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The (un)known history of thoracic incisions. Part I: From "Divine surgery" to the first efforts to access the pericardial cavity

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ABSTRACT
Throughout the history of surgery many inaccuracies have surrounded the chapter related to the emergence of thoracic incisions. It will always be very difficult to determine the exact date and names of those who actually performed the first thoracotomies; obviously those who published or reported the first descriptions should be assumed as such, but the history has not always been well told. In some cases, only surnames are known; in some others, the inconsistency of time lapses opposes all logic. A thorough historical research has been carried out, which has made it possible to compile a brief account about the emergence of the most important thoracotomies, as well as to reveal some findings that are unknown to most thoracic surgeons. This is the first part of a brief account about the known facts, but also, it is especially about the unknown history of the thoracic incisions' origin, which has overcome the test of time.
Keywords: History of medicine, Thoracotomy, Abscess, Lung, Pleural effusion, Pericardium

La historia (des)conocida de las incisiones torácicas. Primera parte: De la «cirugía divina» a los primeros esfuerzos por acceder a la cavidad pericárdica

RESUMEN
A lo largo de la historia de la cirugía numerosas inexactitudes han rodeado el capítulo relacionado con el surgimiento de las incisiones torácicas. Siempre será muy difícil precisar la fecha exacta y el nombre de quienes realmente realizaron las primeras toracotomías; obviamente debe asumirse como tales a quienes publicaron o informaron las descripciones originales, pero la historia no siempre ha sido correctamente contada. En unos casos solo se conocen apellidos; en otros, la incongruencia de los lapsos de tiempo se opone a toda lógica. Se ha realizado una profunda investigación histórica que ha permitido confeccionar un breve recuento del surgimiento de las toracotomías más importantes y descubrir algunos hallazgos desconocidos para la mayoría de los cirujanos torácicos. Esta es la primera parte de un breve relato de hechos conocidos, pero especialmente, de la historia desconocida del origen de las incisiones torácicas que han vencido la prueba del tiempo.
Palabras clave: Historia de la medicina, Toracotomía, Absceso, Pulmón, derrame pleural, Pericardio

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"...I should have dilated the wound with a small piece of wood, keeping the lung warm with a rooster or a fowl until (...) it was totally mortified."

Rolandus de Parma

Preamble

The emergence and chronological evolution of incisions that man has developed to access the thoracic cavity is one of the most exciting chapters in the history of surgery. In the recent past and contrary to what happened in other procedures, there was a tendency to call thoracotomies by the name of the surgeon credited as their creator or important promoter rather than by their anatomical location. This preference has caused some thoracic incisions to be erroneously attributed to men who had no connection whatsoever with their origins, or to others who have been undeservedly proclaimed as their inventors.

Certainly, in the thrilling book of medical history, it is virtually impossible to know for sure who the pioneers were in some cases. However, those digging deep in the search for primacy should at least try to actually find out who was the first to publish, share or teach.

By no means do we intend to present the entire historical evolution of thoracic surgery, as this would be almost impossible. Rather, we have reviewed a huge body of scientific evidence (difficult to reference or mention them all). We have paid special attention to the protagonists and some little-known events related to the rise of classic thoracotomies that have made it to the present day. What is presented in this review comes pretty close to our truth, although we are fully aware that each researcher has his or her own version. When the object of inquiry dates centuries back, it will undoubtedly be difficult to know for sure the authentic version of the facts.

We hope that our work will also be a tribute to all the surgeons who created procedures that, although no longer in use, served as an incentive for others to go further and shape the exciting present of cardiothoracic surgery. Perhaps our keen eye has overlooked some names and their deeds continue to be part of an unknown story, which perhaps others will eventually share.

What was the first thoracic incision?

If we were to try to find a theological origin of thoracic surgery, we would soon come across the fascinating biblical account of the first thoracic surgery at the dawn of mankind. Genesis, the first book of the Holy Scriptures, clearly states that God formed the woman's body precisely by means of a thoracic approach. According to the text in Genesis 2:21 God surgically removed a rib from Adam from which He created Eve, the first woman. The "report" of that "divine surgery" goes as follows: "So the Lord God caused the man to fall into a deep sleep; and while he was sleeping, he took one of the man's ribs and then closed up the place with flesh"[1]. In this brief passage we even witness the first time in history that a man was anesthetized to undergo an undoubtedly painful procedure.

