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General thoracic surgery in Finland, a perspective from the Helsinki University Hospital

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Abstract: The field of thoracic surgery is a rapidly developing field due to exciting developments in technology and oncologic treatments as well as continuous innovation in surgical technique. Although the population of Finland is relatively small, general thoracic surgery is represented at a high level in five centralized university centers, Helsinki University Hospital, Tampere University Hospital, Turku University Hospital, Kuopio University Hospital and Oulu University Hospital. Thus, high case volume and good results are achieved in these centers. Here, we describe a short history, current state and future prospects of the field of cardiothoracic surgery in Finland, with a focus on general thoracic surgery and the perspective of Helsinki University Hospital. From the field's birth in Finland, marked by the first lobectomy, in the late 1930's, it has grown and adapted more and more modern techniques such as totally minimally invasive esophagectomy and robotic lung cancer surgery. Nowadays, most of general thoracic surgery in Helsinki University Hospital is either minimally invasive or robotic and open surgery is the exception to the norm. Helsinki University Hospital has a strong presence in the European general thoracic surgery community and aims to do so in the future by investing on training & education, research and surgical innovation.

Keywords: Thoracic surgery; Finland

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Introduction

The field of thoracic surgery is a rapidly developing field due to advancement in oncologic treatments, such as immunology (1,2), new techniques (3), and new technology (4). General thoracic surgery in Finland is still a rather young field, and most surgeons trained as cardiothoracic surgeons in Finland focus mostly on cardiac surgery. However, especially in Helsinki University Hospital, there has been great success with centralized care in establishing a high-volume general thoracic surgical center.

History

Professor Per Edvin Albert Nylander (1897–1955) is considered to be the father of general thoracic surgery in Finland. He performed the first lobectomy, under local anesthesia, in 1937. The first pneumonectomy in Finland was performed by him in 1940. He was appointed for a full professor for University of Helsinki University as of 1943. During the world war 2, management of thoracic injuries and diseases were directed to his clinic. In the latter parts of 1940's, his clinic started performing thoracoplasties for

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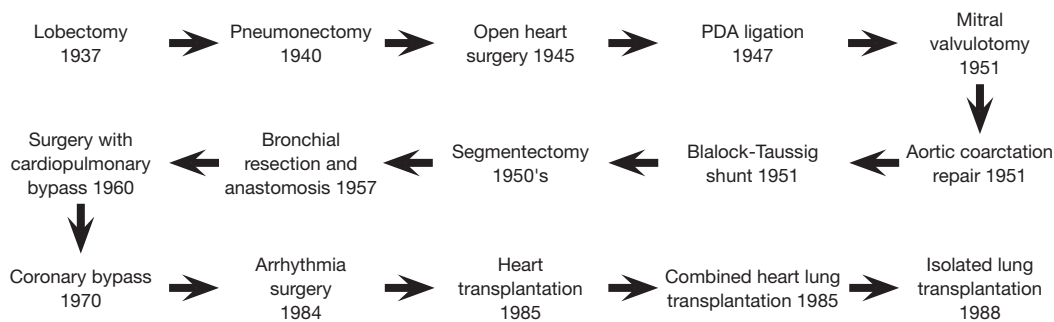


Figure 1 Timeline of surgeries performed for the first time in Finland.

tuberculous disease, more extensive surgery for lung cancer and esophageal surgery. P.E. Nylander was also the pioneer of cardiac surgery in Finland, as he performed the first successful open heart surgery (pericardiectomy, 1945) as well as the first ligation of patent ductus arteriosus in 1947, the first mitral valvulotomy in 1951, the first correction of aortic coarctation in 1952 and the first Blalock-Taussig shunt in 1953. The subspecialty of cardiothoracic surgery was established officially in 1952, and prof. Nylander and his co-chief Olavi Peräsalo were the first ones to receive the official qualifications from the national medical board. After his death, in the 1950's, former students of PE Nylander carried on his legacy as the field developed. Resections for tuberculosis became more commonplace as of extension of hospital system for tuberculosis, and the first segmentectomies were performed in 1950's. The first bronchial resection and anastomosis was performed in 1957 by JE Railo (5).

