



History and development of minimally invasive surgery: VATS surgery

Luca Bertolaccini¹, Gaetano Rocco²

¹Department of Thoracic Surgery, Maggiore Teaching Hospital, Bologna, Italy; ²Department of Surgery, Memorial Sloan Kettering Cancer Center, New York, USA

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Correspondence to: Luca Bertolaccini, MD, PhD, FCCP. Department of Thoracic Surgery, Maggiore Teaching Hospital, Largo Nigrisoli 2, 40133 Bologna, Italy. Email: luca.bertolaccini@gmail.com.

Abstract: History is not only the chronological record of remarkable events, but it is also a branch of knowledge that explains past events. Here, we would try to summarize in few rows the history of the video-assisted thoracic surgery (VATS) revolution. Since the first effort of thoracoscopy one century ago, surgical technology has developed considerably and so have thoracic surgeons. At present, basic and advanced thoracic surgical procedures can be performed by VATS, with minor wounds, a lesser amount of pain, quicker hospital stay, and with excellent outcomes compared with thoracotomy. Therefore, the training of the assistants, the participation of the multi-disciplinary team, the establishment of proper complementary technology becomes of the leading importance to push the boundaries of surgery.

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One should always look to the end of everything, how it will finally come out. For the god has shown blessedness to many only to overturn them utterly in the end.

Herodotus of Halicarnassus (c. 484 – 425/413 B.C.)

History is not only the chronological record of remarkable events, but it is also a branch of knowledge that explains past events. Even if the first known use of the term history was in the 14th century, the etymology was derived from Greek culture. Around the 425 B.C., the Greek geographer Herodotus published *The Histories* (in ancient Greek means *inquiry*), a lengthy account of the Greco-Persian Wars. Before Herodotus, no writer had ever made such a systematic study of the past events trying to explain the cause-and-effect. After Herodotus, historical analysis became an indispensable part of life (1).

Here, we would try to summarize in a few rows the history of the video-assisted thoracic surgery (VATS)

revolution.

The past

Tulio Cesare Aranzi, in 1585, used a light source for endoscopic inspection focused the sunlight through the flask with water to the nasal cavity. Two centuries after, Phillip Bozzini realized the “Leichtleiter”, an aluminium tube to visualize the urogenital tract illuminated by candles and furnished with a mirror reflecting the light and image. Antonin Jean Desormeaux improved the quality of the light source. In 1865, Francis Richard Cruise overlooked the pleural cavity of an 11-year-old girl with pleural empyema and pleurocutaneous fistula (2).

Nevertheless, the history of thoracoscopy begins with artificial pneumothorax. In the same year when Robert Koch discovered the tubercle bacillus [1882], Forlanini noticed that tuberculous cavities collapsed healing when

the patient developed a spontaneous pneumothorax or a massive effusion. Forlanini performed the first artificial pneumothorax inserting a needle obliquely in the anterior axillary line and inoculated air under pressure, and the technique became widely adopted (3). In 1910, Hans Christian Jacobaeus published the *Jacobaeus operation* (4): the creation of an artificial pneumothorax by severing adhesions with galvanocautery that, collapsing the lung, permitted safe access and inspection of the pleural space (5). In this era of enthusiasm, most patients suffered from pulmonary tuberculosis (6).

Nonetheless, Jacobaeus used thoracoscopy in the treatment of adhesions, infections and effusions other than in the diagnose tumours, tuberculosis and other diseases. The use of thoracoscopy was expanded in the sequent years including the talc pleurodesis, the sympathectomy, and treatment of spontaneous pneumothorax. Nevertheless, after the arrival of antibiotics, the improvements in anesthesia and intra-operative oxygenation transform the thoracoscopic biopsies in a valuable tool before dropping into unemployment after 1950 in the era of neglect (6).

The present

The progress of light transmission in the fibre-optic medium and the techniques of image processing, the enhancement of correlated instruments, render video-assisted thoracoscopy more simply and roughly applied in the era of revolutions after 1990 (6). Until rediscovery, many thoracic surgeons were quickly adopting thoracoscopy since contemporary technology allowed the surgeon the vision through the thoracoscope as never before. The accessibility of new endoscopic instruments also rekindled interest in minimally invasive thoracic surgery as the stapler. From these improvements, VATS was born (7). Since 1991, when in Milan (IT) Giancarlo Roviario completed the first VATS lobectomy, several methods for mini-invasive lung resection have been depicted (2). Nowadays VATS occupy a significant position in the diagnosis and treatment of the diseases of the chest. In 1993, during the first international symposium on thoracoscopic surgery in the United States, there was great enthusiasm over VATS techniques. However, the initial fervour for VATS was defeated by a randomized prospective study showing no benefit for using VATS versus thoracotomy and supporting the scepticism for its use in major pulmonary resections (8). Nevertheless, subsequent studies have demonstrated successfully many short-term and long-term benefits

and the safety and oncologic efficacy of VATS (9). VATS not only have similar long-term survival rates in early-stage cancer but also, remarkably, increased tolerance for adjuvant chemotherapy (10).

The evolution

With the re-advent of thoracoscopy, surgeons utilized a multi-port approach with one port used for visualization and extra ports for instrumentation. As this technique was further used for more demanding operations, the initial port configurations were more developed for better ergonomics, viewing, and access to anatomical structures (7). The older rules concerning absolute contraindications for VATS and the standard indications for open thoracotomy were broken down with brilliant results (7). Additional development brought two-port configurations, other approaches, and robotic-assisted surgery. The initial thrust for robotic surgery was the development of a system used to care for injured soldiers on a battlefield in inaccessible places around the world. This military application has not been realised, but as alternative robotics have been integrated into civilian surgical systems. After early applications in general surgery and urology, the robot expanded its arms into thoracic surgery, increasing the applicability of minimally invasive thoracic surgery (7).

Uniportal VATS

Uniportal VATS (UniVATS) started from humble beginnings. One of the authors (GR) was one of the first thoracic surgeons to break down through the remaining barrier to bring thoracic surgery nearly full circle, back to the uniportal approach of Jacobaeus (11). GR popularized the approach, utilizing a uniportal approach for minor procedures (e.g., pneumothorax and wedge resections) (11,12). UniVATS is a component of the development of VATS (13). Thoracic surgeons have been able to perform increasingly complex thoracic procedures (14-18) and have included this approach in their surgical *armamentarium* as an extension of the conventional three or two-port VATS technique (19-23). A limitation in the UniVATS approach could be the instruments mutual interference. Since the UniVATS is performed in a caudal-to-cranial direction via the sagittal plane, the eyes and hands are utilized at the same level during the operation; consequently, a reverse observation plan should be prevented. The effect of the quality of camera holding on the VATS comprises several aspects as

well as accuracy, ergonomic, safety issues and operative time (13,24). The UniVATS approach reduces the trauma of the access port and has brought a new role for an awake non-intubated technique (7).

Conclusions

Since the first effort of thoracoscopy one century ago, surgical technology has developed considerably and so have thoracic surgeons. At present, basic and advanced thoracic surgical procedures can be performed by VATS, with minor wounds, a lesser amount of pain, quicker hospital stay, and with excellent outcomes compared with thoracotomy. VATS is not a Manichean rule because there were many moves between thoracotomy and VATS. A skilled surgeon isolated cannot conquer all the new techniques or approaches. Therefore, the training of the assistants, the participation of the multi-disciplinary team, the establishment of proper complementary technology becomes of the leading importance to push the boundaries of surgery. Nevertheless, it is natural that VATS will keep on evolving since it is a never-ending story and is not the end of history (13).

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appropriately investigated and resolved.

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