Acta Chirurgica Belgica

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tacb20

Preserving the eponym: Klinkenbergh technique for bronchial stump suturing

Elena Prisciandaro, Herbert Decaluwé, Paul De Leyn, Willy Coosemans, Philippe Nafteux, Hans Van Veer, Lieven Depypere, Toni Lerut, Dirk Van Raemdonck & Laurens J. Ceulemans

To cite this article: Elena Prisciandaro, Herbert Decaluwé, Paul De Leyn, Willy Coosemans, Philippe Nafteux, Hans Van Veer, Lieven Depypere, Toni Lerut, Dirk Van Raemdonck & Laurens J. Ceulemans (2021): Preserving the eponym: Klinkenbergh technique for bronchial stump suturing, Acta Chirurgica Belgica, DOI: 10.1080/00015458.2021.1975390

To link to this article: https://doi.org/10.1080/00015458.2021.1975390

Accepted author version posted online: 03 Sep 2021.

TITLE

PRESERVING THE EPONYM: KLINKENBERGH TECHNIQUE FOR BRONCHIAL STUMP SUTURING

AUTHORS

Elena Prisciandaro, MD[1,2]; Herbert Decaluwé, MD, PhD[1,2]; Paul De Leyn, MD, PhD[1,2]; Willy Coosemans, MD, PhD[1,2]; Philippe Nafteux, MD, PhD[1,2]; Hans Van Veer, MD[1,2]; Lieven Depypere, MD, PhD[1,2]; Toni Lerut, MD, PhD[1,2]; Dirk Van Raemdonck, MD, PhD[1,2]; Laurens J. Ceulemans, MD, PhD[1,2]

AFFILIATIONS

1. Department of Thoracic Surgery, University Hospitals Leuven, Leuven, Belgium.
2. Department of Chronic Diseases and Metabolism, Laboratory of Respiratory Diseases and Thoracic Surgery (BREATHE), KU Leuven, Leuven, Belgium

ORCIDs

Elena Prisciandaro: 0000-0001-9312-3998

Herbert Decaluwé: 0000-0002-0877-7717

Paul De Leyn: 0000-0002-4200-227X

Willy Coosemans: 0000-0002-0958-0924

Philippe Nafteux: 0000-0002-1145-4812

Hans Van Veer: 0000-0003-1153-8298

Lieven Depypere: 0000-0001-8230-5649

Toni Lerut : 0000-0002-8965-4283

Dirk Van Raemdonck: 0000-0003-1261-0992

Laurens J. Ceulemans: 0000-0002-4261-7100

CORRESPONDING AUTHOR

Professor Dr. Laurens J. Ceulemans (M.D., Ph.D.)

Thoracic Surgery

University Hospitals Leuven, KU Leuven

Herestraat 49, 3000 Leuven, Belgium

Tel.: 0032 16 34 68 20

Fax: 0032 16 34 68 21

E-mail: laurens.ceulemans@uzleuven.be

LinkedIn: www.linkedin.com/in/laurens-ceulemans-1190a7a1

Twitter: @CeulemansLJ

FUNDING

Dr Prisciandaro's fellowship in Thoracic Surgery at the University Hospitals Leuven, Belgium was granted by the European Society of Thoracic Surgeons (ESTS) Biology Club, funded by Medtronic.

DISCLOSURE OF INTEREST

The authors report no conflict of interest in regard to this study.

Unrelated disclosures are:

- HVV is supported by Kom Op tegen Kanker, the Flemish Cancer Society and by the Clinical Research Fund of the University Hospitals Leuven.
- LDP is supported by a starting grant from the University Hospitals Leuven (KOOR-UZ Leuven).
- DVR is supported by the Broere Charitable Foundation.
- LJC is supported by a KU Leuven University Chair funded by Medtronic and a post-doctoral grant from the University Hospitals Leuven (KOOR-UZ Leuven).

ACKNOWLEDGEMENT

The authors would like to thank all the nursing, paramedical and supporting staff of the Department of Thoracic Surgery, anaesthesiologists, intensive care physicians and pulmonologists involved in the Thoracic Surgery Program at the University Hospitals Leuven, Belgium.