Throughout history, there has been no doubt about the veracity of that passage among the followers of many religions; however, at the beginning of this century, that truth seems to have begun to change[2]. The Hebrew word "*ṣēlāʿ*" is translated as "rib" only in the fragment of the aforementioned text even though it appears several times in the Old Testament[3]. Thus, during the last two decades, biblical scholars have started questioning the true definition of the term according to its intended context. It is beyond the scope of this review to address these inquiries in depth, but the hypothesis most widely accepted by biblical archaeologists at present points to the conjecture that Eve was actually fashioned from Adam's baculum, a bone found in the penis of most mammals that has disappeared in the human species[4,5]. This, of course, has given rise to fierce debates and it would be difficult to lean towards one theory or the other. For now, it would be advisable just to be cautious in speculating that the first thoracic surgery in history took place in the quiet garden of Eden.

Somewhat more recently most scholars have placed thoracic surgery in the Old Kingdom of Egypt (2700 - 2200 B.C.E.) or even earlier. This coincides with the presumed date when the original medical treatise is believed to have been written and which, more than a thousand years later, gave rise to what is known today as the Edwin Smith Papyrus. James Henry Breasted (**Figure 1**), who translated the scroll, suggested that Imhotep (approximately 2690 - 2610 B.C.E.) could have been its author, but evidence found in the text itself and more recent find-

ings, which will not be analyzed in this review, are pointing in other directions[6-10]; therefore, perhaps his merit as the first thoracic surgeon in history could also be in question[11]. Sometime after 1930, following the publication of Breasted's first translation, many researchers began to claim that the pages of the ancient treatise contain the first historical reference to pleural infection[12-14]; some have even suggested that his description emphasizes the need to drain the infected fluid[15], which can be interpreted as a commentary on early pleurocentesis. Other authors refer that the famous papyrus alludes to lesions of internal organs of the thorax[8,16,17] and sense in its pages the very possible birth of thoracic surgery.

It would be extremely difficult to pinpoint the origin of such erroneous references; what is certain is that Breasted clarifies at several points in his work that the anatomical area referred to as "thorax" by the ancient Egyptians, in the 8 cases apparently related to thoracic surgery in the treatise he translated, is formed by the superficial soft tissue externally delimited by the skin and internally by the sternum (whose lesion is described in one case) and the true ribs. The translator explicitly notes: "In the discussion of the shoulders and thorax, our treatise, as far as it was preserved, reports no observations of the internal organs except for an undoubtedly precautionary remark drawing attention to the presence of two vessels under the thorax, one running to the lungs and the other to the heart"[18]. Therefore, it is completely false to state that the Edwin Smith Papyrus makes an alleged reference to any pleural or other internal organ of the thorax, much less to surgical procedures within the thoracic cavity.

Figure 1. James Henry Breasted (August 27, 1865 - December 2, 1935). Taken from: James Henry Breasted. Wikipedia: The Free Encyclopedia (https://es.wikipedia.org/wiki/James_Henry_Breasted).

And then... Who was the first thoracic surgeon?

Once the practice of thoracic surgery in ancient Egypt has been ruled out, at least in the pages of the Edwin Smith Papyrus, Hippocrates (**Figure 2**) is presumed to have been the first thoracic surgeon in history. He is credited with the first recorded open evacuation of an empyema by placing small metal cannulas as drains for several days. It is difficult to determine the exact period of the procedure. Approximate dates such as 500 and 229 B.C.E.[19,20] have been considered, but they do not coincide with the period of the Father of Western Medicine, who also in the search for better therapeutic alternatives for thoracic affections of traumatic origin, outlined surgical principles still in force after 22 centuries.

