The Peerian Journal
Open Access | Peer Reviewed
Volume 27, February, 2024
ISSN (E): 2788-0303
Website: www.peerianjournal.com
Email: editor@peerianjournal.com

Evolution of lower respiratory tract surgery

Bakhromova Odina Alisherovna
Master's degree, Tashkent Medical Academy, Faculty of General Surgery Uzbekistan, Tashkent.
E-mail: azimbaevaodina4@gmail.com
Eshonkhodjaev O.D - Associate Professor of Medical Sciences
Khayaliev R.Y. - Associate Professor of Medical Sciences
Tursunov N.T - Associate Professor of Medical Sciences
Rikhsiev Z.G - Doctor of the Department of Lung and Mediastinal Surgery

Abstract: This article studies the evolution of lower airway surgery. Today, early innovative diagnosis and prevention of tracheal defects is one of the most urgent problems in medicine.
Keywords: Evolution, instrumental diagnostics, defects, plasticization methods.

Evolution of lower airway surgery

The first surgical interventions on the lower respiratory tract date back to BC in ancient civilizations. The oldest surgical technique is rightly recognized as tracheostomy. The chronology of this operation goes back so long that even with the most scrupulous approach it is impossible to establish when and by whom the earliest tracheostomies were performed. The first written source describing a surgical technique similar to tracheostomy was the Indian book Rigveda. If we rely on this oldest monument of literature, tracheostomies were performed as early as the Bronze Age (Colice G.L., 1994). Five centuries later, the ancient Egyptian sage Imhotep, later revered as the god of medicine, outlined the prototype of the modern tracheostomy on a papyrus (Musso C.G., 2005). The ancient Greek healer and founder of medicine, Hippocrates, also did not ignore this issue, describing tracheal intubation. The eminent military leader Alexander the Great used a sword to open the tracheal lumen in connection with the development of acute airway stenosis in a soldier who had choked on a bone (Szmuk P. et al., 2008).

In the Middle Ages, no research on the respiratory tract is recorded. Moreover, in the few references dating back to the 13th century, there is a negative perception of tracheostomy, which in turn explains the refusal to perform it until the 19th century. The negative consequences of the operation, which limited its use, can be argued by unsatisfactory knowledge of anatomy (Watkinson J.J. et al., 2000).

Tracheostomy was further developed during the Renaissance and is associated with the name of a scientist such as Vesalius (Gillespie N.A., 1948). Perhaps, from that time till today tracheostomy has firmly entered the medicine and became one of the most popular surgical interventions on the trachea in the world practice.

Nowadays tracheostomy can be performed in outpatient conditions for vital indications or in hospital in urgent or planned order. The course of the operation has been developed in sufficient detail taking into account anatomical features of patients (Figure 1) (Littman I., 1982; Parshin V.D., 2008).

Now, when the necessity to perform tracheostomy in the presence of appropriate indications does not cause any disputes and the technique of the operation is thoroughly worked out, complications

The Peerian Journal
Open Access | Peer Reviewed
Volume 27, February, 2024
ISSN (E): 2788-0303
Website: www.peerianjournal.com
Email: editor@peerianjournal.com

that tracheostomy and intubation lead to in patients who need ventilator for a long time raise more and more questions. A defect forming in the area where the tracheostomy tube is inserted requires reconstructive intervention.

However, reconstructive surgery of the tracheobronchial tree was developed much later. Belsey R.'s ideas about the importance of successful reconstruction of the trachea after extensive resection have been cited by scientists for 70 years (Belsey R., 1950).

Amirov F.F. in his monograph singled out two stages of development of reconstructive surgery of airways. The first one starts from the second half of the XIX century and continues till 1940. This period is marked by the works of otorhinolaryngologists in the field of reconstructive plastic surgery of the larynx and cervical trachea. The leading representatives of this direction are Gliick T., Konig F., Hacker E., Ivanov A.F., Ilyashenko N.A., Bokshtein Y.S., Rauer A.E., Usoltsev N.N., Khitrov F.M. and others.

The author considers the second stage from 1940 until the monograph was published in 1962. During this period, many developments in reconstructive surgery of the thoracic trachea and bronchi belonging to such scientists as Daniel R.A., Bucher R.M., Kergin F.G., Sealy W.S., Amirov F.F., etc. are described. (Amirov F.F., 1962).

