



Thoracic surgery in France

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Abstract: Until recently, thoracic surgery in France was associated with vascular or cardiac surgery. It is now increasingly performed as a specific activity. Training of a thoracic surgeon has a common part with cardiovascular surgery during a 6-year curriculum including theory and practical practice acquired both by simulation and clinical fellowship. There are 343 board-certified surgeons performing thoracic surgery in 147 authorized centers. To be authorized to perform thoracic surgery, these centers must have at least 2 qualified surgeons and perform a minimum of 40 procedures per year for thoracic cancer. The discussion of the cases in a multidisciplinary tumor board (MDTB), validated by a written conclusion, is also mandatory and is a prerequisite for operating on patient for any cancer. All thoracic surgery procedures are recorded in a national database, Epithor. This database gives a precise idea not only of the activity but also of operative data, morbidity, mortality and follow-up. In 2023, participation to Epithor database will be a prerequisite for the certification of thoracic surgeons. Major changes in diagnostic and therapeutic options, development and innovations in video-assisted and robotically-assisted surgery, forthcoming transbronchial approaches will more likely lead to reorganize thoracic surgery with specialized and expert multidisciplinary boards as well as a concentration in high volume centers.

Keywords: Thoracic surgery; education; database

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Until recently, thoracic surgery was not considered in France as an exclusive specialty but as a component of a larger specialty, that is cardio-thoracic or cardio-vascular surgery or even general surgery. With the redesign of education and training of surgical residents and the increasing complexity of this surgery, thoracic surgery is

now recognized as a specialty in its proper place.

Thoracic surgery is practiced in France in a hospital system that includes four distinct types of structures:

- (I) University hospital centers, which are public institutions of a significant dimension, most often located in large cities, linked to the university and

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providing most training of physicians and surgeons. Most university professors are employed in these hospitals.

- (II) General hospitals, also public but smaller in size. Although they participate in teaching and have some recognized services, few of them have a thoracic surgery department.
- (III) Private non-profit hospitals, some of which have high-volume, recognized thoracic surgery departments.
- (IV) Private clinics. Few do thoracic surgery alone, i.e., not associated with another specialty.

In France, contribution to the national social security system is mandatory. As a result, the majority of hospital costs are covered and patients are operated on “free of charge” when they undergo a major operation, that is the case for the majority of thoracic surgery procedures. The so-called “rest to pay”, that are expenses not reimbursed by the national social security system, concerns some accommodation costs and possible extra fees for patients who choose to be operated on in private clinics. These costs are partially or fully covered by complementary health insurance companies depending on the level of subscription. In 2020, 95% of the population subscribed to a mutual insurance company.

Who performs thoracic surgery?

In 2020, there were 934 thoracic and cardiovascular surgeons of which 755 men and 149 women with an increase in female surgeons in the younger age groups. Nowadays, the male/female ratio is close to 30% among junior thoracic surgeons.

Among them, 343 board-certified surgeons in France are actively performing thoracic surgery in 147 authorized centers. One third of these surgeons are practicing in private clinics, the others mainly working in university hospitals of private non-profit institutions.

In order for a center to be authorized to perform thoracic surgery, it must have at least 2 qualified surgeons and perform a minimum of 40 procedures per year for thoracic cancer (regardless of the type of procedure ranging from diagnostic thoracoscopy to pulmonary resection) and at least 20 curative procedures per year per surgeon. The discussion of the cases in a multidisciplinary tumor board (MDTB), validated by a written conclusion, is also mandatory and is a prerequisite for operating on patient for any cancer. The MDTB must comprise the following

specialists: pulmonologist, oncologist, thoracic surgeon, radiologist, pathologist. The activity thresholds are defined by the National Cancer Institute (INCa) and regularly re-evaluated. While the thresholds have been raised substantially for certain cancers (breast, ovary), the same has not been done recently for lung cancer, but is under discussion.

Until the 2000s, the practice of thoracic surgery by surgeons having only this specialty was rare. This surgery was performed either by cardio-thoracic surgeons (most often cardiac surgeons with a secondary activity in thoracic surgery), by thoracic and vascular surgeons, or by digestive and thoracic surgeons. Thus, contrary to other countries, esophageal surgery is nowadays rather performed in digestive surgery departments, with only few thoracic centers having a large activity in this field. Since the 2000s, the trend has been towards exclusive specialization in thoracic surgery. This trend will increase with the training of residents, which differs depending on whether they have a cursus in thoracic, cardiac or vascular surgery. This difference is explained by the increasing complexity and specialization of these specialties. Consequently, the number of centers has been reduced while their activity is increasing.

Certification

Under the 2004 health insurance law, French National Authority for Health (HAS) is in charge to plan and carry out the certification process of surgeons and surgical teams. The aim of accreditation is to improve quality of clinical practice and patient safety, by reducing number and severity of care-related adverse events. It is a free and voluntary individual process although a team accreditation process is currently being evaluated.

For thoracic surgery, approved accreditation bodies define the certification program. It contains analysis of adverse events relating to surgery, assessment of professional best practices, implementation of recommendations and participation in knowledge development activities. One of the teachings is an e-learning dealing with several technical topics.