Girolamo Fabrizi d' Acquapendente (May 20, 1537 - May 21, 1619) in his book "*Opera chirurgica*"[21] detailed many procedures described several centuries before his time. He noted: "...when the collection of matter oppressing the chest [empyema, author's note (AN)], cannot be drained [by other means (AN)] (...) it is compulsory to resort to manual surgery, which is to open the chest, to relieve the patient, and remove him from the enormous risk hanging over him". To leave no room for doubt about the far-off origins of thoracic surgery, he added that: "these procedures (...) which in the past were carried out relatively often and safely, seem to have fallen into oblivion in our times, like almost all the other surgeries worth mentioning". Finally, the treatise lists several surgical procedures performed by Hippocrates, which, according to Fabricius, had not been practiced for centuries.

He points out that the famous ancient physician described several thoracotomies in different locations: He suggested opening the thorax at the 5th in-

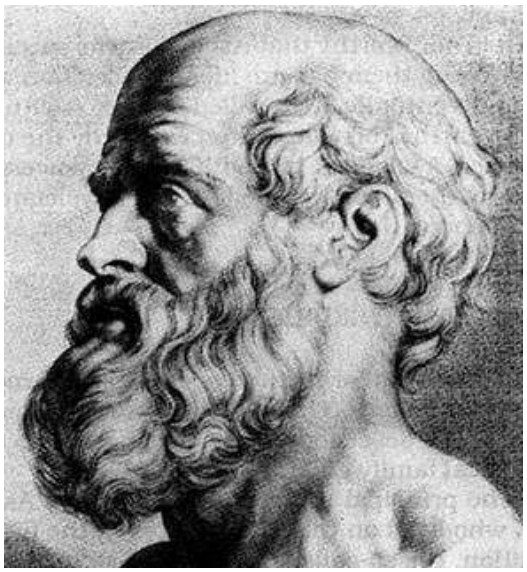

Figure 2. Hippocrates (460-370 B.C.E.). The father of Western medicine, he should probably also be considered the first thoracic surgeon in history. Taken from: Hippocrates. EcuRed: Enciclopedia cubana en la red (https://www.ecured.cu/Hip%C3%B3crates).

tercostal space (ICS) ("above the sixth rib, not below the fifth") to avoid injury to the liver, diaphragm, lungs, and intercostal nerve-vascular bundle, as well as "four or five fingers distal to the breast bone [sternum (AN)] where there are few muscles"...and the path of the internal thoracic arteries is circumvented. He also proposed posterior, antero-lateral and antero-axillary approaches,[21] more than two thousand years before they were reintroduced into modern surgical practice. In the work of Hippocrates, his advice to allow progressive drainage of pleural effusions and to avoid edema by re-expansion is noteworthy.

The first drainage of the pericardial cavity

Following the chronological line of history, the oldest information about the diagnosis of cardiac tamponade and the first - fortuitous - evacuation of the pericardium may be traced in an Arthurian legend written between 1200 and 1210 A.D., but based on events supposedly taking place 6 centuries earlier. In the poem "Parzival, a chivalric epic" by Wolfram von Eschenbach, a man is wounded in the chest, practically without bleeding. Arriving at the scene of the trauma, Sir Gawain, King Arthur's nephew and one of the Knights of the Round Table, realizes that "he is not mortally wounded. The blood is only pressing on his heart"[22]. He grasped a branch of the linden tree, slipped the bark off like a tuve and inserted it into the body through the wound. Then he bade the woman suck on it until blood flowed toward her. The hero's strength revived so that he could speak and talk again[23]. It is striking that, in his work, von Eschenbach, who presumably had no in-depth knowledge of medicine (some scholars have pointed out that he could not even read or write[24], which seems to be contradictory), briefly described the pathophysiology and treatment of hemopericardium, at least four centuries before other surgical approaches for draining these effusions were suggested in Europe[25].

Who performed the first pulmonary resection?

