

Laryngotracheal stenosis; sequelae of unrecognized laryngeal injuries in motorcycle accident patients

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- Objective** : *To report the causes and outcome of laryngotracheal stenosis in motorcycle accident patients*
- Design** : *Retrospective descriptive study.*
- Setting** : *Department of Otolaryngology, Faculty of Medicine, Chulalongkorn University.*
- Subject** : *Consecutive inpatient cases with blunt laryngeal injuries and laryngotracheal stenosis during 1993-1997.*
- Method** : *Data extracted from outpatient records and admission charts was reviewed and analysed for the causes, clinical presentations and outcome of blunt laryngeal injuries and their sequelae in patients in motorcycle accidents.*
- Results** : *There were 42 patients (34 males and 8 females) of 59 blunt laryngeal injuries caused by motorcycle accidents. The mean age of the patients was 23.3 ± 10.3 years (range 2-54 years). The associated injuries were neurological trauma (28 cases), maxillofacial trauma (3 cases) and fractures of extremities (6 cases). In 14 patients diagnosis of laryngeal injury could be made at the first seen and six of them developed laryngotracheal stenosis. The other 28 patients were later recognized with laryngeal injuries. All of them developed laryngotracheal*

stenosis. Out of these 28 patients, 11 cases had clear evidence of unrecognized injury (fractures of thyroid cartilage and/or cricoid cartilage and vocal cord paralysis) before developing laryngotracheal stenosis which were diagnosed by retrospective investigation with CAT-scan and endoscopic examination, respectively. The time lapse between removal of the endotracheal tube and detection of stenosis was 72 days. The results of treatment was poor and 11 of 34 patients (32.25%) needed permanent tracheostomy tubes.

Conclusions : *Thirty-four of 42 (80.95%) patients with blunt laryngeal injury after motorcycle accidents developed laryngotracheal stenosis. Eleven of them (32.35%) had clear evidence that suggested unrecognized laryngeal injury at the beginning. In the other 17 patients (50%), were cases that might have been caused by internal injury from prolonged orotracheal intubation or aggravation of the existing mucosal injury by orotracheal intubation which delayed diagnosis and treatment with consequent poor outcome.*

Key words : *Laryngeal injury, Laryngotracheal stenosis.*

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วินัย แวดวงธรรม, ภาคภูมิ สุปียพันธ์ุ. กล่องเสียงตีบตันในผู้ป่วยที่ได้รับอุบัติเหตุทางมอเตอร์ไซด์ ผลสืบเนื่องจากการบาดเจ็บของกล่องเสียงที่ไม่ได้รับการตรวจรักษาตั้งแต่ในระยะแรก. จุฬาลงกรณ์เวชสาร 2542 ม.ค; 43(1): 29-38

วัตถุประสงค์ : เพื่อรายงานผู้ป่วยที่มีกล่องเสียงตีบตันภายหลังจากเกิดอุบัติเหตุทางรถมอเตอร์ไซด์ในโรงพยาบาล จุฬาลงกรณ์ระหว่างปี.ศ. 2536-2540

รูปแบบของการศึกษา : การศึกษาเชิงพรรณน่าย้อนหลัง

สถานที่ศึกษา : ภาควิชาโสตนาสิก ลาริงซ์วิทยา คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

กลุ่มเป้าหมาย : ผู้ป่วยที่ได้รับบาดเจ็บจากอุบัติเหตุทางมอเตอร์ไซด์ระหว่างปี 2536-2540