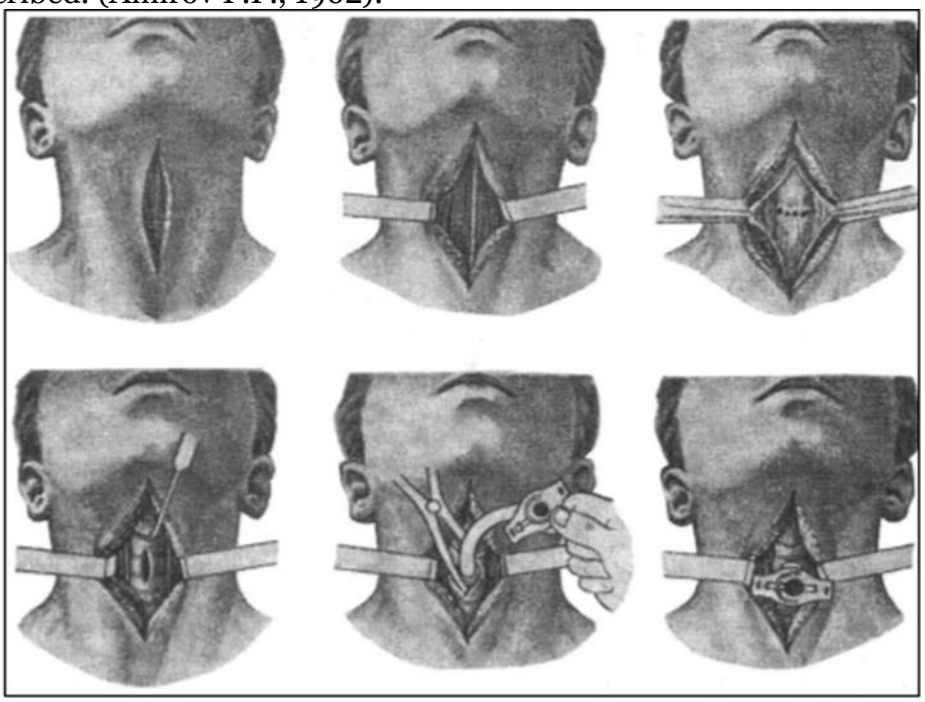

Figure 1: Tracheostomy (surgical procedure)

The successor of Amirov F.F. in such a difficult area of medicine was academician Perelman M.I., who devoted a sufficient number of works to the prevention, diagnosis and treatment of tracheal stenosis (Perelman M.I., 1972, 1999).

To date, thoracic surgeons perform circular resections to treat scar strictures of the trachea. For the first time this surgical intervention was performed by Küster E. in 1886 when the pathological focus

The Peerian Journal
Open Access | Peer Reviewed
Volume 27, February, 2024
ISSN (E): 2788-0303
Website: www.peerianjournal.com
Email: editor@peerianjournal.com

was localized in the cervical trachea. The operation involves removal of the tracheal segment in the affected area with subsequent anastomosis (Küster E., 1886).

Except that in practice this intervention has a chance of success when several rings of the trachea are affected (Kuzmichev A.P. et al., 1967; Koroleva N.S., 1980; Kharchenko V.P., 1999). Even in the situation when the volume of resection is small and one can count on radical treatment, complications are possible, the most formidable of which is anastomosis failure. One of the reasons for this may be the accession of secondary infection. In such cases it is necessary to put a temporary tracheostomy with a possible prospect of reconstruction in the scope of resection with repeated suturing. But in this case it is necessary to take into account the risks associated with increasing tension between the sewn rings and the probability of repeated failure of the anastomosis. As the number of damaged tracheal rings increases, the chances of success of circular resection and restoration of the organ's integrity surely decrease.

In the case of extensive defects that are more than half of the tracheal length, this technique is not applicable at all (Anichkin V.V., 1988).

To prevent anastomosis failure, I.A. Khoroshilov et al. slightly modified the technique of circular resection in the classical sense. The authors proposed to suture the anterior wall of the distal end of the trachea using non-absorbable suture material to the periosteum of the inner surface of the sternum. No restenosis of the trachea in the distant period was registered in patients aged 16 years and 61 years, for whom the application of this technique was described (I.A. Khoroshilov et al., 2006).