According to the "official history", some decades after von Eschenbach wrote his poem, possibly in 1252[26], Rolando de Parma and his disciple Hugo Borgognoni de Lucca successfully performed for the first time a pulmonary resection in a patient in whom the viscera was herniated by an open wound of the thoracic wall[27,28]. For many years Rolando has been considered the protagonist of this event, based on his own description of the intervention[29]. However, Teodorico Borgognoni de Lucca (1205-1296), son of Hugo, mentioned the same case in a manuscript of his own and pointed out that the real surgeon was his father, while his master merely assisted and observed. It is difficult to determine whether Teodorico's statement is true or whether it was based on simple family loyalty[26].

However, there are historical inconsistencies that make it impossible to be objectively sure that what is known so far is strictly true. According to uncertain biographical sketches Rolando de Parma was born in the second half of the 12th century (more accurate data place that time between 1195 and 1198) and presumably died around 1286; Hugo de Lucca is believed to have been born sometime between 1160 and 1180, and died around 1257. If the statement that Rolando was born in the last half of the 12th century is true, it is unlikely that he would have had a disciple at least 15 years older than himself. In other words, if this was indeed the time of Hugo's birth, he would have been over 70 years old (or over 90!) at the time of the disputed surgery, an

extremely advanced age (he died 5 years later) and possibly very disabling in the middle of the 13th century. It is obviously difficult to imagine such an old man performing the first pulmonary resection in history.

On the other hand, it has also been argued that Chirurgia (Rolandina), the work of Rolando de Parma, was primarily a reworking of the texts of his teacher Ruggero de Frugardo (Roger of Parma or Salerno, who was presumably born before 1140 and died around 1195), and that it contains lit-tle or no original contribution. There seems to be evidence that Chirurgia de Ruggero (Rogerina) has descriptions and images of surgical approaches to traumatic lung injuries (**Figure 3**)[30], that have not been sufficiently mentioned and investigated by scholars of the history of medicine. Consequently, it could be theorized that the above-mentioned pulmonary resection was actually performed in Ruggero's time. Curiously, there is a consensus, in almost all the literature consulted, that Rolando was a disciple of Ruggero, but researchers seem to overlook the detail that the time of the master's death coincides almost exactly with the birth of the pupil, at least according to the inaccurate dates that are known. For this educational relationship to be true, Rolando' birth must have occurred at least around 1160, which would then also make him over 90 years old at the time of the Bologna surgery. Further research is undoubtedly needed to unravel these supposed intricacies surrounding the first atypical pulmonary resection in history.

Figure 3. The center and right figures in the upper panel show the opening of the thorax to remove an arrow and a spear. Taken from: Ballesteros Massó *et al.* History of Traumatology and Orthopedic Surgery. University of Jaén[30].

Other first steps to the heart

There are certain gaps in the knowledge about the evolution of thoracic surgery and the development of thoracotomies throughout the following five centuries. Only a few relevant facts stand out in that period that would be worth mentioning. Presumably in 1535 Álvar Núñez Cabeza de Vaca (1490-May 27, 1559) by means of a thoracotomy, which site has not been well defined, extracted an arrowhead from the vicinity of the heart (**Figure 4**) of a Native American Indian who survived the intervention[31].

Some consider this fact to be the birth of cardiac surgery[32] and others, erroneously, have placed the surgery 100 years later than when it really should have occurred[31,33]. It is difficult to establish the year in which it took place, since we only have the later testimony of Cabeza de Vaca. However, taking into account the chronology of his odyssey in the lands of what is now the United States, we may assume that the intervention took place in the last period of his indigenous captivity, presumably in 1534 or 1535.

On the other hand, it is also possible that Jean Riolan the Younger (February 15, 1577-February 19, 1657) around 1650[34], while writing his autobiography, suggested trephining the sternum with a trocar, one inch above the xiphoid, to evacuate pericardial effusions with a cannula. Others point out that a century later[35,36] Jean Baptiste Sénac (1693-December 20, 1770) proposed another approach to treat the same ailment which consisted on the introduction of a trocar in the third ICS (the fifth or sixth has also been mentioned[37]), a few inches outside the sternum[38,39]. However, no evidence seems to support that either of these two great men of science ever performed these procedures[37,40]. It has been pointed out that, in his treatise on operative surgery of 1835, Velpeau[37] noted that in 1754, an adult man in whom an internal abscess had protruded "between the first two pieces of the sternum" [sic] was treated by the