วิธีการศึกษา : รวบรวมและวิเคราะห์ข้อมูลจากบัตรผู้ป่วยนอกและเพิ่มผู้ป่วยใน

ผลการศึกษา : จากจำนวนผู้ป่วยที่มีการบาดเจ็บของกล่องเสียงจากสาเหตุภายนอกทั้งหมด 59 ราย พบว่า 42 ราย (ชาย 34 คน, หญิง 8 คน) ที่มีสาเหตุจากอุบัติเหตุทางรถมอเตอร์ไซด์ อายุเฉลี่ยของผู้ป่วยอยู่ระหว่าง 23.3+10.3 ปี (2 - 54 ปี) อาการบาดเจ็บร่วมที่พบด้วยได้แก่ การบาดเจ็บต่อสมอง 28 ราย การบาดเจ็บบริเวณใบหน้า 3 ราย และการบาดเจ็บที่แขนขา 6 ราย ในจำนวนผู้ป่วย 42 ราย มีผู้ป่วยเพียง 14 รายเท่านั้นที่สามารถตรวจวินิจฉัยพบการบาดเจ็บต่อกล่องเสียงเมื่อแรกรับและ 6 ราย เกิดกล่องเสียงตีบตันตามมา ผู้ป่วย 28 รายที่เหลือสามารถตรวจพบพยาธิสภาพได้ในภายหลัง ในผู้ป่วยกลุ่มนี้พบว่ามีผู้ป่วย 11 รายที่สามารถตรวจพบย้อนหลังว่ามีการบาดเจ็บของกล่องเสียงตั้งแต่แรกจากการตรวจด้วย CAT-scan โดยพบว่ามีกระดูก thyroid หักและ/หรือกระดูก cricoid หัก และจากการส่องกล้องตรวจพบอัมพาตของสายเสียงก่อนที่จะเกิดอาการกล่องเสียงตีบตัน ระยะเวลาเฉลี่ยที่แพทย์สามารถตรวจพบว่ามีกล่องเสียงตีบตัน = 72 วัน การรักษากล่องเสียงตีบตันส่วนใหญ่ได้ผลไม่ดี และมีผู้ป่วย 11 คน (33.25%) ยังคงต้องใส่หลอดคอช่วยหายใจอยู่

สรุป : พบผู้ป่วยกล่องเสียงตีบตัน 34 ราย (80.95%) จากผู้ป่วยที่มีการบาดเจ็บของกล่องเสียงด้วยอุบัติเหตุมอเตอร์ไซด์ 42 ราย ผู้ป่วย 11 รายจาก 34 ราย (32.35%) เกิดจากไม่สามารถวินิจฉัยได้ว่ามีบาดเจ็บที่กล่องเสียงในระยะแรก ผู้ป่วย 17 ราย จาก 34 ราย (50%) อาจเกิดการบาดเจ็บต่อกล่องเสียงจากการใส่ท่อหลอดคอช่วยหายใจเป็นเวลายาวนาน หรือเกิดจากการใส่ท่อช่วยหายใจลำบากเป็นปัจจัยกระตุ้นให้อาการบาดเจ็บต่อเนื้อเยื่อที่มีการบาดเจ็บอยู่แล้วให้มีมากขึ้น ผลการรักษาผู้ป่วยที่มีการบาดเจ็บของกล่องเสียงที่ได้รับการวินิจฉัยภายหลังแล้วเกิดกล่องเสียงตีบตันตามมาไม่ดี

คำสำคัญ : *Laryngeal injury, Iaryngotracheal stenosis.*

Injuries to the larynx and cervical trachea are rare, compared to the total number of injuries to head and neck areas. The infrequency of this injury is due to protection of the larynx by the mandible above, sternum below and by the heavy sternocleidomastoid muscles laterally. With the head in a flexed position, the larynx is completely protected. The rare blunt injury to the laryngotracheal complex occur in motorcycle accidents when the extended neck is forced against the ground or other hard subjects.⁽¹⁾

Some motorcycle accident patients sustain severe multiple organ injuries and are unconscious when they arrive at hospitals. With urgency of management, severe bleeding per mouth and difficulty in intubation may lead to a misdiagnosis of the laryngotracheal injury. Furthermore, the intubation itself, either via nasotracheal or orotracheal approach, by unskilled doctors may aggravate any existing injury in the laryngotracheal area as well.

Prolonged intubation, mechanical ventilation support, infection and tracheostomy after intubation can increase injury to the laryngotracheal structure. Failure to recognize an injury at the beginning can cause severe long-term morbidity. Unsatisfactory late outcomes include aphonia, dyspnea and laryngotracheal stenosis. Successful repair of chronic laryngeal and tracheal stenosis remains inconsistent and rather disappointing.⁽²⁾

Causes and outcomes of laryngotracheal stenosis in motorcycle accident patients will be reported herein.

Materials and Methods

Medical records of all consecutive patients with laryngotracheal injury who were admitted to the

Otolaryngology Department, the King Chulalongkorn Memorial Hospital during 1993 - 1997 were reviewed and analyzed for etiology and patient outcome.