It is more difficult to replace defects localized in the tracheal bifurcation area, when in addition to the problem of restoring the integrity of the airways, there are also difficulties in adequate lung ventilation. The publication by Kharchenko V.P. mentions the uniqueness of the operation performed at the turn of the last decades of the XX century. In an oncologic patient upper lobectomy on the left side was accompanied by circular resections of the left main bronchus and trachea bifurcation. The anatomy of the tracheobronchial tree was reconstructed by means of anastomosis between the trachea, the right main bronchus and the left lower lobe bronchus with formation of a new tracheal bifurcation (Kharchenko V.P., 2004).

An aggravating factor in surgery of lower airway defects in tracheal stenosis is the presence of an accessory joint between the trachea and esophagus. For their separation Parshin V.D. proposed a transstracheal access, when the tracheal lumen was opened circularly in the area of tracheo-esophageal fistula. The precision access allowed performing organ-preserving surgery (Parshin V.D., 2013). In the twentieth century, methods of tracheal prosthetics were introduced by Gubanov A.G., Zenger V.G., Kotelnikova I.V., Perelman M.I., Sotelo R., Fersini M., Guijarro J.R., Banis J.C., etc. (Amirov F.F., 1962).

Increasing interest in this treatment option stimulated this direction, and the work continues to the present day. Porous and silicone prostheses have replaced solid prostheses. Still, total tracheal prosthesis continues to be considered only in the framework of the experiment, as none of the observations demonstrated a long-term effect (Yamamoto S. et al., 2013; Ratnovsky A. et al., 2015; Vearick S.B. et al., 2018).

Another attempt to address the issue of extended tracheal defects was the use of autografts. Hollow vein, aorta, esophagus, gallbladder, small intestine, bladder, bronchus, pericardial and thyroid-pericardial flap, pectoral muscle, lung tissue flap, forearm flap, posterior tibial artery, cortico-

The Peerian Journal
Open Access | Peer Reviewed
Volume 27, February, 2024
ISSN (E): 2788-0303
Website: www.peerianjournal.com
Email: editor@peerianjournal.com

periosteal-cutaneous flap of the medial femoral condyle, etc. were used to replace the defect. These operations were fraught with the lack of adequate blood supply and great traumatization. It would seem that such an unpromising technique should have become only the property of history, but experimental studies in this direction continue in our time (Anichkin V.V. et al., 1996; Yu P. et al., 2006; Wurtz A. et al., 2006, 2010, 2013; Kashiwa K. et al, 2009; Chen Q.K. et al., 2010; Fanous N. et al., 2010; Topolnitsky E.B. et al., 2012; Fabre D. et al., 2013; Al-Khudari S. et al., 2013; Yazdanbakhsh A.P. et al., 2015; Zhang S., Liu Z., 2015; Ninkovic M. et al, 2016; Chinen T. et.al, 2016; Kubo T. et al, 2018; Xie H. et al, 2019; Tran J., Zafereo M., 2019; Liu J. et al, 2019; Liu J. et al, 2019; Peng Q. et al, 2019; Mundi N. et al, 2019).

There are quite a few works based on tracheal allografting. In the second half of the XX century, there are a sufficient number of experiments on tracheal transplantation. The first such operation in our country was performed by Levashev Y.N. and associates in 1990 to an adult patient (Levashev Y.N. et al., 2009).

When analyzing the world literature, there are many publications on the performance of allotransplantation in children and adults (Sesterhenn K., Rose K.G., 1977; Amirov F.F., 1978; Wagner E.A. et al., 1980; Elliot M.J. et al., 1996; Backer C.L., 1998, 2000; Herberhold C. et al., 1999). Given that the implanted organ was an isolated skeleton, allotransplantation could not become a panacea, since isolated transplantation of such an organ, deprived of adequate blood supply, was fraught with high risks of necrosis. The question of the possibility of a two-stage approach including revascularization was gaining popularity (Hardillo J.A. et al., 2000). Many attempts have been made to revascularize the trachea. Surgical methods involve the use of a "guide" such as an artery or vein, wrapping with omentum, muscle, fascia, pleura or pericardial adipose tissue (Nakanishi R., 2007; Xu L., et al., 2014; Nemska S. et al., 2016).

