled operation\(^{29}\).

4. Patients should stop smoking\(^{21}\).

5. Perform surgery in the late morning, after bronchial obstruction due to nocturnal accumulation of secretion has resolved\(^{21}\).

6. Special attention to analgesia in patients with aspirin-induced asthma.

7. Physicians, surgeons, and anesthesiologists should maintain close communication and cooperation.

To prevent complications, peak expiratory flow should be monitored, and additional therapy, including short courses of steroid treatment\(^{11,43-49}\), should be administered to improve the peak flow, aiming at more than 80% of percent change from their personal best PEF during the observation period or of the predicted value with a diurnal variation of less than 20%.

Although measurement of PEF alone does not provide a sufficient basis for predicting respiratory outcome, monitoring of peak expiratory flow facilitates the assessment of preoperative asthmatic status and is useful in determining whether preoperative therapeutic targets can be reached. Daily monitoring of peak expiratory flow can assist in confirming the optimal time for surgery. Larger studies are necessary to establish criteria defining conditions under which patients with bronchial asthma can undergo surgery.

References


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Peak expiratory flow を用いた成人気管支喘息患者における術前管理について

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気管支喘息患者は術後合併症の出現の頻度が高い。われわれは、全身麻醉下で手術を計画した気管支喘息患者の peak expiratory flow (PEF) の測定を術前に行い術前合併症との関連について prospective study を行った。

対象は 15 人。平均年齢 54.3 歳。大発作をきたした 2 例を含む 6 例は、呼吸状態が不良であったため手術を延期したが、術前の計測によって PEF 検査値は上昇し、日変動の減少を認める。術中、術後に合併症を得なかった。15例のうち術前発作が出現しなかったものはいない。術前に発作を頻回であった 1 例は術後に無気肺と気管支喘息発作を認めた。術前に気道感染をきたした 1 例は術後に wheezing を認めた。これら呼吸器合併症をきたした 2 例は術前の支気管肺気腫によっても術前 2 週間の観察期間中術前の PEF が自己最高 PEF の 80% 以下、予測 PEF の 60% 以下になることがあった症例であった。

術前に PEF を monitor することは、PEF が低値になる症例や術前に発作をきたした症例、気道感染をきたした症例では特に必要であると考えられた。

〈Key words〉 Anesthesia, Bronchial asthma, Peak expiratory flow monitoring, Perioperative period, Surgical procedure