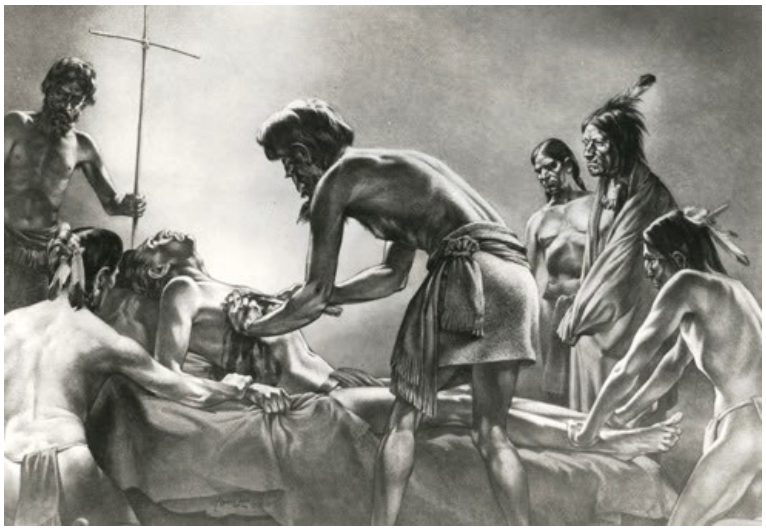

Figure 4. Staging of the supposed first surgery in the vicinity of the heart, performed by Alvar Núñez Cabeza de Vaca. Taken from: Internet Classroom - The First Recorded Surgical Operation in North America was performed by Cabeza de Vaca in 1535 when he took an arrowhead out of the chest of an Indian (https://www.angelfire.com/zine/excel/spexplorers.html).

Frenchman Claude Nicolas Lecat[41] (**Figure 5**), anatomist and chief surgeon of the Hospital of Rouen, who enlarged the cutaneous opening, "curetted the face of the bone that had been altered by caries" [sic] and "a few days later (...) he communicated the inside of the abscess with a trephine"[37].

Although he apparently did not intend to access the pericardial cavity, this may have been the first trephining of the sternum (apparently without complications and aided by the fistula). Curiously, no references to this case have been found in the contemporary literature, which is why we decided to include it in this review, despite the fact that trephining of the sternum to access the mediastinal cavity is a technique that, to our knowledge, is no longer used today.

The first anterior thoracotomy to evacuate a... pleural effusion?

At some point, perhaps the exact date will never be known, but certainly at the end of the 18th century, the French surgeon Pierre Joseph Desault (**Figure 6**) has been credited for having accessed the pericardium for the first time through a thoracotomy, to puncture it[40] and evacuate an effusion diagnosed by auscultation[42]. However, this does not seem to be the true story.

According to a mid-19th century encyclopedia of practical medicine,[42] Desault "opened the thorax between the sixth and seventh ribs on the left side, near the point of the heart. He introduced his fingers into the thorax and perceived a cavity filled with water, which he took in by the pericardium. Three other surgeons —author's note—], examined the parts and had the same opinion; and Desault enlarged the opening and allowed almost a jar of liquid to drain out". The text goes on to report that once the cavity was evacuated, the surgeon reinserted his finger and perceived a conical-tipped body tapping against it. Despite the surgery, the patient died within days and at autopsy the conical body was found to be the heart, covered and closely adherent to the intact pericardium; the opening had actually been made into a cavity formed by a membrane joining the edge of the left lung

Figure 5. Claude Nicolas Lecat (1700-1768): author of the first sternal trepanation? Taken from: Portrait de Claude-Nicolas Lecat. Wikimedia Commons: The free media repository (https://commons.wikimedia.org/wiki/File:Portrait_de_Claude-Nicolas_Lecat.jpg).