ARTICLE TYPE

- *History of surgery*

WORD COUNT

Abstract: 133 words

Main text: 1211 words

Figures: 5

References: 13

ABSTRACT

The technique for bronchial stump suturing following lung resection which is currently applied in the Department of Thoracic Surgery at the University Hospitals Leuven, Belgium owes its name to the Dutch surgeon Dr. Klinkenbergh (1891-1985).

A true pioneer of cardio-thoracic surgery in Europe, Dr. Klinkenbergh dedicated himself to the surgical treatment of pulmonary tuberculosis. His work was praised by his peers for his precision and the reasoning behind every gesture.

The Klinkenbergh technique consists in performing two running sutures which cross each other *'in the same manner as the laces of a shoe'* to close the bronchus, limiting the occurrence of broncho-pleural fistulas. In our experience with more than 100 patients in the last 5 years (2016-2020) who underwent open pneumonectomy for benign or malignant disease, less than 2% developed post-operative broncho-pleural fistulas.

KEY WORDS (5)

Bronchial stump; Eponym; Klinkenbergh; Lung Surgery; Pneumonectomy

MAIN TEXT

Introduction

What's in a name? In particular, eponyms, i.e. common nouns derived from the name of a person, are a long-lived institution in surgery, as they honour the work of notable figures who have made relevant and lasting contributions to their field. They enrich medical literature and provide mnemonics to identify specific diseases, procedures or surgical instruments.

However, if on one hand the use of eponyms plays a role in the preservation of historical memory (e.g. Farabeuf, DeBakey, Boerhaeve, Billroth and many others) [1,2], on the other hand, the true story behind the name is often deemed to be forgotten [3].

At the University Hospitals Leuven in Belgium, the name of a particular suturing technique of the bronchial stump is kept alive, which - to the best of our knowledge - is unknown to most other centres. This technique owes its name to Dr. Klinkenbergh, a Dutch surgeon whose work – as outstanding as it was -, is sadly almost forgotten.

Dr. Klinkenbergh: his life and work

Dr. Marie Chrétien Albert Klinkenbergh (**Figure 1**) was born in Sittard, the Netherlands, on August 17, 1891, as the son of a physician. After gymnasium, he enrolled at the University of Utrecht, where he obtained his medical degree in 1921. He then travelled to Switzerland and France to refine his surgical skills, focusing on the treatment of pulmonary tuberculosis.

Dr. Klinkenbergh later moved back to the Netherlands, to be trained under the esteemed and world-renown Prof. Dr. Schoemaker in The Hague (**Figure 2**). In 1926 he was appointed as head of the surgical department of the St.-Antonius Hospital in Utrecht and connected to the Berg and Bosch Sanatorium in Bilthoven, where he fully dedicated himself to clinical practice, putting to good use his previous experiences [4].

As a true pioneer in cardio-thoracic surgery, Dr. Klinkenbergh was one of the founders of the first Dutch *lung team*, a multidisciplinary board for the management and treatment of pulmonary diseases, in 1942. He also made several valuable contributions to the development of cardiac surgery, implementing the surgical technique for pericardial decortication to treat chronic constrictive pericarditis [5]. One of his many disciples, Dr. Brom, later became one of the fathers of cardiac surgery in Europe. Dr. Klinkenbergh instead dedicated himself to the surgical treatment of pulmonary tuberculosis, developing the bronchial stump closure technique that still holds his name.

His work was praised by his peers for the swiftness of his operation, his precision and the reasoning behind every gesture; notably Prof. Dr. Overholt, an acclaimed US thoracic surgeon at that time, commended Dr. Klinkenbergh for 'simplifying every single step' during an operation.

Besides that, he was praised as a very beloved and appreciated teacher, as he devoted a great deal of time to the education of his disciples, priding himself that after training under him they had truly become surgeons. He died in Utrecht on November 19, 1985, at the age of 94 [6].

The Klinkenbergh technique for bronchial stump suturing

The Klinkenbergh technique was first described in 1955 by Hirdes and Bosch [7] and consists in performing two running sutures which cross each other 'in the same manner as the laces of a shoe' to close the bronchus (**Figure 3a**). In this way, any increase of the tension on the suture (oedema of the bronchial mucosa, coughing, etc.) will tighten the suture threads, preventing leakage. Later in Leuven, Prof. Dr. Deneffe (cf. infra) underlined that while suturing, the *pars membranacea* is protected by folding it inside the bronchial lumen, whereas the *pars cartilaginea* constitutes the outer layer for the entire bronchial circumference (**Figure**

3b). The bronchial stump is then protected with a pleural flap and buried in the mediastinum, for additional fat coverage.

