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Tracheobronchial injuries. Conservative treatment☆

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Abstract

Tracheal lacerations are iatrogenic, localized, low impact injuries with longitudinal tears (in about 1:20,000 intubations). In contrast traumatic tracheobronchial ruptures are high velocity injuries with horizontal transections. Between 1986 and 2002, we treated 27 tracheobronchial injuries (8 bronchial 3 of them iatrogenic, 19 tracheal 17 of them iatrogenic (+1 horizontal rupture + 1 tracheoesophageal stabbing)). Extension of the tears 5–12 cm. All bronchial ruptures, the tracheal rupture as well as six iatrogenic tracheal tears have been managed operatively. All the other underwent conservative treatment. Indications: (1) critically ill patients, (2) delay in diagnosis >72 h, and (3) refusal of operation. It consists in endotracheal intubation for 5–9 days. This way we prevent pressure peaks as well as retention achieving a continuous control. Conservative group: 12/13 patients survived, neither stenosis nor megatrachea. Operative group: 1 patient died (MOF), 1 postoperative stenosis (Montgomery tube for 2 months). Tracheobronchial ruptures have to be operated. Lacerations show frequently discret clinical signs, but typical X-rays. They can be dealt with conservatively in the majority of cases as well as operatively. According to our experience, conservative treatment is safe and shows a mortality as low or lower than operative procedures.

Keywords: Trachea; Lacerations; Conservative treatment; Mortality

1. Introduction

Iatrogenic injuries in the thoracic region are all but uncommon events. Revising the records, we can find a certain incidence for several types of injuries requiring interventions: about 1:200 for chest tube caused ones up to 1:20,000 for intubation related injuries.

About 1% of all operations, we have to perform in repair of these injuries.

Tracheobronchial injuries can be of either traumatic or iatrogenic origin.

We should differentiate strictly between these two types of lesions, because there are two totally different mechanisms, leading to different morphological appearance types and therapeutic options.

Trauma means high velocity, high deceleration high impact in general and more or less complete horizontal transections of the trachea, sometimes combined with esophageal damage [1]. In the bifurcational region, we face usually a pattern of multiple irregularly running trauma lines.

In contrast to them, iatrogenic manipulations are locally limited low impact injuries, caused either by intubation guides or by brusk over inflation of the cuff, creating lacerations. We face all the time longitudinal tears along the border between membranous and cartilagineous part of the trachea sometimes with extension to the (right) main bronchus, rarely of the main bronchus itself.

Among the iatrogenic lacerations, we face two different clinical appearance types too: the first one (Fig. 1) shows a suddenly developed and marked mediastinal and subcutaneous emphysema, which is recognized usually without delay. The second one (Fig. 2), without emphysema is recognized usually with a certain delay of days up to a week, despite typical radiologic signs.

2. Material and methods

From 1986 to 2001, we dealt with 27 treacheobronchial injuries: 19 of them have been tracheal, eight have been bronchial injuries. Among the tracheal injuries there were

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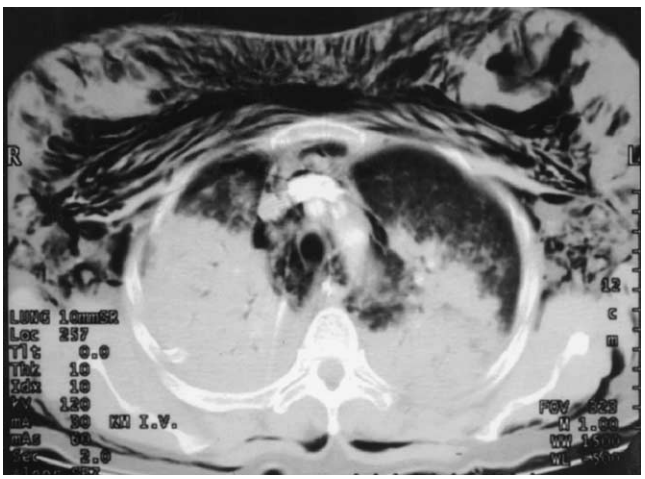

Fig. 1. Mediastinal and subcutaneous emphysema after tracheal laceration (type I).