The predecessor of Finnish Society for Thoracic Surgery, *Suomen rintakirurgiyhdistys* was formed in November 1957. After a decade of disagreements and cliques between the former students of professor Nylander, the thoracic surgeons of Finland were united under Dr. Pekka Tala, who acted as president for the society for over ten years. At the same time, the field of thoracic surgery was changing, as with the advent of effective medications, surgery for tuberculous disease became uncommon, and the use of hypothermia and cardiopulmonary bypass was emerging. The first open heart surgery with cardiopulmonary bypass in Finland was performed in 1960 at Turku University Hospital. During these times, valve surgery and surgery for congenital heart disease became more common and the first coronary artery bypass was done by P Harjola in 1970. In the 1980's coronary artery surgery was commonplace and modern arrhythmia surgery was started in 1984 in Helsinki

by A Järvinen and the first heart transplantation was done in 1985 in Helsinki by S Mattila. The first combined heart- and lung transplantation was performed in 1988 and first isolated lung transplantation in 1990, both by S Mattila and A Harjula (6). During the 1990's the field grew and became a major surgical specialty in Finland. In 1997, to celebrate its 40 years of history, the new name Finnish Society for Thoracic surgery was taken (5). The timeline of surgical firsts is shown in *Figure 1*.

In 1980 the specialty of thoracic surgery was changed to include in its training cardiac surgery, general thoracic surgery and vascular surgery. Vascular surgery was a part of cardiothoracic surgery in Finland until 1999, when vascular surgery was formally established as an independent surgical specialty.

Since early 2000s, general thoracic and oesophageal surgery was formed as independent section under cardiothoracic surgery within Helsinki University Hospital. Within the unit, the first video-assisted thoracoscopic (VATS) lobectomy in Finland was done in 2006, and the first segmentectomy a year later in 2007 (7). The first hybrid esophagectomy was performed in 2008 and the first minimally invasive esophagectomy in 2009. Robotic surgery program was initiated in 2010, with thymectomy and proceeded to lobectomy in 2011. As of January 2013, with formation of Heart and Lung center within Helsinki University Hospital, general thoracic and oesophageal surgery was established as independent department with 30-bed patient floor and independent administration. To this date, this is the only dedicated unit nationally, receiving national consultations for thoracic diseases, alongside being the sole thoracic surgery unit for 2.2 million inhabitants. First chair of thoracic and oesophageal surgery was Dr. Jarmo Salo from Jan 2013 to Feb 2015; who can be considered the pioneer of modern general thoracic and

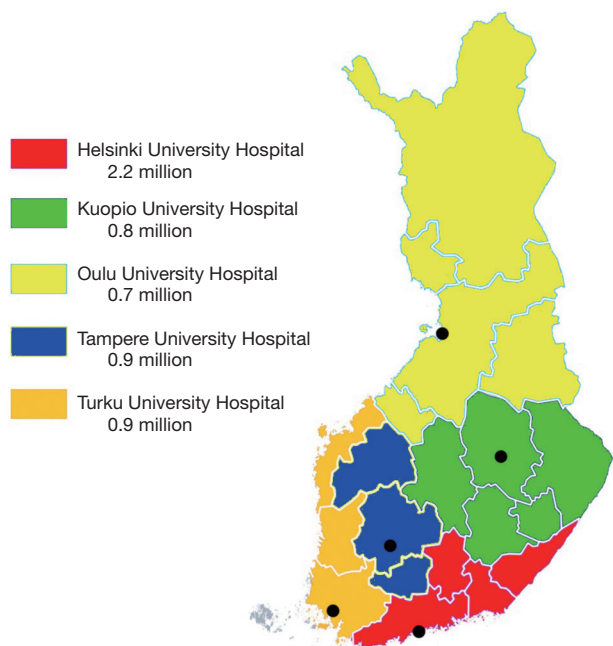


Figure 2 The university hospitals of Finland and their referring districts with population sizes.

oesophageal surgery within Finland. Since his retirement, Dr Jari Räsänen was appointed as the chair of general thoracic and oesophageal surgery in Helsinki University Hospital.