Klinkenbergh carried out over 600 lung resections for pulmonary tuberculosis at the Berg and Bosch Sanatorium in Bilthoven between 1949 and 1953, with surprisingly low mortality (19 patients, 3.1%) and morbidity at that time. Remarkably, post-pneumonectomy broncho-pleural fistulas (BPFs) were reported in 2% of the cases [7]; an impressive result, considering that almost 70 years later BPF remains one of the most dreaded complications after pneumonectomy, with an incidence ranging from 4.5% up to 20% [8,9] and an associated mortality, reaching up to 50%,[10]. Surprisingly, Dr. Klinkenbergh was not included among the authors of the aforementioned paper [7].

The Klinkenbergh technique owes its efficacy to two particular features:

First, it can performed on a clamped bronchial stump, thus favouring asepsis and protecting the main airway from blood dripping; this reduces the risk of infection and post-pneumonectomy empyema, especially in patients undergoing lung resection for pulmonary tuberculosis.

Secondly, compared to interrupted stitches, the running suture allows a better approximation of the bronchial mucosae, increasing the air and fluid tightness [11] and, together with the pleural flap coverage and the folding of the *pars membranacea* inside the bronchial lumen, sealing of the bronchial stump.

Klinkenbergh's legacy in Leuven

This technique has found its way to the University Hospitals Leuven in the late seventies by Prof. Dr. Deneffe, who trained in Toronto under Prof. Dr. F.G. Pearson and in Leuven under Prof. Dr. Stalpaert, who in turn was a disciple of Prof. Dr. Brom.

The technique was passed on by our former teachers (**Figure 4a**) and is still performed today by the eight staff surgeons from the department of thoracic surgery (**Figure 4b**) for bronchial stump closure after open thoracotomy pneumonectomy/anatomical resections with excellent outcomes (**Figure 5**). Clamping the bronchial stump (as in the original Klinkenbergh technique) is not deemed necessary in case of pulmonary resections for lung cancer or non-infectious diseases (as tuberculosis and other bacterial and mycotic lung infections have become rare), therefore the suture is usually nowadays performed on an open bronchus to avoid damaging the bronchial cartilage and/or mucosa. Of course, caution is needed to avoid spillage of secretions. For left pneumonectomies, a bronchial clamp can be used to extract the left main bronchus so that the manual suture can be performed near the carina. A long bronchial stump is more prone to necrosis and can be a source of collection of bronchial secretions and infection. After pneumonectomy, we rinse the pleural cavity with approximately five litres of saline solution.

Mainly after right pneumonectomy and/or after induction therapy, an intercostal muscular bundle is dissected and used to cover the bronchial stump after suturing. If this muscle is not available, a pleural flap or mediastinal fat pad is used as coverage. Our institutional database revealed that out of more than 100 patients who underwent open pneumonectomy for benign or malignant disease in the last 5 years (2016-2020), less than 2% developed post-operative BPFs, similarly to the Berg and Bosch Sanatorium experience.

Furthermore, in a reported series of 56 consecutive patients who underwent extrapleural pneumonectomy for malignant pleural mesothelioma between 2003 and 2014, not a single BPF (0%) was observed [12].

Conclusion

In conclusion, the 70-year-old Klinkenbergh technique is still a safe, effective and reliable option for bronchial stump closure, especially after pneumonectomy. Dr. Klinkenbergh left behind a unique legacy in his field; his contributions to lung surgery are still pertinent and find its representation in everyday surgical practice at the University Hospitals Leuven. To end with Lord Byron's words, ´*These are deeds which should not pass away, and names that must not wither …*´[13].