17 (89%) iatrogenic lacerations in addition to a blunt horizontal transection and a combined tracheoesophageal stab wound each. Both trauma victims have been young men. Among the 17 patients with iatrogenic laceration there were 15 (88%) women, age between 51 and 78 years. The extent of the laceration was within a range between 5 and 12 cm. There was no additional esophageal injury in this group.

All injuries have been sequelae of intubation two of them after double lume tubes.

Among the eight bronchial injuries, there were only 3 (37%) iatrogenic lacerations, one of them by a feeding tube, the other two by double lumen tubes.

All trauma patients have been operated immediately, with exception of the patient with the combined stab wound, who could be dealt with conservatively successfully.

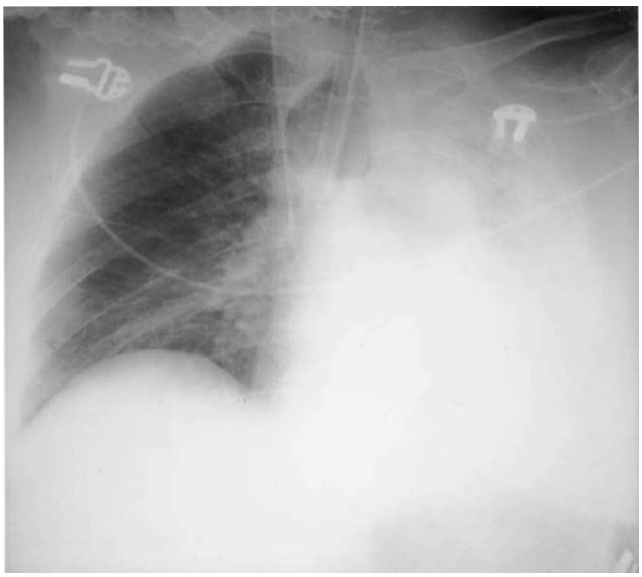

Fig. 2. Typical X-rays after tracheal laceration: overinflated peer shaped cuff and atelectesis of the left side (type II).

Two of the iatrogenic lacerations (one tracheal, one left main bronchus in case of a right sided lobectomy) occurred in preparations for thoracic procedures. They have been detected in time and repaired immediately from the operative site during the planned operation.

Five other iatrogenic tracheal lesions have been operated, four of them from a right sided posterolateral approach, one from a cervicomediastinal approach. Intraoperative ventilation was achieved by a leftsided single lumen bronchial tube (Fa. Rüsch GmbH, Kernen). Operation consisted in a simple closure of the tear with interrupted sutures without special protection of the suture line.

The remaining 13 (65%) patients and the two others with iatrogenic injuries of the bronchi have been dealt with conservatively.

Indication for conservative treatment was:

(1) a delay in diagnosis of more than 3 days
(2) refusal of the operation by the patient or
(3) bad physical condition in severely ill patients.

The conservative procedure consisted in intubation with a well matched endotracheal tube (large bore, low-pressure-high-volume-cuff) for 5–7 days with varying ventilation modes, depending on the individual situation of each patient. A slight inflation of the cuff is necessary in order to keep the gap between the wound edges open and to prevent retention (Fig. 3). Calculated antibiosis and daily bronchoscopic control in order to clean up the situs and to assess the state of granulation tissue formation complete the procedure.

3. Results

All but one patient in the conservative group survived. Death was absolutely unrelated to the tracheal lesion (brain stem incarceration in encephalitis as the underlying disease). All patients underwent bronchoscopic control. Up to 6 months later, neither a stenosis nor a megatrachea could be observed.

In the operative group one patient with tracheal laceration died of multiorgan failure at the day 12 (lung contusion, flail chest, multiple fractures as underlying traumatisation).

One patient in the latter group, operated with a cervicomediastinal approach-initially operated with a tracheostomy by otolaryngologist-experienced a stenosis of the trachea, which must be treated by Montgomery tube for months.