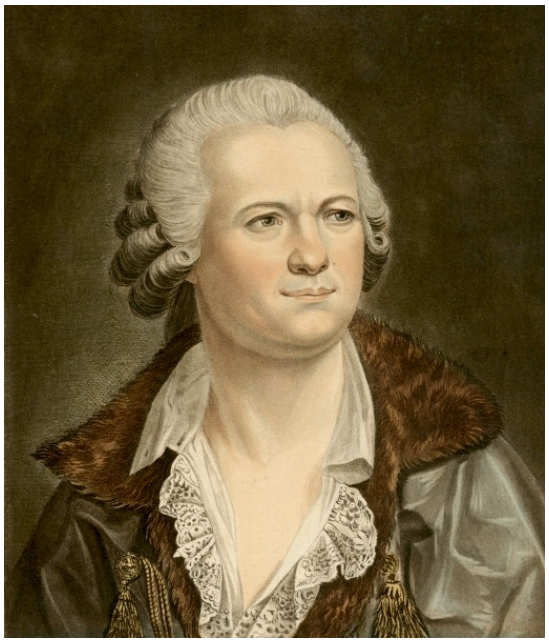

Figure 6. Pierre Joseph Desault (February 6, 1744 - June 1, 1795). Much uncertainty surrounds the true purpose of his famous thoracotomy: did he evacuate the thoracic or pericardial cavity? Taken from: Pierre Joseph Desault. Wikipedia: The Free Encyclopedia (https://es.wikipedia.org/wiki/Pierre_Joseph_Desault).

to the pericardial sac.

Unfortunately, no other data have been found to allow a more accurate diagnosis, or at least to guess the cause of the patient's death; neither are the characteristics of the fluid extracted very well explained. It has been mentioned that the effusion was due to pleuritis[43], if so, its cause could have been pneumonia, but obviously a wide variety of conditions could have motivated the intervention, including a septated lung abscess. In any case, the causes of the false attribution of a pericardial puncture to Desault are unknown, since at the time it was specified that the Frenchman had attempted to perform the procedure by inferring the existence of a hydropericardium,[43] which was not found in the end[40]. The surgery ended with the opening of the pleura alone.

It has been stated that this procedure took place in 1798[44,45,] but by that date Desault had already been dead for three years. Certainly, the year in which the book of the Gallic surgeon "Oeuvres chirurgicales" was published, where the description of his procedure should appear, has been pointed out, but this cannot be confirmed because it has been impossible to access this treatise. This is a common practice among researchers of the history of medicine and perhaps the most frequent cause of an erroneous transmission of wrong historical dates from generation to generation.

Epilogue

Probably, in a strict surgical sense, most of the anecdotal events included in this account were not really meant to be part of the history of thoracotomies. However, precisely the most distinctive feature of man's efforts to access the thoracic cavity, until the beginning of the 19th century, was that most of the healing techniques or therapies were performed through traumatic wounds, as a consequence of centuries of wars and invasions carried out by the human species.

As will be seen in the following parts of this review, the experience gained during those years of practicing a very old surgery made possible, in many cases, the creation of novel approaches to deep organs, particularly the heart, procedures that are still used in the operating rooms of the 21st century.

REFERENCES

1. Santa Biblia. Nashville: B & H Publishing Group; 2007.
2. Gilbert SF, Zevit Z. Congenital human baculum deficiency: the generative bone of Genesis 2:21-23. Am J Med Genet. 2001 Jul 1;101(3):284-5. [DOI]
3. Mariottini C. Congenital Human Baculum Deficiency, Adam's Rib, and the Formation of Eve [Internet]. 2009 [cited Jan 25, 2020]. Available at: https://claudemariottini.com/2009/07/09/congenital-human-baculum-deficiency-adam%E2%80%99s-rib-and-the-formation-of-eve/
4. Zevit Z. Was Eve made from Adam's Rib - or his Baculum?. Biblic Archaeol Rev. 2015;41(5):32-5.
5. Godfrey N. Which "Bone" was Eve made from? Vridar [Internet]. 2010 [cited Feb 2, 2020]. Available at: https://vridar.org/2010/06/20/which-bone-was-eve-made-from/
6. Venardos N, Mitchell JD. Empyema. En: Brown CVR, Inaba K, Martin M, Salim A (Eds). Emergency General Surgery – A Practical Approach. Switzerland: Springer International Publishing; 2019.