FIGURE LEGENDS (5)

Figure 1. Portrait of Dr. Klinkenbergh. Available at: http://resources.huygens.knaw.nl/retroboeken/persoonlijkheden/#source=1&page=809&view=imagePane. (accessed July 6; 2021)

Figure 2. Prof. Dr. Schoemaker and his team during an operation in 1922. Dr. Klinkenbergh is the second on the top left. Photograph by P. van Tol. Available at: https://commons.wikimedia.org/wiki/File:Jan_Schoemaker_performing_a_surgical_operation,_1922._Photog_Wellcome_V0029747.jpg (accessed July 6; 2021)

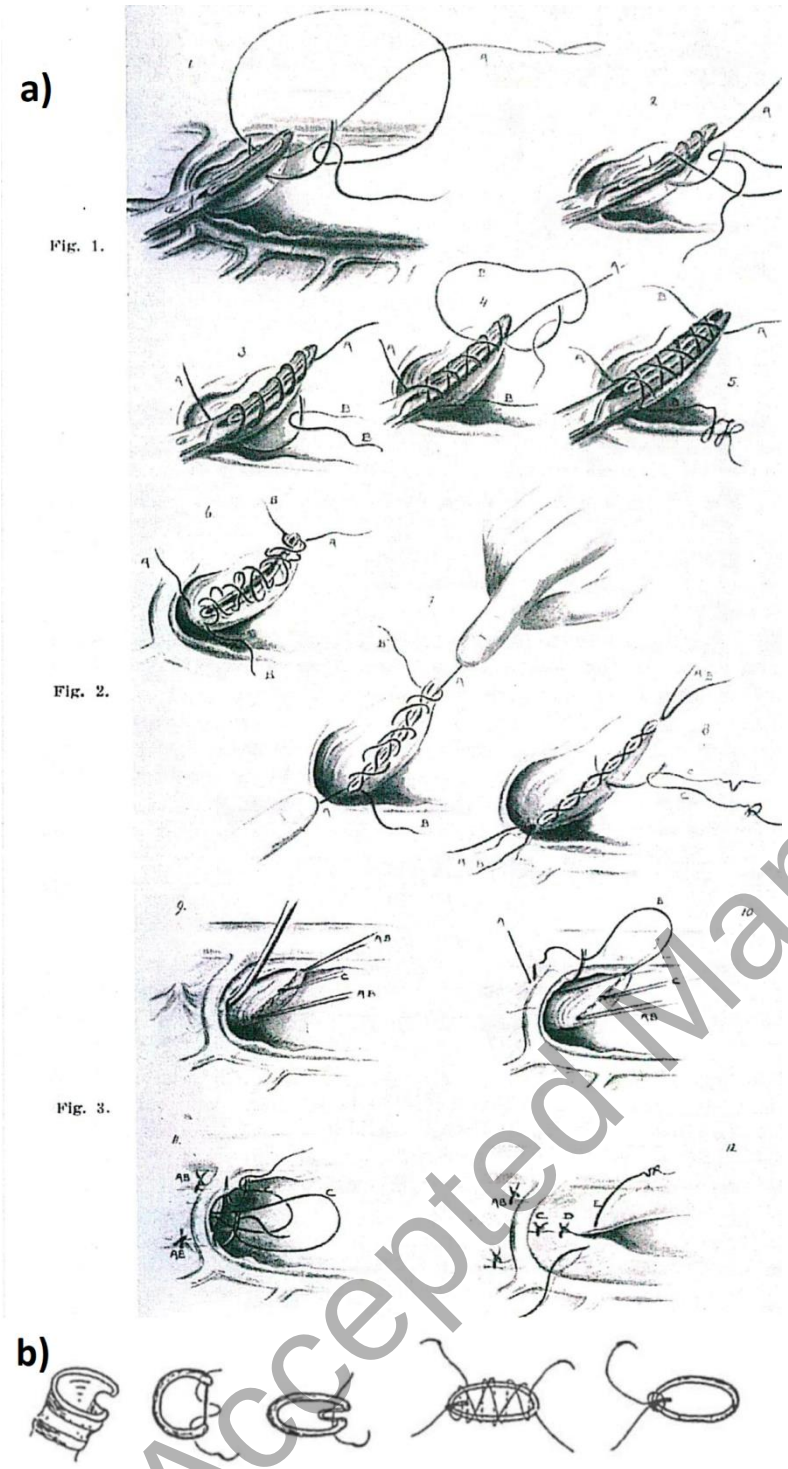

Figure 3: a) The Klinkenbergh technique for bronchial stump suturing. From Hirdes JJ, Bosch MW. Pneumonectomy in pulmonary tuberculosis without thoracoplasty; clinical results and lung function studies. J Thorac Surg 1955;30:719-40.

b) The *pars membranacea* is folded inside the bronchial lumen and the *pars cartilaginea* is the outer layer of the bronchus on its entire circumference. Drawing by Em. Prof. Dr. Deneffe (†) available at the Department of Thoracic Surgery at the University Hospitals Leuven, Belgium.