Present day

General thoracic surgery is practiced widely throughout Finland, as some thoracic operations such as wedge resections, empyema surgery, pneumothorax surgery and in some cases lung cancer surgery are done in larger municipal central hospitals. The tertiary centers for general thoracic surgery are the five university hospitals: Helsinki University Hospital (HUH), Tampere University Hospital, Turku University Hospital, Kuopio University Hospital and Oulu University Hospital. Of these, HUH is the only one in which cardiac surgery and general thoracic surgery are independent units with dedicated patient floors. The location and districts, as well as population served are displayed in *Figure 2*.

Within HUH, between 2010 and 2019, a median annual case load of 1,004 cases. Of these, 64% were elective operations and the rest (36%) either urgent or emergency surgeries. The annual numbers are shown in *Figure 3*. In

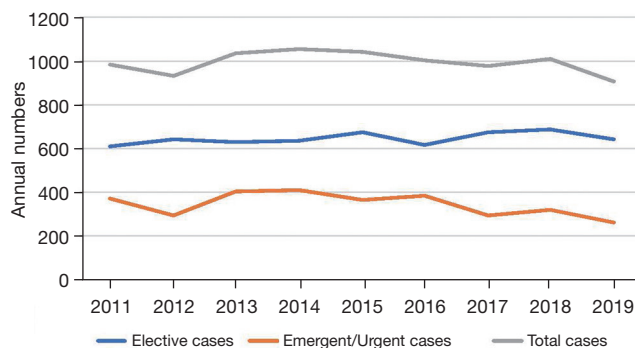


Figure 3 Operations per year at Helsinki University Hospital General Thoracic Department.

addition, a median of 1,066 upper endoscopies, with a median of 729 interventional endoscopies under general anesthesia, were performed by our unit.

Within the past decade, the paradigm has shifted in our unit from open lung- and esophageal surgery to minimally invasive strategies. In 2010, we performed 150 lung resections, of which 116 were open procedures (77%), whereas in 2019 our unit performed 189 lung resections with 153 VATS resections (81%) as shown in *Figure 4*. The increasing number of cases is most likely due to the population structure of Finland becoming older, as well as further regulations to centralize lung cancer surgery to high-volume centers in 2017. Our unit has been an early adopter of minimally invasive esophagectomy, as even in 2010, only 13 of 43 (30%) esophagectomies were done open. In 2019, only 2 of 45 (4%) esophagectomies were open surgeries, the yearly cases are outlined in *Figure 5*. In our institution, the standard operation for esophageal cancer is a total minimally invasive esophagectomy, with laparoscopy and thoracoscopy. A cervical incision is added in case the anastomosis is planned to be cervical. Open approaches to the thorax and/or abdomen are seldom used and, in most cases, they are performed due to the need for conversion intraoperatively (e.g., bleeding control).

The use of robotics assisted thoracic surgery (RATS) in HUH has been steadily increasing during the last years. The RATS were started in 2010 with 14 surgeries that year. In 2019, 85 RATS procedures were performed. The most common robot-assisted (RA) procedures in 2019 were RA lobectomy (N=24, 28.2%), RA Heller myotomy (N=16, 18.8%), RA repair of a paraesophageal hernia (N=13, 15.3%) and RA thymectomy (N=12, 14.1%).