p. 367-75.
7. Dobanovački D, Milovanović L, Slavković A, Tatić M, Mišković SS, Škorić-Jokić S, et al. Surgery Before Common Era. Arch Oncol. 2012;20(1-2):28-35. [DOI]
8. Rashid MA, Lund JT. Trauma to the heart and thoracic aorta: the Copenhagen experience. Interact Cardiovasc Thorac Surg. 2003;2(1):53-7. [DOI]
9. Sprumont P. Anatomical Terms: towards Development of Terminologies (terminogenesis). Eur J Anat. 2016;20(3):249-80.
10. Dodia H, Sansiya K. A study of penetrating thoracic and abdominal injuries. IOSR-JDMS. 2015; 14(8):64-95.
11. Chandramohan P. Glimpses under the history of medicine. Arch Med Health Sci. 2014;2(1):100-5. [DOI]
12. Davies HE, Davies RJ, Davies CW; BTS Pleural Disease Guideline Group. Management of pleural infection in adults: British Thoracic Society Pleural Disease Guideline 2010. Thorax. 2010;65(Suppl 2):II41-II53. [DOI]
13. Breen DP, Daneshvar C. Role of interventional pulmonology in the management of complicated parapneumonic pleural effusions and empyema. Respirology. 2014;19(7):970-8. [DOI]
14. Perikleous P, Rathinam S, Waller DA. VATS and open chest surgery in diagnosis and treatment of benign pleural diseases. J Vis Surg [Internet]. 2017 [cited Feb 22, 2020];3:84. Available at: https://doi.org/10.21037/jovs.2017.05.03
15. Rahman NM. Advances in the Management of Empyema [Internet]. London: Royal College of Physicians [cited Feb 22, 2020]; 2017. Available at: https://www.rcplondon.ac.uk/file/5763/download
16. Yazici Ü, Yazicioğlu A, Aydin E, Aydoğdu K, Kaya S, Karaoğlanoğlu N. Penetrating chest injuries: analysis of 99 cases. Turk J Med Sci. 2012;42(6):1082-5. [DOI]
17. Cosío Lima L, Gámiz González R, Cosío Pascal M. Herida penetrante del tórax por un proyectil de arma de fuego localizado inicialmente en el ventrículo izquierdo y luego en la arteria renal derecha. Acta Méd Grupo Ángeles. 2017;15(1):57-60.
18. Breasted JH. The Edwin Smith Surgical Papyrus. Illinois: The University of Chicago Press; 1930.
19. Ferguson MK. Introduction. En: Ferguson MK (Ed). Difficult Decisions in Thoracic Surgery: An Evidence-Based Approach. 3th ed. London: Springer-Verlag; 2014. p. 1-13.
20. McCauley L, Dean N. Pneumonia and empyema: causal, casual or unknown. J Thorac Dis. 2015; 7(6):992-8. [DOI]
21. De Aquapendente F. Crisol de la cirugía (Traducido al castellano por Don Pedro González de Godoy). Madrid: Mercader de Libros (Iván García Infanzón); 1676.
22. Maisch B, Ristić AD, Seferović PM, Tsang TSM. A Historical Perspective. En: Maisch B, Ristić AD, Seferović PM, Tsang TSM (Eds). Interventional Pericardiology: Pericardiocentesis, Pericardioscopy, Pericardial Biopsy, Balloon Pericardiotomy, and Intrapericardial Therapy. Heidelberg: Springer; 2011. p. 1-13.
23. von Eschenbach W. Parzival: A knightly epic. New York: G. E. Stechert & Co.; 1912.
24. von Eschenbach W. Parzival. Madrid: Ediciones Siruela; 1999.
25. Paget S. The Surgery of the Chest. Bristol: John Wright & Co.; 1896.
26. Lindskog GE. A history of pulmonary resection. Yale J Biol Med. 1957;30(3):187-200.
27. Munguía Canales DA, Ibarra Pérez C, Rodríguez Pérez ME. Pioneros de la cirugía torácica mexicana. Gac Med Mex. 2011;147(4):342-9.
28. París Romeu F, González Aragoneses F. Figuras pioneras de la cirugía torácica española. Arch Bronconeumol. 2002;38(1):37-48. [DOI]
29. Ricketts BM. The surgery of the heart and lungs. New York: The Grafton Press; 1904.
30. Ballesteros Massó R, Gómez Barrena E, Delgado Martínez AD. Historia de la Traumatología y Cirugía Ortopédica [Internet]. Grupo de Investigación - CTS-380: Cirugía Ortopédica. Jaén: Universidad de Jaén [cited Feb 27, 2020]; 2002. Available at: http://www.ujaen.es/investiga/cts380/historia/epoca_medieval.htm
31. Asensio JA, Ogun OA, Mazzini FN, Perez-Alonso AJ, Garcia-Núñez LM, Petrone P. Predictors of outcome in 101 patients requiring emergent thoracotomy for penetrating pulmonary injuries. Eur J Trauma Emerg Surg. 2018;44(1):55-61. [DOI]
32. Concha Ruiz M. Inicio y desarrollo histórico de la cirugía del corazón. Bol R Acad Córdoba Cienc Bellas Letras Nobles Artes. 1992;63(122):185-94.
33. Asensio JA, García-Núñez LM, Petrone P, King D, Castrellon R, Duran D, *et al*. Operative management of pulmonary injuries: Lung-sparing and formal resections. En: Asensio JA, Trunkey DD (Eds). Current Therapy of Trauma and Surgical Critical Care. Philadelphia: Mosby-Elsevier; 2008. p. 282-97.
34. Glower DD. Pericardium and constrictive peri-

