Postoperative Complications of Endoscopic Upper Airway Laser Surgery in Kasr Al-Ainy Hospital: A Prospective Study

NEAAMAT I. ABD EL-RAHMAN, M.D.; MOHAMED S. RIFAI, M.D.; HASSAN M. AHMED, M.D.; ABEER A. MOHAMED, M.D. and SHYMAA F. ABD EL-FATTAH, M.D.
The Department of Anesthesiology, Faculty of Medicine, Cairo University

Abstract

Background: Laser surgery of the upper airway is performed endoscopically under the microscope. One of the advantages of this type of surgery over an open partial technique is that it only removes the lesion, preserving larger adjacent free areas and maintaining the laryngeal skeleton closed. However, because of the increase in the use of this technique for laryngeal and hypopharyngeal lesions, a greater number of complications may be expected. The aim of this study was to evaluate the incidence, type, and clinical significance of postoperative complications of upper airway lesions treated with laser surgery.

Patients and Methods: Following approval of departmental ethics and research committee and obtaining written informed consent, sixty-six patients undergoing endoscopic airway laser surgery starting from January 2012 to December 2012 were included in the study. These patients were examined by the ENT consultant, diagnosed as having any airway pathology indicated for endoscopic airway laser surgery, and scheduled for surgical management. Routine investigations were performed preoperatively in addition to specific investigations related to the pathology including chest X-ray, indirect laryngoscopy and arterial blood gases in addition to meticulous assessment of the airway. Patients with severe stridor, tracheostomised patients and patients with history of any previous anesthetic complications were excluded. Intraoperative standard monitoring was performed, followed by induction in the presence of all equipments for difficult airway management. Safety features for laser surgery were taken regarding the patient and medical personnel. Anesthesia was maintained and the patients were monitored for HR, BP, SaO₂, EtCO₂ and the postoperative complications related to airway management, anesthetic management and surgical management.

Results: Postoperative complications were as follows: respiratory distress (e.g. tachypnea, working accessory respiratory muscles) (18%-twelve patients), ICU admission (6%-four patients), one patient had pneumothorax, another one had surgical emphysema and two were tracheostomised due to unrelied airway oedema, all four patients were admitted in ICU under observation, and vomiting (9%-six patients).

Conclusion: Post-operative complications of endoscopic laser surgery of the upper airway are relatively low. Every anesthetist who is involved in this should have a clear concept of management for these complications, and strategies to avoid these complications should be performed.

Key Words: Upper airway laser – Endoscopic postoperative – Complications.

Introduction

ENDOSCOPIC techniques take the upper hand nowadays in almost all surgical fields including laryngeal surgeries. Awareness of the anesthetic management of these cases and possible complications is a must. Anesthetic safety for endoscopic laryngeal laser surgery has been a major limiting factor for laser applications in the larynx and the hypopharynx. Several anesthetic techniques have been proposed and each technique appears to have its own limitations [1,2].

A prospective study of patients who undergone this modality of surgery at Kasr Al-Ainy Hospital was done. Conclusion from this study showed the incidence of postoperative complications however anesthetic or surgical and the management of them.

Patients and Methods

Following approval of departmental ethics and research committee and obtaining written informed consent, patients undergoing endoscopic airway laser surgery aged six years or more, starting from January 2012 to December 2012 were included in the study. Patients with moderate to severe stridor, tracheostomised patients and history of any previous anesthetic complications were excluded. These patients were examined by the ENT consultant, diagnosed as having airway pathology indicated for endoscopic airway laser surgery, and scheduled for surgical management. Routine preoperative evaluation with assessment of any co-existing disease was done including history of any endoscopic procedures, history of any voice changes,
dysphagia or dyspnea. Standard airway assessments to predict the ease of intubation and visualization of the laryngeal inlet through the pre-operative flexible laryngoscopy was performed. At the end of the preoperative assessment, the anesthesiologist should have some idea of the size, mobility, and location of the lesion.

Intra-operative, all patients were monitored by standard monitoring including ECG, non-invasive blood pressure, and pulse oximetry. Premedications were given including midazolam as anxiolytic (2mg slowly I.V.), metoclopramide as a prokinetic (10mg slowly I.V.) and ranitidine as H2 receptor blocker (50mg slowly I.V.). All equipments for difficult airway management were available including blades of different sizes, endotracheal tubes of different sizes, laryngeal mask, stylet and flexible fiberoptic endoscopy. Equipments for suction were ready in OR. Laser-proof tubes of different sizes (4, 4.5, 5 and 5.5) were available. All operating room personnel were wearing safety glasses appropriate for the laser in use (CO₂ laser).