Results

There were 59 patients with blunt laryngeal injury admitted to the Otolaryngology Department during 1993 - 1997. The etiology were motorcycle accidents (42 cases), assaults (7 cases), falling (6 cases) and car accidents (3 cases).

Of the forty-two patients with blunt laryngeal injury caused by motorcycle accidents, 34 were males and 8 females. The mean age of these patients was 23.3 ± 10.3 years (range 2-54 years). The associated injuries were neurological trauma (28 cases), maxillofacial trauma (3 cases) and fractures of extremities (6 cases).

Only 14 patients diagnosis of laryngeal injury could be made at the first seen, and the other 28 patients laryngeal injury were recognized later. Clinical presentations of those with early diagnosis included voice change (9 cases), neck swelling with subcutaneous emphysema (7 cases), hemoptysis (4 cases) and neck pain (3 cases). Besides mucosal laceration and cartilage exposure, the other injured laryngeal structures were fractures of thyroid cartilage (6 cases), fractures of cricoid cartilage (4 cases) and vocal cord immobility (6 cases). Six patients had transient unconsciousness and the last had severe neurological trauma requiring craniectomy. Immediate tracheostomy was performed in six patients and this avoided prolonged intubation in this group. Finally, six patients of recognized group developed moderate to severe laryngotracheal stenosis by Cotton's classification (more than 70% obstruction of the lumen).^(3,4) However, all of them were successfully decanulated within one year (three months to one year).

Among the other 28 patients in the delayed diagnosis group, all of them developed laryngotracheal stenosis. Twenty-one patients had associated neurological injury; seven cases required craniectomy and the other 14 cases had cerebral contusions. There were two patients whom immediate tracheostomy was performed. Seven patients required only endotracheal intubation and 19 cases had prolonged intubation followed by tracheostomy later. The mean duration between intubation and tracheostomy was 13 days. Eight of the 19 intubated patients needed assisted ventilation. In this group, there were six patients who had clear evidence of fractures of thyroid cartilage and/or cricoid cartilage (Figure 1) and other five patients had vocal cord paralysis before granulation tissue developed by retrospective investigation with CAT - scan and endoscopic examination, respectively. For the other 17 patients, the exact etiology of the laryngo-tracheal stenosis could not be assessed because they had histories of both blunt laryngeal injury and prolonged orotracheal intubation due to

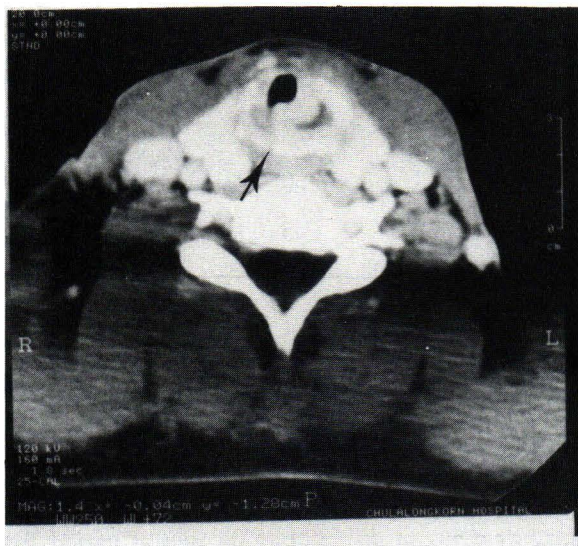


Figure 1. Granulation tissue involving subglottic area and fracture of cricoid cartilage. (arrow)

other associated injuries.

Patients who had moderate to severe laryngotracheal stenosis presented with inability to decannulate either endotracheal or tracheostomy tubes (29/34 cases) and symptoms of upper airway obstruction. The time lapse between removal of the endotracheal tube and development of upper airway obstruction was vary 7 to 180 days (mean = 72 days).

Area of stenosis varied from the supraglottic region to tracheostomy site (Figure 2). The most common stenotic segment was the subglottic area (14 cases, or 41.18%). Nine patients (26.47%) had long stenotic segments, extending from the glottic area to the tracheostomy site. The associated laryngeal injuries, included vocal cord immobility (17/34), fractures of thyroid cartilage (10/34) and fractures of cricoid cartilage (9/34). These injuries posed difficulty in correction and resulted in poor outcome.