Since 2007, HAS collects, adverse events reported by doctors committed in accreditation process and, with the help of approved bodies, analyzes them and produces risk-reduction tools named Patient Safety Solution (PSS).

Accreditation can help validate the Continuing Professional Development which—by law—is compulsory for all medical doctors in practice in France.

Surgical education and training

Residency training requirements in cardiothoracic surgery

If successful at the national medical exam—named ECN—and taking place at the end of the 6th year of medical studies, students can choose their specialty based on their ECN rank. A reform of the third cycle of medical studies in France has led to the replacement of the previous time-based qualification (number of years spent in training) by training based on the progressive acquisition of skills.

The thoracic and cardiovascular surgery diploma takes a total of six years and is split into three successive phases to be completed in both university and non-university settings.

- ❖ Phase 1 (1 year) = “basic training” divided in two steps: 6 months in thoracic and cardiovascular surgery, and 6 months in any other surgical department.
- ❖ Phase 2 (3 years) = “in-depth development”: residents go through six semesters of progressively more detailed and in-depth training. Three of these semesters are spent in thoracic and cardiovascular surgery. Other semesters are spent in an approved hospital environment, principally in cardiovascular medicine, vascular medicine, pulmonology, anesthesia-intensive care unit, vascular surgery or radiology and medical imaging, as a complement to the internships in thoracic and cardiovascular surgery. The residents are expected to be able to operate under conditions of “supervised autonomy” and must learn to identify and treat postoperative complications. At the end of the “in-depth development phase”, the resident chooses an orientation: thoracic surgery alone or cardiac surgery (adult or pediatric) or thoracic and vascular surgery, or cardio-vascular surgery.

Students can apply to change their specialty pathway at any time up to the second semester of this phase. Before moving on to the next phase, the resident must support a medical thesis.

- ❖ Phase 3, the “accountable autonomy” or “consolidation” phase, lasts 2 years. This is the essential phase of training in which the resident achieves self-reliance and is considered as a junior doctor.

In addition, students are also evaluated on their activities at simulation centers: during their Phase 2 they have the opportunity to participate in a simulation-based training course named Bootcamp. This meeting is

dedicated to simulation approaches. It enables students to take part in several simulation workshops adapted to training requirements for thoracic and cardio-vascular surgery. The goals of the bootcamp, as identified by the residency training program directors and the national specialty committee, were to create a national, centralized, simulation-based skills workshop focusing on key basic procedures within thoracic surgery. It is worth noting that for endoscopy techniques, studies have shown that novice bronchoscopists who self-train on a high-fidelity simulator acquire basic competencies similar to those of moderately or even highly experienced bronchoscopists. High-fidelity simulation has been integrated within the learning curriculum and will replace traditional training on-patient learning methods (1).

Clinical skills are taught in a highly structured way, beginning with e-learning, seminars and bedside teaching and master studies are based on evidence-based clinical education.

For all students, specific different programs are also developed:

- ❖ EFPMO (The French School for Multiple-Organ Procurement): in order to professionalize those involved in organ procurement through a national, validating and specific training course for organ procurement surgeons;
- ❖ Aorta-tour and VATS-tour (minimally invasive thoracic surgery): the concept is based on a “*tour de France*” of expert centers, with two days of immersion at each center. The objective is to offer young thoracic, cardiac and vascular surgeons training to enable them to develop aortic surgery (Aorta-tour) or minimally invasive video- and robotic-assisted surgery (VATS-tour) at their center. The list of expert centers is given by the French Society of Cardio-Thoracic Surgery.

Medical and cardiothoracic surgeon board certification

The final qualification as surgeons (diploma of specialist studies) is validated by an oral presentation certified by the university where the students apply.

For a national harmonization, teaching and training of all fellows in thoracic and cardio-vascular surgery is controlled and followed by a national board of thoracic and cardio-vascular surgeons: the goal of this board is to provide initial training for thoracic and cardio-vascular surgeons, in order to check his/her training and to validate the obtained

qualifications. Teaching dispensed by the board is based on a founding core of knowledge on thoracic and cardiovascular surgery. Surgeons do progress and specialize in the disciplines of their choice through and thanks to this core knowledge.

Theoretical knowledge is evaluated on the basis of the progression of the resident through the online education program. Practical knowledge is assessed during the residency with a digital portfolio in Epithor and Epicard (national surgical databases) listing the surgical procedures that the resident has performed him/herself or has participated in. Evaluation is based on a standardized form covering five areas: professionalism, autonomy and responsibility, psychomotor dexterity and adaptation, clinical knowledge and its implementation, involvement in academic activities and their ability to apply their knowledge to clinical cases.

A national surgical certification through the French Board of Cardiovascular and Thoracic Surgery isn't mandatory, but strongly recommended after 2 years of practice as senior in order to get sufficient numbers of operations as one of the eligible criteria is to have done more than 100 operations as main operator. Fellows may be admitted for the thoracic surgery, adult cardiac surgery, or cardiac congenital surgery options, or for several of these options. The vascular specialty is complementary to the thoracic and adult cardiac surgery options and is subject to an additional evaluation.