Intravenous cannula was inserted (20G) and maintenance fluid infusion was started. The patients were pre-oxygenated for 3-5 minutes. Intravenous induction was done by propofol (2mg/kg) + fentanyl (1 microgram/kg) + succinylcholine (1mg/kg), and then intubation was accomplished by using laser tube of appropriate size. The tube was secured by adhesive tapes and the 2 cuffs were inflated with air and saline. Tissues adjacent to the lesion could be protected with moistened pads or swabs. In all cases, the eyes should be taped, closed and covered with moist swabs.

General anesthesia was maintained using isoflurane as inhalational anesthetic at 1-2 volume% and atracurium as a muscle relaxant for maintenance after recovery from succinylcholine at a dose of 0.5mg/kg then every 30 minutes. Mechanical ventilation was started and adjusted with tidal volume (4-10ml/kg) and respiratory rate (10-16 breath/minute) to maintain the ETCO₂ between 35 and 40mmHg obtained through capogram that was connected after induction and intubation, using FIO₂=1. Prophylactic corticosteroids were used, giving 2mg/kg hydrocortisone and 0.2mg/kg dexamethasone.

During recovery, suction under direct vision using direct laryngoscope was done to ensure clean airway. Extubation was done when the patient was fully awake with complete recovery of muscle power and haemodynamic stability with maintained SPO₂ more than 97% on 100% O₂ and spontaneously breathing. The residual muscle relaxant was reversed by 2.5mg prostigmine and 1mg atropine. If the patient can maintain patent airway with good ventilation and oxygenation he was transferred to the recovery room under observation for 2 hours using mask oxygen and pulse oximetry to be discharged after 2 hours if MAS (mean Aldert score) was more than or equal to 9. Arterial blood was sampled for arterial blood good analysis after 2 hours, before transfer to the ward, on room air. The patient was then transferred to the ward.

If the patient showed any respiratory distress during recovery following extubation in the form of:

1- Clinically: Shallow rapid breathing, upper airway obstruction in the form of tracheal tug and intercostals muscle retraction, sweating.

2- Monitoring parameters: Decreased SPO₂ below 90 on room air or CO₂ accumulation in ABG then, reintubation was done for tracheostomy and after recovery the patient was transferred to HDU for overnight observation.

Data collection:

Data collection included, (1) Demographic features: Age, sex, weight, (2) Pre operative upper airway assessment: A. clinically: Mouth opening, thyromental distance and Mallampati classification, b. complaint: Either difficult breathing or change of voice, c. flexible laryngoscopy to identify the type of lesion, (3) Pre-operative ABG, (4) Intra-operative ABG and (5) The post-operative complications including respiratory distress due to oedema that may affect the base of tongue, vocal cords or arytenoids or due to laryngeal spasm. Haemodynamics in the form of (HR, BP, SPO₂) instability and vomiting were also recorded.

Statistical analysis:

Analysis was done with SPSS software, Version 6.0 (SPSS, Chicago, IL, USA) Categorical data were reported as percentages and tables of frequency, and continuous data as means (standard deviations SD). Categorical variables were compared by the Chi-square test and continuous variables by the Student’s t-test, p value <0.05 was considered statistically significant Risk was expressed as crude and adjusted odds ratios (OR).

Results

Sixty Six patients included in the present study were monitored to document the rate of postoperative complications of endoscopic upper airway laser surgery in Kasr Al-Ainy Hospital. Duration of study: 12 months starting January 2012 to December 2012.
The most frequent lesion was vocal cord paralysis requiring either unilateral or bilateral cordectomy, most probably post thyroidectomy. They represented 36% (twenty eight patients). There were twenty two patients with vocal cord mass as polyps, granuloma while 33% were admitted for direct laryngoscopy and excisional biopsy of their laryngeal masses for differential diagnosis representing 33%. Multiple polyposis represented 3% (two patients). Other pathology represented 21% Fig. (1).

Postoperative complications were as follows:
- Respiratory distress (e.g. tachypnea, working accessory respiratory muscles) (18%-twelve patients).
- ICU admission (6%-four patients). One patient had pneumothorax, another one had surgical emphysema and two were tracheostomised due to unrelieved airway oedema. All four patients were admitted in ICU under observation.
- Vomiting (9%-six patients).