Treatment options for laryngotracheal injury in different stages were variable. Acute injury or minimal soft stenosis was treated by laryngofissure (midline thyrotomy), mucosal reparation and internal fixation of thyroid and cricoid fragment by wiring. Cases in the late stage with hard stenosis were treated with various technique eg. endoscopic CO₂ laser vaporization, arytenoidectomy, cordectomy, segmental resection of trachea with end-to-end anastomosis and expansion laryngotracheoplasty with costal cartilage or hyoid bone graft augmentation. For some cases in which laryngotracheoplasties were performed, internal lining was provided by buccal mucosal graft and stenting with silicone tubes. Details of treatment procedure for laryngotracheal stenosis in this series are shown in Table I.

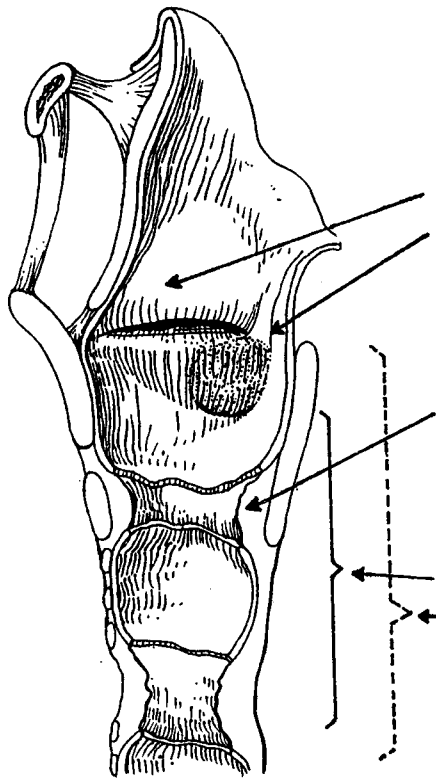


Figure 2. The stenotic sites and associated injuries.

The level of stenotic segment		The associated injuries	
Supraglottic area	1	thyroid fracture	1
Glottic area	5	thyroid fracture	2
		fixation of right vocal cord	1
		fixation of left vocal cord	2
		fixation of both vocal cords	2
Subglottic area	14	thyroid fracture	2
		cricoid fracture	4
		right vocal cord paralysis	2
		left vocal cord paralysis	3
		Subglottic to tracheal area	5
Glottic to tracheal area	9	thyroid fracture	5
		cricoid fracture	3
		fixation of left vocal cord	1
		fixation of right vocal cord	2
		fixation of both vocal cords	4

Table 1. Treatment procedures used in 34 patients with laryngotracheal stenosis.

Type of surgical procedure	Number of procedure
Endoscopic CO ₂ laser vaporization	84
Microscopic cordectomy	3
Microscopic arytenoidectomy	2
Laryngofissure with granulation removal and internal stent	7
Augmented thyroplasty	6
Tracheal resection with end-to-end anastomosis	5

The result of treatment for these patients was poor because of the location and extensive stenosis. In this series, there were 11 out of 34 patients (32.35%) whose decannulation was unsuccessful and needed lifelong permanent tracheostomy. The remainder of patients, stenosis was successfully corrected by

several procedures. Some patients had to be treated with CO₂ laser vaporization periodically. The average times for CO₂ laser vaporization was 1-15 with the mean of 2.7 and the follow-up period varied from three months to five years with the mean of 18.8 months.

Discussion

Management of an acute laryngeal injury remains to be a diagnosis and therapeutic challenge. The decisions made upon patient arrival at the emergency department will determine the survival of the patients and eventually the outcomes of the airway and voice.⁽⁵⁾ Maintenance of the airway for the motor-cycle accident victims who usually have multiple organ injuries, especially neurological and maxillofacial injury, is the first priority. Because severe injuries can lead to a need for urgent control of airways with orotracheal tube intubation and bleeding which may mask the injured region, the attending physicians can miss the diagnosis of laryngotracheal injury. From this series, only 14 of 42 patients (33.33%), diagnosis were properly recognized when first seen. Eleven patients had clear evidence of laryngeal injury at the outset but were not recognized. The rest of cases, laryngotracheal stenosis could not be assessed as whether the existing injury was aggravated by orotracheal intubation or prolonged orotracheal intubation caused the laryngotracheal stenosis. Anand et al⁽⁶⁾ and Massoud et al⁽⁷⁾ reported 9% and 16% of laryngotracheal stenosis caused by external laryngeal trauma respectively, but none mentioned about the unrecognized laryngeal trauma.