carditis. En: Sellke FW, del Nido PJ, Swanson SJ (Eds). Sabiston & Spencer Surgery of the Chest. 9ª ed. Philadelphia: Elsevier; 2016. p. 1675-90.
35. Saplacan V, Cuttone F, Massetti M. The Ignored Birth of Cardiac Surgery: The History of the Surgical Treatment of Heart Wounds and Pericardial Effusions. En: Picichè M (Ed). Dawn and Evolution of Cardiac Procedures: Research Avenues in Cardiac Surgery and Interventional Cardiology. Milán: Springer-Verlag; 2013. p. 19-28. [DOI]
36. Gluer R, Murdoch D, Haqqani HM, Scalia GM, Walters DL. Pericardiocentesis - How to do it. Heart Lung Circ. 2015;24(6):621-5. [DOI]
37. Velpeau AALM. New Elements of Operative Surgery. Washington: Duff Green; 1835.
38. Kleinschmidt O. Operaciones en el mediastino. En: Kirschner M (Ed). Tratado de Técnica Operatoria General y Especial. Barcelona: Editorial Labor S.A.; 1944. p. 704-1036.
39. Shumacker HB. The evolution of cardiac surgery. Bloomington: Indiana University Press; 1992.
40. Trousseau A. Lectures on Clinical Medicine, delivered at the Hôtel-Dieu, Paris. Vol. 3. Philadelphia: Lindsay & Blakiston; 1869.
41. Hoerr NL, Osol A. Blakiston's New Gould Medical Dictionary: A Modern Comprehensive Dictionary of the Terms Used in All Branches of Medicine and Allied Sciences. 3ª ed. New York: McGraw-Hill; 1956.
42. Forbes J, Tweedie A, Conolly J, Dunglison R. The Cyclopaedia of Practical Medicine: Comprising Treatises on the Nature and Treatment of Diseases, Materia Medica and Therapeutics, Medical Jurisprudence, etc., etc. Vol. 2: Emphysema − Inflammation. Philadelphia: Lea and Blanchard; 1849.
43. Copland J. A Dictionary of Practical Medicine. New York: Harper & Brothers publishers; 1855.
44. Rolleston HD. Cardio-vascular Disease since Harvey's Discovery. The Harveian oration. Cambridge: University Press; 1928.
45. Sherman HM. The future of heart surgery. Cal State J Med. 1910;8(7):227-32.