No cases of exaggeration of pre-existing comorbidity were reported Fig. (2).
Patients suffered post-operative respiratory distress were twelve patients. Ten of them were due to airway oedema (15%), eight of them improved with conservative treatment including intravenous steroids plus oxygen therapy and racemic adrenaline nebulizer. The other two patients with airway oedema required tracheostomy.

One patient with respiratory distress was due to surgical emphysema and required chest tube. The underlying pathology in this patient was juvenile multiple papillomatosis. The other patient was discovered to have pneumothorax and also was managed with chest tube insertion. The underlying pathology in this patient was subglottic stenosis. Fig. (3).

Four patients required ICU admission (the two tracheostomised patients with airway oedema and those with surgical emphysema and pneumothorax). Patients were identified into two groups in accordance to the incidence of occurrence of post-operative complications (airway complication group, respiratory distress, and non-airway complication group). Both groups were compared regarding possible risk factors (Table 3).

Factors that were found to constitute significant risk factors for postoperative airway complications are; patient history particularly; preoperative dysphagia and history of difficult intubation; OR (4.2) and (8.8), $p$-value (0.03) and (0.05) respectively. In addition to preoperative hypoxia, preoperative hypercarbia, operative duration, and number of intubation trials.

On the other hand, other parameters such as age, gender, history of smoking, airway examination, and preoperative voice changes were not found to be risk factors for postoperative airway complications ($p$-value >0.05).

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Airway complication group (n=14)</th>
<th>Non-airway complication group (n=46)</th>
<th>$p$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td>33±13</td>
<td>41±18</td>
<td>0.07</td>
</tr>
<tr>
<td>Male gender</td>
<td>9 (64%)</td>
<td>25 (54%)</td>
<td>0.55</td>
</tr>
<tr>
<td>Smoking</td>
<td>7 (50%)</td>
<td>15 (32%)</td>
<td>0.2</td>
</tr>
<tr>
<td>Preoperative voice changes</td>
<td>10 (71%)</td>
<td>34 (74%)</td>
<td>0.75</td>
</tr>
<tr>
<td>Preoperative dysphagia</td>
<td>4 (28%)</td>
<td>2 (4%)</td>
<td>0.03</td>
</tr>
<tr>
<td>Previous vocal cord operations</td>
<td>0 (0%)</td>
<td>18 (39%)</td>
<td>0.5</td>
</tr>
<tr>
<td>Preoperative Pa CO₂</td>
<td>48±4</td>
<td>38±5</td>
<td>0.01</td>
</tr>
<tr>
<td>Intubation trials</td>
<td>2 (1-3)</td>
<td>1 (1-3)</td>
<td>0.04</td>
</tr>
<tr>
<td>Operative duration</td>
<td>48±15</td>
<td>25±17</td>
<td>0.05</td>
</tr>
</tbody>
</table>

$\text{PaO}_2$: Arterial $\text{O}_2$ tension.  
$\text{Pa CO}_2$: Arterial $\text{CO}_2$ tension.  
$p$-value : <0.05 denotes significance.

Discussion

Sixty six patients were randomly studied over a period of one year (from one January 2012 to 31 December 2012). They suffered variable airway lesions such as vocal cord paralysis, vocal cord nodules, polyps, granulomas, papillomas and tracheal stenosis. Vocal cord paralysis was the most frequent lesion representing 36% of cases followed by vocal cord mass (33%) and the least was multiple polyposis. Patients presenting with moderate to severe stridor were excluded. All sixty six patients were subjected to endolaryngeal laser surgery and observed for the incidence of postoperative complications.

Patients with preoperative hypoxia or hypercarbia, those showing difficulty of intubation with frequent intubation trials or prolonged procedures showed higher incidence of post-operative respiratory complications such as tachypnea or hypoxia. This showed that the rate of complications might be related to the surgical scale and operative time.

Pneumothorax has occurred in one case of juvenile multiple papillomatosis and it was managed by insertion of chest tube, then the patient was transferred to intensive care unit under observation. However another case of subcutaneous emphysema was reported after laser dilatation of subglottic stenosis which was managed by insertion of chest tube, then the patient was transferred to the intensive care unit under observation. Diagnosis was confirmed later on by chest X-ray. A case of acute subcutaneous emphysema and pneumothorax was reported by Leemann B. et al., during laser surgery with percutaneous transtracheal jet venti-
lation, usually caused by obstruction of the upper airway or displacement of the tracheal catheter [3].