In 1999, Gudovsky L.M. et al. patented a technique of trachea and larynx defect replacement, where revascularization was performed using microsurgical technique. According to the volume of the trachea and larynx lesion, a skin and bone flap with a vascular pedicle including the radial artery and comitant veins was formed on the forearm. Before immersing the graft into the previously formed bed in the area of the injury, it was stitched so that separate knotted sutures were placed above the bone on one side and intradermally on the other. The flap was fixed in the defect area in such a way that the skin was facing the tracheal lumen and the bone component overlapped the length of the defect. The feeding pedicle was immersed into the tunnel, which was previously formed subcutaneously between the lower airway defect area and the recipient vessels. In order to revascularize the flap, anastomoses were made between the accompanying vessels and branches of the carotid artery and jugular vein. As an example from clinical practice, the data on the successfully performed operation in a 20-year-old patient with an extensive defect of the lower airways are presented (Gudovsky L.M. et al., 1999).

Klepetko W. et al. published successful results of clinical observation. A 57-year-old patient with chronic obstructive pulmonary disease and with stenosis of the distal trachea underwent lung transplantation and two-stage tracheal allotransplantation. Bilateral lung transplantation was accompanied by immersion of the donor's trachea into the recipient's greater omentum and suturing into the abdominal wall like a stoma. Sixty days later, the tracheal allograft retained its functional and structural integrity. Six months after lung transplantation, the patient underwent cricotracheal resection. Reconstruction with end-to-end anastomosis was achievable, and the tracheal allograft

The Peerian Journal
Open Access | Peer Reviewed
Volume 27, February, 2024
ISSN (E): 2788-0303
Website: www.peerianjournal.com
Email: editor@peerianjournal.com

was fully explored. Thirty-one months after transplantation, the patient was in stage 0 bronchiolitis obliterans. Human trachea wrapped in omentum can be used for two-stage allografting (Klepetko W.et al., 2004).

In 2011, Delaere P. reports successful tracheal allografting. Revascularization of the graft in heterotopic position was performed. Immunosuppressive therapy was performed before surgery. The allograft was wrapped in the fascia of the recipient's forearm. Once revascularization was achieved, the mucosa was gradually replaced by the mucosa of the recipient's cheek. After four months, the trachea was completely covered by the mucosa, which consisted of the respiratory epithelium of the donor and the mucosa of the recipient's cheek. After withdrawal of immunosuppressive therapy, the tracheal allograft was moved to the correct anatomical position with intact blood supply. No side effects were observed (Delaere P.et al., 2011). The issue of tracheal reconstruction Delaere R. and associates devoted other works (Delaere R. et al., 2001, 2003, 2005, 2010, 2014, 2016).

In 2017, Kim W.S. et al. published their research. At the preclinical stage, pigs underwent tracheal reconstruction with a free vascularized myofascial flap. Twelve weeks after the surgical intervention, none of the animals showed signs of respiratory distress, and flat epithelium with sparse cilia was observed on the inner surface of the implant. The technique was tested in clinical practice. During the two-year follow-up period, no respiratory system disorders were observed in the patient (Kim W.S. et al., 2017). Transplantation of the isolated trachea even with satisfactory revascularization did not provide the necessary effect. S.S. Dydykin proposed to transplant not just an isolated trachea, but to connect the donor organ to the recipient's vessels feeding it. This allowed to restore the blood supply of the transplant. A detailed algorithm of cadaveric material sampling is described in the paper. In situ dissection of the trachea together with the thyroid gland, thyroid arteries and veins, bronchial arteries, a fragment of the brachial vein was performed from the donor. Allotransplantation of the trachea as part of the organ complex is presented schematically (Figure 3) (Dydykin S.S., 1998, 2001).

Previously, transplantation of the thyrotracheal complex was considered only in an animal model (Lenot B., 1995; Delaere P.R., 1995). The blood supply of the human trachea is more complex and required serious anatomical substantiation. At the preclinical stage a series of experiments on cadaveric material were performed to work out the anatomical aspects of thyrotracheal complex intake and transplantation (Parshin V.D. et al., 2008). This variant of allotransplantation was used three times. For the first time in 2006 the technique was tested in clinical practice on the basis of B.V. Petrovsky All-Russian Center of Surgery in a patient with scar lesion of the trachea. To date, the patient is alive and teaches physical education at school.