4. Discussion

Beginning in the late 1960s and the early 1970s, we can find case reports concerning tracheobronchial lesions [2–6], mostly created by the stiff Carlens tube, called uniformly

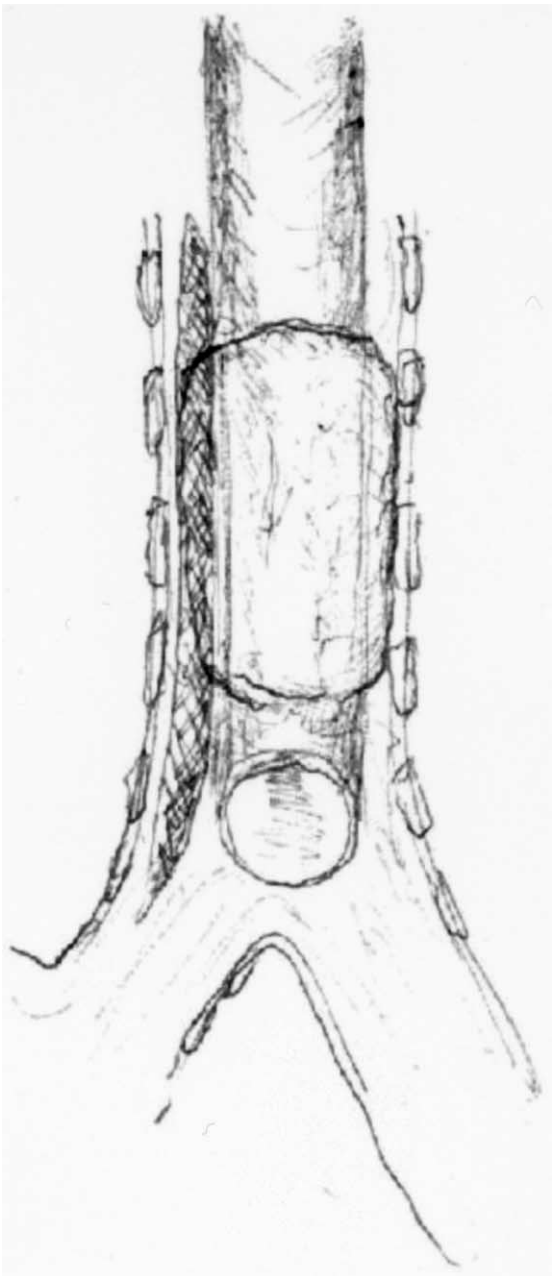

Fig. 3. Conservative treatment: large bore endotrachial tube.

ruptures. This terminology leads to misunderstandings, as pointed out in Section 1.

Nearly all the affected patients did experience an operative closure of the tear, usually via right sided posterolateral thoracotomy through the fourth intercostal space Marty-Ané [7]. Repair itself is easily accomplished by some interrupted sutures, in general no further protection of the sutures has to be done.

In 1994, Angelillo-McKinley [8] introduced the far less traumatic transtracheal repair from a cervical approach, actually seemingly the preferred approach in publications.

In the last years, some articles were published covering larger series of patients [1,9]. Some of these describe conservative treatment, however, performed only in very small (around 2 cm) tears. Some of the authors use glue, which we consider superfluous if not contraindicated, because it can promote retention.

As we presented our experience the first time in 1994 [10], hardly anyone appeared to be convinced about the advantages of this procedure, despite the fact that these advantages are evident. Later on Ross [11], Molins [12] and Borasio [13] confirmed our experience.

The lesions we encountered have been caused either by single or by double lumen tubes as well in elective as in emergency intubation, rarely in case of reaperture of a tracheostomy.

The strong prevalence of women (15/17) is easily explained by the fact that female airways are smaller in size.

We have seen these injuries, e.g. in case of varicose vein exhairesis exclusively for cosmetic reasons in a young woman, or we observed it in case of a mobilisation of a frozen shoulder under general anaesthesia. The question remains: Should we do surgery in these cases also in the knowledge that there is an viable alternative nonoperative option, without visible marks, without consecutive scars?