Another case was reported by Sánchez-Etayo, in Hospital Clinic Universitari de Barcelona, Department of Anaesthesiology, Barcelona, Spain. A 59-old male underwent laryngeal microsurgery with a carbon dioxide laser for extirpation of a polyp in the anterior commisure of the vocal cord and Reinke oedema in the right vocal cord. During the immediate post-operative period, the appearance of progressive subcutaneous emphysema was observed and respiratory difficulty was reported. A chest radiograph showed large areas of subcutaneous emphysema, pneumomediastinum and pneumothorax. The patient was sedated with propofol 2mg/kg and a conventional laryngoscopy was performed before the administration of succinylcholine 1mg/kg for endotracheal intubation. Bilateral pleural drains were inserted. The patient was transferred to the intensive care unit where artificial ventilation was instituted [4].

In another study done by Wetmore et al., over forty patients with laryngeal papillomatosis underwent a total of 222 carbon dioxide laser laryngoscopies over the 6 1/2-year period from June 1977 through December 1983. One episode of bilateral pneumothorax and one episode of cervical subcutaneous emphysema, both associated with the use of jet ventilation anesthesia were reported [5].

A nonfatal case of pneumothorax was reported by Dedhia et al., after Endoscopic laser therapy for respiratory distress due to obstructive airway tumors in nine patients [6].

In this study, ten patients with post-operative respiratory distress due to airway oedema were observed. Two of them were tracheostomised and transferred to the intensive care unit for observation. The results in this current study support the belief that, prolonged procedures and intermittent ventilation with repeated intubation increase the risk of airway edema. Microscopic laryngeal surgery generally could affect airway resulting in edema due to airway instrumentation. Tamura et al., has found one case of oedema of the tumour after Nd-YAG laser treatment on tracheobronchial lesions among 83 cases [7].

In another study done by Wetmore et al., over forty patients for detection of Complications of laser surgery for laryngeal papillomatosis, six patients with laryngeal edema or fibrosis were reported. They mentioned that the occurrence of minor complications such as small anterior glottic webs and persistent edema was relatively high, especially in those patients who required multiple laser laryngoscopies [8].

Post-operative complications of endoscopic laser surgery of the upper airway are relatively low. Every anesthetist who is involved in this should have a clear concept of management for these complications, and strategies to avoid these complications should be performed. In this study we did not discuss the complications related to a special disease one by one; some more detailed research work will be carried out on this in the future. The incidence of complications of laser surgery for the lower airways requires also further research work because of the variation in the frequency and types of complication.

References
الملخص العربي

الأهداف: إن عمليات الليزر التي يتم إجرائها للممرات الهوائية العليا لها مزاياها ومخاطرها. من المرايا الهامة أن النتائج الوظيفية الخاصة بالعملية أفضل بكثير من مثيلتها التقليدية لكن هذا لا يعني أنها مثالية فهناك بعض المضاعفات التي إن لم ينتبه لها طبيب التخدير ويتني بها ويحسن التعامل معها فإنها من المحتمل أن تؤدي إلى كارثة. لذلك من خلال هذه الدراسة المستقبلية حاولنا رصد المضاعفات المحتملة حدوثًا بعد هذا النوع من العمليات وما هي الطرق المتاحة للتعامل معها وما نسبتها في مستشفى القصر العيني الجامعي لمدة عام وإعطاء الإشارة للمخاطر المحتملة.

الطريقة: أجريت دراسة مستقبلية للمضاعفات بعد العملية في ست وستين مريض خضعوا لجرحية الليزر للممرات الهوائية العليا وتم تحليل بياناتهم خلال الفترة من يناير 2012 وحتى ديسمبر 2012 في مستشفى القصر العيني، كلية الطب، جامعة القاهرة.

النتائج: اشتملت المضاعفات على ضيق التنفس بنسبة 18% وفي، بنسبة 9% والحاجة إلى رعاية مرکزة بنسبة 8%. تحت ملاحظة حدوث المضاعفات الخاصة بالتنفس بصورة عالية في المرضى الذين لديهم تاريخ مرضى يعصف بهم، مشاكل تدخينية سابقة متعلقة بالأنبوبية الحنجوية، نقص في نسبة الأكسجين بالدم أو زيادة بنسبة ثاني أكسيد الكربون قبل العملية، زيادة مدة العملية أو محاولات متكررة لوضع الأنبوبية الحنجوية.

خاتمة: إن المضاعفات المصاحبة لما بعد جراحة الليزر للممرات الهوائية العليا قليلة الحدوث. يجب على كل طبيب تجيير يقوم بتخدير مرضى عمليات الليزر أن يكون له هدف واضح للسيطرة على تلك المضاعفات ومبادئ، لمنع هذه المضاعفات من الظهور.