Figure 4. a) The *founding fathers* of general and cardiothoracic in Leuven; from left to right: Em. Prof. Dr. Stalpaert (†); Em. Prof. Dr. G. Deneffe (†); Em. Prof. Dr. J. Gruwez; Em. Prof. Dr. Lacquet (†); Em. Prof. Dr. P. Broos: Em. Prof. Dr. W. Daenen; Em. Prof. Dr. T. Lerut.

b) The current members of the Department of Thoracic Surgery at the University Hospitals Leuven in Belgium: from left to right: Prof. Dr. L. Depypere; Prof. Dr. H. Decaluwé; Dr. H.

Van Veer; Prof. Dr. D. Van Raemdonck; Prof. Dr. P. De Leyn (chair); Prof. Dr. L. Ceulemans; Prof. Dr. Ph. Nafteux; Prof. Dr. W. Coosemans.

Pictures Courtesy: Prof. Dr. D. Van Raemdonck

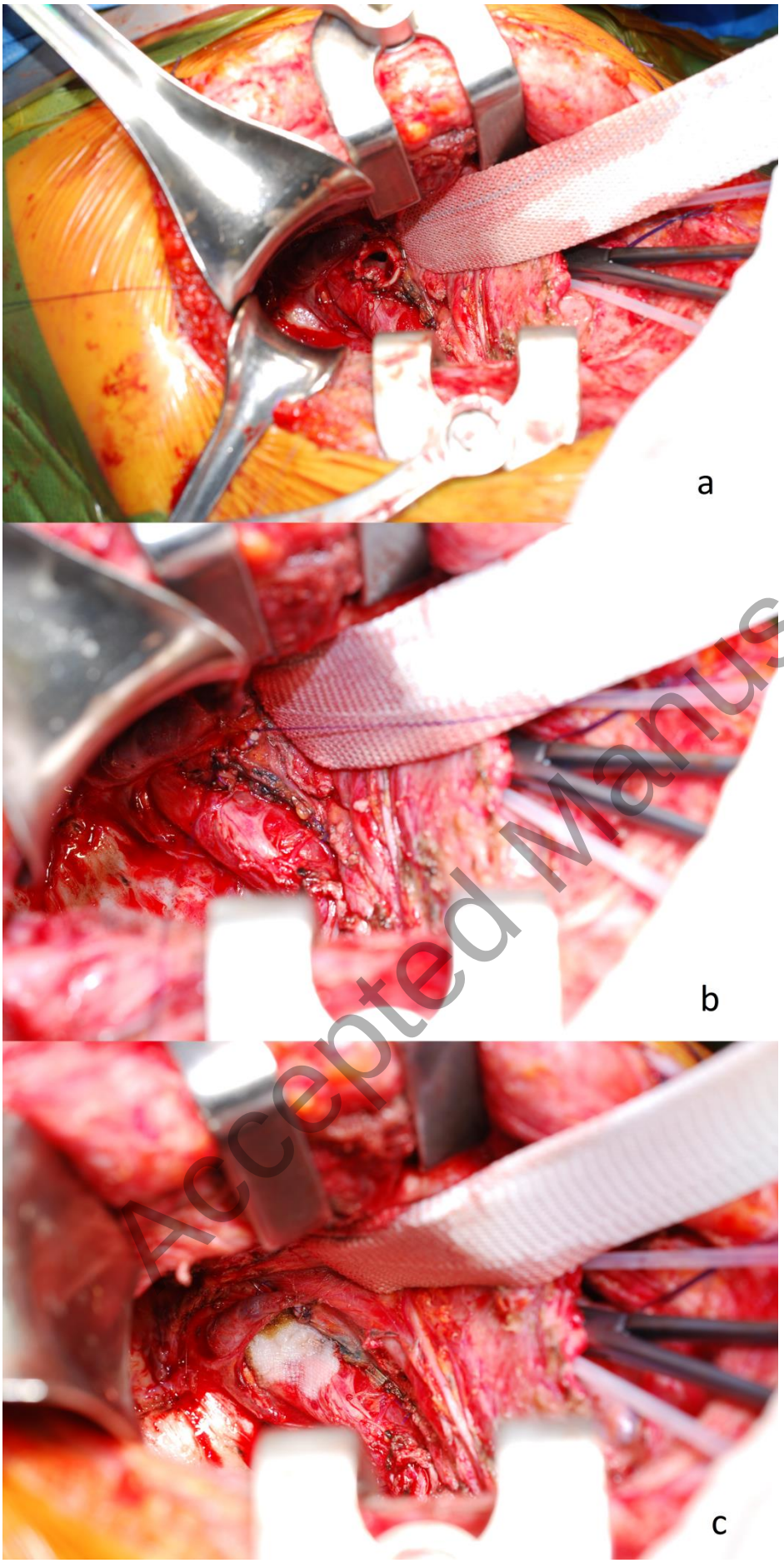

Figure 5. Intra-operative picture of the Klinkenbergh technique for bronchial stump suturing after pneumonectomy. **a)** The *pars membranacea* is folded. **b)** The *pars cartilaginea* is closed with a single running suture. **c)** The bronchial stump is covered by the azygos vein.

Pictures Courtesy: Prof. Dr. D. Van Raemdonck

REFERENCES (13)

(1) Thomas PB. Are medical eponyms really dying out? A study of their usage in the historical biomedical literature. J R Coll Physicians Edinb. 2016;46:295-299.

(2) Cooley DA. In pursuit of an eponym. Tex Heart Inst J. 2004;31:117.

(3) Sealy WC. Classics in thoracic surgery. On the care and preservation of eponyms: the case of Branham's sign. Ann Thorac Surg. 1985;40(3):311-4.

(4) Persoonlijkheden in het Koninkrijk der Nederlanden in woord en beeld. http://resources.huygens.knaw.nl/retroboeken/persoonlijkheden/#source=1&page=809&view=imagePane (accessed July 6; 2021)