Endotracheal intubation, particularly in difficult and uncooperative cases, may aggravate an injury ranging from mild to severe laceration of mucosa. Some neurological injuries need prolonged intubation with mechanical ventilatory support during the recovery course. These may aggravate damaged mucosa and form fibrotic stenosis afterwards. The two major mechanisms hypothesized to cause laryngeal injury from an endotracheal tube are the movement

of the tube with abrasion of mucosa and pressure necrosis.⁽⁸⁾ Whited studied laryngotracheal sequelae in long-term endotracheal intubation patients and found that patients whom were intubated for 2-5 days had 6% incidence of transient laryngeal injury. Those whom were intubated for 6-10 days had a 5% incidence of chronic irreversible laryngeal stenosis, while those whom were intubated for 11-24 days had a 12% incidence of extensive translaryngeal stenosis. He concluded that the incidence of acute and chronic laryngotracheal sequelae increased with the length of intubation beyond 10 days, and he recommended intubation times of seven days or less.⁽⁹⁾ However, the most optimal time that patients should be converted from orotracheal intubation to tracheostomy in traumatic patients is still controversial.^(10,11,12) Most laryngotracheal stenosis patients in this series had associated neurological injuries (28 cases or 82.35%). There were some cases requiring prolonged intubation for more than seven days (12 cases) and who needed ventilation support (8 cases).

Schaefer et al. showed that orotracheal intubation, size and type of orotracheal tube, ventilation support machine, nosocomial respiratory infection and medical care were risk factors for developing laryngotracheal stenosis, and they recommended management of unstable airways by tracheostomy rather than endotracheal intubation. They believed that placement of the endotracheal tube across an injured larynx could convert a simple mucosal laceration into a complex one.⁽¹³⁾

Direct fiberoptic laryngoscopy and CAT-scan are important investigation techniques for evaluating an injury.^(1,13,14,15) Fuhrman et al suggested that in stable patients, the emergency department evaluation should

be initiated with an indirect endoscopic examination or a small flexible nasopharyngoscope to assess the airway. CAT-scan, direct laryngoscopy, bronchoscopy and esophagoscopy were then selectively used depending on the initial findings. They concluded

that early operative management should be employed in blunt laryngotracheal trauma. Delayed intervention had been shown to result in poorer voice and airway results.⁽²⁾ The details of management protocol for blunt laryngeal trauma are shown in figure 3.⁽¹⁶⁾