The Peerian Journal
Open Access | Peer Reviewed
Volume 27, February, 2024
ISSN (E): 2788-0303
Website: www.peerianjournal.com
Email: editor@peerianjournal.com

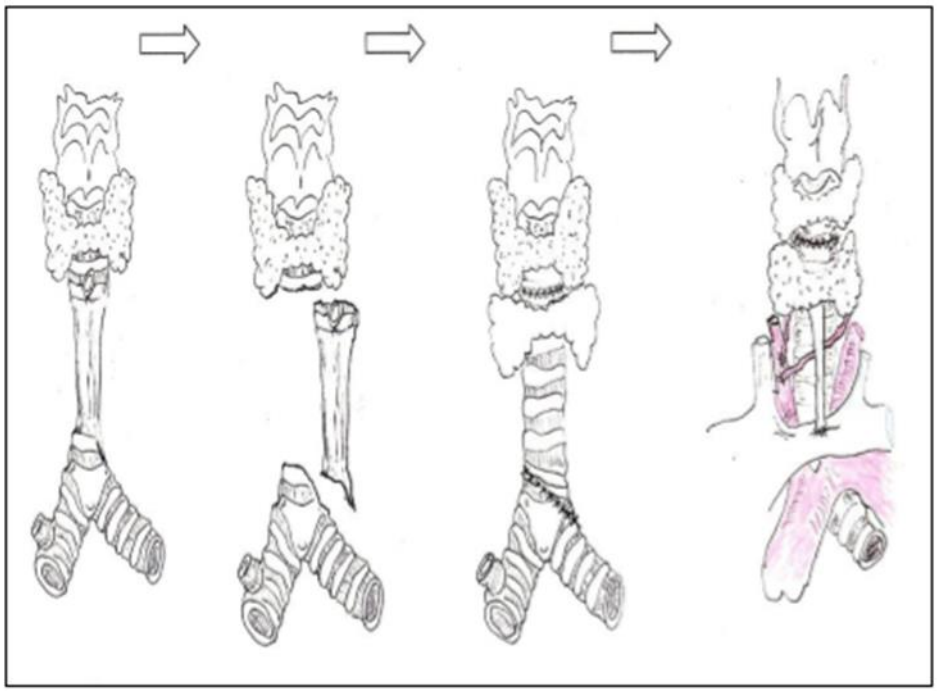

Figure 2: Scheme of tracheal allotransplantation as part of the organ complex.

The fate of the other two patients cannot be traced, as the contact with them after discharge was lost (Dydykin S.S., 2006). The proposed surgical technique undoubtedly has all the prospects for further development in clinical practice, despite the fact that it faces all the difficulties of today's transplantology.

List Of References

1. Hakobyan A.S. Some current problems of clinical research of stem cells / A.S. Hakobyan, D.Y. Belousov, M.R. Rysuly, A.V. Kulikov. // Qualitative clinical practice. - 2010. - №1. - C. 22-28.
2. Aleksandrov V.N. Tissue-engineered trachea transplantation as an alternative to allogeneic trachea / V.N. Aleksandrov, L.I. Kalyuzhnaya-Zemlyanaya, D.V. Firsanov, [and others]. // Bulletin of Surgery named after I.I. Grekov. I.I. Grekov. - 2017. - T. 176. - №4. - C. 110-114.
3. Amirov F.F. Plastic operations on the trachea and bronchi / F.F. Amirov. - Tashkent: Gosmedizdizdat Uz SSS, 1962. - 173 c.
4. Amirov F.F. Reconstructive operations on trachea and bronchi (Experim. researches.) / F.F. Amirov; Edited by E.N. Meshalkin. Meshalkin. - Tashkent: Medicine, 1978. - 246 c.
5. Yuri Levada Analytical Center (Levada-Center). Organ donation and transplantation in the public opinion of Russians / Analytical Center of Yuri Levada (Levada-Center) // Transplantology. - 2014. - №1. - C. 8-19.
6. Anichkin V.V. Tracheobronchoplastic operations / V.V. Anichkin, A.A. Oladko, G.F. Sapko, [and others]. - Vitebsk, 1996. - 272 c.

The Peerian Journal
Open Access | Peer Reviewed
Volume 27, February, 2024
ISSN (E): 2788-0303
Website: www.peerianjournal.com
Email: editor@peerianjournal.com

7. Anichkin V.V. Circular resection of the tracheal bifurcation with preservation of the lung function: diss .... Dr. of medical sciences: 14.00.27 / Anichkin Vladimir Vladimirovich. - Vitebsk, 1988. - 488 c.
8. Baranovsky D.S. Obtaining functionally complete mesenteric epithelium in vitro for tissue engineering of trachea / D.S. Baranovsky, A.V. Lyundup, V.D. Parshin // Bulletin of RAMS. - 2015. - T. 70. - № 5. - C. 561-567.