(5) Klinkenbergh MC. Chronic constrictive pericarditis; surgical aspects. Dis Chest 1951;19:684-689.

(6) In memoriam M.C.A. Klinkenbergh. https://www.ntvg.nl/artikelen/memoriam-mca-klinkenbergh/volledig. (accessed July 6; 2021)

(7) Hirdes JJ, Bosch MW. Pneumonectomy in pulmonary tuberculosis without thoracoplasty; clinical results and lung function studies. J Thorac Surg 1955;30:719-40.

(8) Cerfolio RJ. The incidence, etiology, and prevention of postresectional bronchopleural fistula. Semin Thorac Cardiovasc Surg. 2001;13(1):3-7.

(9) Mazzella A, Pardolesi A, Maisonneuve P, et al. Bronchopleural Fistula After Pneumonectomy: Risk Factors and Management, Focusing on Open-Window Thoracostomy. Semin Thorac Cardiovasc Surg. 2018;30:104-113.

(10) Di Maio M, Perrone F, Deschamps C, Rocco G. A meta-analysis of the impact of bronchial stump coverage on the risk of bronchopleural fistula after pneumonectomy. Eur J Cardiothorac Surg. 2015;48:196-200.

(11) Joly H, Tobee FM. Suture des bronches par double surjet sur pince écrasante suivant la technique de Klinkenberg [Bronchial suturing by double overcast using clamp forceps according to Klinkenberg technic]. Poumon Coeur 1956;12:311-3.

(12) Frick AE, Nackaerts K, Moons J, et al. Combined modality treatment for malignant pleural mesothelioma: a single-centre long-term survival analysis using extrapleural pneumonectomy. Eur J Cardiothorac Surg. 2019;55:934-941.

(13) Lord Byron GG. Poems; Childe Harold´s pilgrimage. Canto LXVII; lines 1-2.