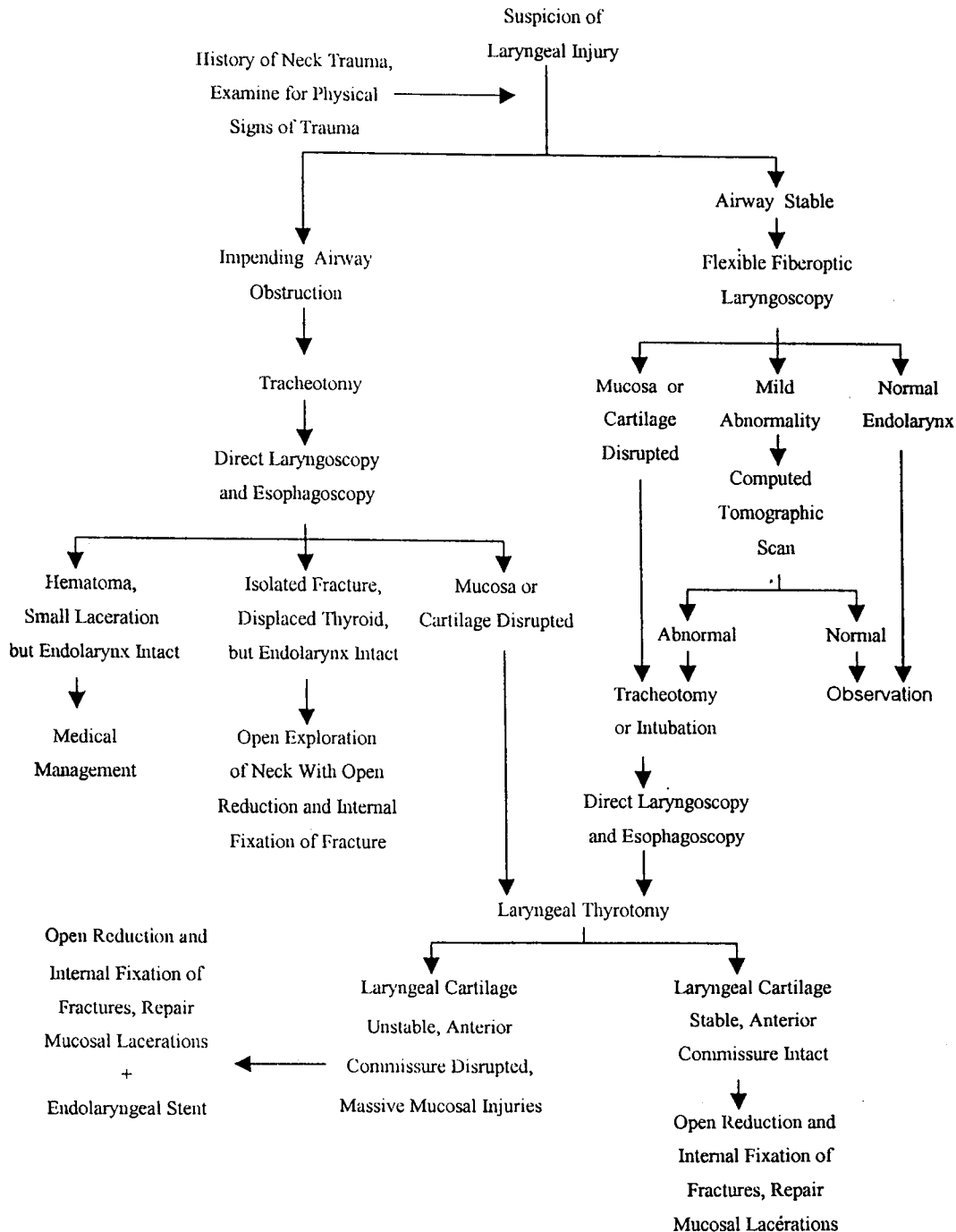


Figure 3. Management protocol for the acute laryngeal injury (Schaefer SD. The treatment of acute external laryngeal injuries. Arch Otolaryngo l Head Neck Surg 1991; 117: 35-39)

The goal of laryngotracheal reconstruction in late stages is to provide a stable airway with preservation of phonation, and effective cough and swallowing without aspiration.⁽¹⁷⁾ The method of treatment depends on the nature of the stenosis (early or mature), the location, extent and severity of the stenosis, the overall medical condition of the patients, and the surgeon's experience and preference. The treatment options include endoscopic CO₂ laser radial vaporization,⁽¹⁸⁾ arytenoidectomy⁽¹⁹⁾ and posterior cordectomy⁽²⁰⁾ (for bilateral cord paralysis and fixation), tracheal resection with end-to-end anastomosis^(6, 21) and laryngotracheoplasty with augmentation technique.⁽²²⁾

Site, length of stenotic segment and immobility of vocal cords have a prognostic effect on the result of treatment. McCaffrey concluded that factors which had a significant effect on the outcome were the site of stenosis and the diameter of the stenosis.⁽²³⁾ Massoud et al, showed that longer lengths of stenotic segments and their anatomical sites with glottic involvement were unfavorable determinants of outcome.⁽⁷⁾ The findings of this report are consistent with those studies. Six of eleven cases with severe laryngotracheal stenosis that could not be decannulated had long segment stenosis with glottic involvement.

Conclusions

Thirty-four out of 42 (80.95%) patients with blunt laryngeal injury after motorcycle accidents developed laryngotracheal stenosis. At presentation, eleven cases (32.35%) had clear evidence suggesting unrecognized laryngeal injury. In the other 17 patients (50%), the existing mucosal injury might have been aggravated by internal injury either from difficult or prolonged endotracheal intubation with consequent

delay in diagnosis and poor outcome of treatment. Eleven patients (32.35%) needed a permanent tracheostomy. This severe complications from blunt laryngeal injuries had a great effect on quality of their life, so it should be prevented by early recognition and proper management.

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