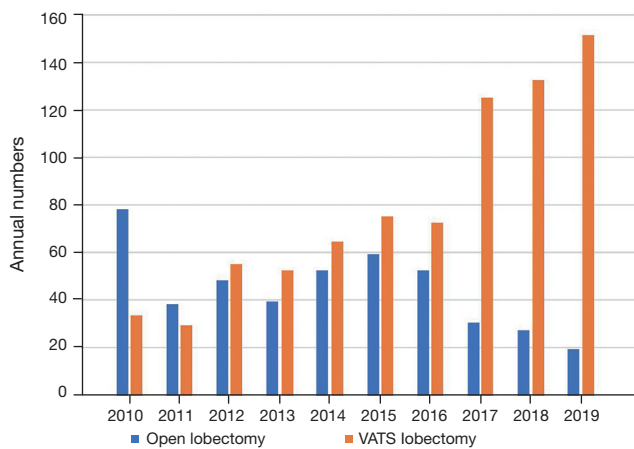


Figure 4 Lobectomies per year performed in Helsinki University Hospital. VATS, video-assisted thoracoscopic surgery.

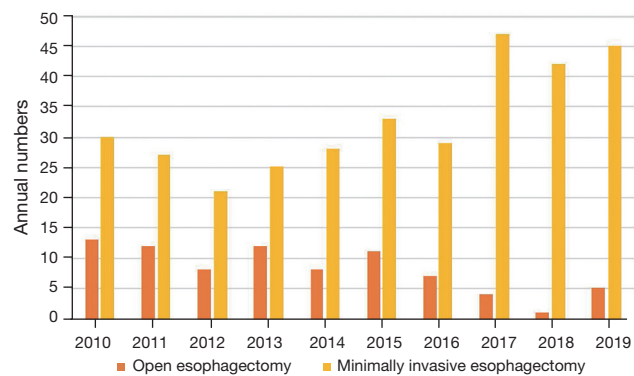


Figure 5 Esophagectomies per year performed in Helsinki University Hospital.

Training

HUH having the only dedicated general thoracic and oesophageal surgery unit within Finland, the importance of training is seen paramount objective of the unit. In Finland the Cardiothoracic surgical specialization is a 6 to 7 years process, in which the trainee spends the first 1.5 to 3 years in a regional hospital and goes through basic training in all of the surgical subspecialties. The later years of training are spent in a university clinics cardiothoracic unit. A national written board exam is undertaken at the end of the specialization. Adoption of cardiac and thoracic-focused training program as of 2014 within our residency program in University of Helsinki

has resulted in focused training and clearer professional development after board certification. Emphasis of training extends to medical students of University of Helsinki, providing hands-on clinical education as a staple part of the curriculum and offering one-month elective internship for the medical students. International training of the faculty has been considered imperative, resulting to most of the faculty receiving additional specialist training in advanced fellowships in North America: Dr Jari Räsänen (Univ. Pittsburgh, PA, USA; 2009–2010), Dr Ilkka Ilonen (Memorial Sloan Kettering Cancer Center, NY, USA; 2017–2018) and Dr Henna Söderström (McGill Univ., Quebec, Canada; 2020–2021), and more to come. Faculty and trainees are also encouraged and actively participate in international congresses and training courses. Completing either the European Board of Cardiothoracic Surgery (EBCTS) examination or EBTS Thoracic examination is also highly encouraged.

Research

Research projects underway at the HUH Department of General Thoracic and Esophageal Surgery are focusing on benchmarking and validation and retrospective data analysis using Finland's centralized registry databases. Within the last five years, numerous Ph.D. theses from our clinic have been successfully defended (8–11). Also, a Finnish Cancer Center (FICAN) Flagship project on thoracic malignancies (esophageal cancer, lung cancer and mesothelioma) has been launched and is led by Dr Ilonen (<https://www2.helsinki.fi/en/researchgroups/happy-lungs>).

Future

The need for general thoracic specialists and surgery is expected to rise as the general population in Finland is becoming older (12). The overall case load is predicted to rise during 2025–2035. There are plans to include more advanced endoscopic procedures such as POEM and POEM-F into our repertoire as well as expanding the use of robotic-assisted surgery. Multiple translational research projects are underway utilizing e.g., patient derived organoids, liquid biopsies and mitochondrial research. The goal of HUH General Thoracic Surgery Department is to achieve a place as a leading clinic in the international scene of thoracic surgery.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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