In other instances, when we face critically ill patients: are we allowed to perform surgery with a certain or with a high risk? Should we do surgery, as Hofmann [14] recommends, with a mortality of about 42% (also if the repair via thoracotomy is not a technically very demanding operation)?

Finally: Is the much more sophisticated operation, introduced by Angelillo-Mackinlay [8] later presented by Mussi and colleagues [15] superior to the conservative treatment?

5. Conclusion

Tracheal lacerations can be dealt with successfully several ways. Conservative treatment should be considered as a valuable alternative to the well-established operative treatment. The results are comparable.

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Appendix A. Conference discussion

Dr. A. Turna *(Istanbul, Turkey)*: I would like to know what the patient compliance was with the endotracheal tube, and did you compare the patient compliance with the endotracheal tube and the patients with the Montgomery tube in the conservative setting?

Dr. Lampl: We don't and didn't use Montgomery tubes for these patients. We used it once for a postoperative stenosis for some months. Therefore we cannot compare Montgomery with endotracheal tubes.

Dr. G. DiRienzo *(Bari, Italy)*: I probably misunderstood the initial phase of your lecture. You showed that case of long-standing tracheal laceration from 5 days, I think, something like that, but I didn't understand exactly what you meant. Do you mean that the conservative management of this lesion is also indicated for early lesions, I mean for patients with a tracheal laceration from one day, larger than 1 cm? Do you suggest conservative treatment for these kinds of patients?

Dr. Lampl: You can do it if you would like to do so. There are several indications for an operation. You have seen that we operated on some patients. One indication for operation is if such an injury occurs in preparation for or during an intrathoracic operation: chest is just open for repair. If there is a patient with huge, increasing emphysema, you should operate him. But it's not necessary to operate all patients. There are several reasons for conservative treatment, as I pointed out.

Dr. H. Wertzel *(Lostau, Germany)*: My question is maybe a little bit similar. Would you say that you can also treat longitudinal, traumatic, full-thickness lacerations over a few centimeters conservatively?

Dr. Lampl: Yes, we can do so, if the origin is iatrogenic. In traumatic origin I didn't ever see a longitudinal laceration. Usually these injuries are horizontal or irregularly-shaped disruptions. There is a great difference. And if there is a high-impact trauma, usually there is a combined injury, and therefore you should perform operations in case of traumatic injury. In case of the iatrogenic ones, called lacerations, you have the choice between operative and conservative.

Dr. Wertzel: Don't you get mediastinitis if it's a full-thickness with its connection of the airway with the mediastinum?

Dr. Lampl: No. You don't get mediastinitis if you keep it open. If you keep open the gap a little bit, there is no pressure and all the fluid can go out, and therefore there is no retention. There is a positive effect from blocking slightly the cuff in the region of the injury.

Dr. A. Tcherveniakov *(Sofia, Bulgaria)*: What is the length of the hospital treatment of both groups of patients? To be honest, in our practice operative treatment in such cases is a method of choice. Do you think that hospital stay is an important factor?

Dr. Lampl: As I pointed out, 5 to 7 days for conservative treatment. In cases with operative treatment, mostly it depends from the underlying diseases or injuries.

Dr. I. Poliakov *(Krasnodar, Russian Federation)*: I have a short comment for two presentations. We have to clarify the name of the presentation: Tracheal lacerations, conservative treatment for patients with severe concomitant conditions but not for primary injury.

Dr. Lampl: A comment to the comment: Laceration and trauma are clearly differentiated. That's what I would like to point out in this presentation.

Appendix B. ICVTS on-line discussion

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Date: 19-Mar-2004

Message: Tracheobronchial ruptures may be spontaneous or acquired. Tracheobronchial lacerations rarely complicate the surgical procedures in general anesthesia. Short women, the type of intubation (with single-lumen or double-lumen tube), the site of the tear (the pars membranacea), mechanical factors, such as repeated attempts at intubation or the overdistention or rupture of the cuff and anatomic abnormalities of the trachea are considered as being the main causes of these complications, although it can be difficult to make out a laceration that happens after an intubation without difficulties. Except for the case of intraoperative evidence, the appearance of symptoms such as head and neck emphysema, hemoptysis, and dyspnea should raise the suspicion of tracheobronchial laceration. Tracheobronchoscopy is the mandatory investigation to establish the diagnosis and to identify the anatomy to choose the appropriate treatment and approach [1].

Small body size of the women and therefore the risk of placing the tube too far downwards in a short trachea and/or an inadequate tube size might be responsible. Additionally, a vulnerable and weak trachea is often suspected in woman. Inadequate intubation tube size is one of the most important risk factors. Furthermore, the circumstances of intubation play an additional role, since the proportion of emergency intubations with stress situations is very high. A fiberoptic bronchoscopy and a conventional radiography of the thorax are the preferable tools of diagnosis. Tracheobronchoscopy can sufficiently determine the extension and depth of the lesion, thus allowing to plan the best treatment. In contrast, computerized tomography (CT) is only necessary in some cases of suspicion in non-detectable mediastinal bleeding or mediastinal emphysema, which are not visible by conventional chest X-ray, while oesophagoscopy is very seldom and only indicated if a tracheooesophageal connection is suspected. Early diagnosis and surgical repair are the goals to persecute to achieve the best outcomes in these potentially lethal lesions. Oesophagoscopy is often required in patients with penetrating and post-tracheotomy injuries due to the possibility of an associated oesophageal perforation, and in these cases a barium swallow may be helpful too. Blunt and post-intubation trauma, instead, are rarely associated with oesophageal injuries as it is evident due to the mechanism that produces them. The surgical approach should be thoracotomy if the trauma involves the 1/3 inferior trachea and/or a mainstem, the cervicotomy in the case it was injured the 2/3 superior trachea and the larynx. Posterior tracheal wall tears may be repaired via the new transcervical/transtracheal technique. The conservative treatment should be reserved to those patients with minimal signs and symptoms [2].

The prognosis of tracheal lacerations depends both on the general health of the patient and on the rapidity of diagnosis and treatment [3].

It is strongly recommended that the airway be extubated as soon as possible. In most cases extubation can be accomplished before the patient leaves the operating room or the recovery room [4].

Conveniently localized short lacerations, especially if they do not involve the whole thickness of the tracheal wall, can be treated with

antibiotics and intubation with the cuff inflated distal to the tear, avoiding high intra-bronchial pressures also after eventual extubation. In all other cases surgical repair is preferred. The indications for surgical repair are based upon a synopsis of clinical, radiological, and endoscopical findings. Respiratory distress in the absence of a pneumothorax, rapidly increasing subcutaneous and mediastinal emphysema, and/or pneumothorax showing continuous air leak and no reexpansion of the lung after intercostal suction drainage are strong indicators for the need of surgery. We found these criteria in all patients who during emergency endoscopy had tears involving the full thickness of the organ, longer than approximately 2 cm. Furthermore, transmural ruptures involving the paracarinal region and/or prolapse of the oesophageal wall into the tracheal lumen are indications for surgery. In none of our patients was a CT-scan necessary to make the decision for or against surgery. The principles of surgery for airway injuries include trimming the borders of the rupture in case of transverse disruptions, mucosa to mucosa repair, and if necessary, the use of protective tissue (muscle, pericard, pleura, mediastinal fat pads) for the anastomosis or suture line, respectively. Like most authors, we prefer the use of absorbable suture material, applying continuous running sutures whenever possible. As to our experience, an additional "protective" tracheostomy as advocated by some authors is unnecessary and would only mean additional trauma to the trachea. "Non-operative" treatment is reserved for patients in whom the laceration is either small (less than approximately 2 cm) and amenable to adequate cuff positioning, or not involving the whole thickness of the tracheobronchial wall, as well as for patients in a poor general condition with a very high operative risk [5].

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