Numbers of thoracic and cardiovascular surgery residents per year

A total of 203 thoracic and cardiovascular surgeons are currently in training. With the 2017 reform the number of residents entering training in thoracic and cardiovascular surgery has become much more easily identifiable. There are 25 positions per year. These positions are uniformly distributed over France national territory, according to the capacity of training centers.

French national database

Under the impulse of MD, former president of the French Society of Thoracic and Cardiovascular Surgery (SFCTCV), and thanks to its commitment a national database named EPITHOR (2,3) was created in 2003. Since this date, over 20,000 patients per year are recorded in the database and more than 90% of surgeons do fill the base. Participating

to this program has now become compulsory to receive accreditation, what should help the base to reach complete exhaustivity.

Computerized data of the patients of each center contributing to the Epithor registry, with the exception of identification data, are also used for statistical purposes to evaluate and improve surgical practices on a national scale, in particular by measuring the adherence of practitioners to the recommendations issued by the French Society of Thoracic and Cardiovascular Surgery, and their impact on clinical results.

The software makes it possible for the surgeon to benchmark his activity against national averages.

In 2007, a morbidity score (Thoracscore) was created (4), based on 15,000 patients of the Epithor data. It was the first index of 30-day mortality in thoracic surgery and has been adopted by several European societies.

This database has been extended for cardiac surgery (Epicard).

Lung diseases

As for any department of thoracic surgery, the majority of operated cases are lung cancers. In France, there are more than 45,000 new cases of lung cancer per year with a mortality of 33,000 patients. There are about 8,000 lung cancer resections per year. Lobectomy is performed in the majority of cases (72%). Anatomical segmentectomies are more performed (10%) than wedge resections (6%) (5). As in many countries, there is a trend toward a decrease of pneumonectomies (6%). In 2020, the main approach, all stages together, is thoracotomy (60% of cases). But for early-stage tumors, minimally invasive approaches were used by 60% of surgeons, mostly VATS, RATS representing 7% of minimally invasive surgical (MIS) approaches. However, compared to the 2010 to 2015 period, there is a major change as VATS was used only in 3.7% of patients at that time.

There is currently no official lung cancer screening program in France. However, authorities may soon accept formal screening of at-risk populations, due to pressure from chest physicians and oncologist, particularly since the release of the NELSON trial results (6). When formal screening is implemented, it is likely to contribute to an increase in the rate of VATS.

Transplantation activity in France is supervised by the Agence de biomédecine (ABM), a public institution under the supervision of the Ministry of Health. There

are currently 10 labelled and authorized transplant centers (including one pediatric center) in France. Since the first French lung transplant in 1987, more than 5,000 procedures have been performed (1). The number of lung transplants performed is 400 per year.

Video-assisted, robotically-assisted thoracic surgery and forthcoming techniques

As in many other countries, the use of VATS for major pulmonary resections and other thoracic complex procedures had a slow start in France. Reticence was strong and the technique was only gradually imposed, mainly after the publication of the 2013 ACCP recommendations (7). The publication of the first results from the Epithor database was another important factor in supporting the development of the technique (8,9) and as reported above, VATS and RATS were used in 40% of major pulmonary resections in 2020 (5). In high-volume centers, especially those interested in these techniques for several years, VATS rates for major pulmonary resections are around 80%.

It seems that some French thoracic surgeons are following the trend towards sublobar resections in selected indications, in particular early-stage NSCLC. The first international conference on the subject was held in Paris (10) and was so successful that other editions were subsequently organized in the USA and Japan.

The rapid development of advanced video-assisted techniques as well as the raise of indications for sublobar resections will sooner or later pose the problem of low volume centers. Indeed, the lack of mastery of certain technically and/or technologically complex procedures could lead to a loss of opportunity for some patients (11).

The next evolution—or revolution—will come from alternate techniques to current surgery. By this we mean the emergence of endobronchial techniques. As these techniques should be part of thoracic surgery, we suggest naming these “thoracic endosurgery”.

A thorough knowledge of endobronchial anatomy and expertise in rigid bronchoscopy, Endobronchial ultrasound (EBUS) or electromagnetic navigation bronchoscopy (ENB) will become indispensable for general thoracic surgeons. Interventional endoscopy should be mastered even more by those who have no access to an interventional pulmonologists team. For example, mediastinal evaluation by EBUS and mediastinoscopy are complementary. A thoracic surgeon who is proficient in EBUS has the ability to decide which tool or combination of tools to use to

optimize patient care (12).

New alternatives to surgery are emerging in various medical disciplines. This is even more true in the thoracic field with the advent of advanced bronchoscopic techniques (13). Transthoracic CT image-guided thermal ablation therapies, including radiofrequency (RFA), cryoablation and microwave (MWA) therapies, offer potentially curative therapeutic opportunities for those early-stage lung cancer patients who are unable to tolerate surgery. However, they encompass some morbidity that can be reduced by transbronchial access. This is why, guided endobronchial techniques are emerging for biopsy, nodule localization before VATS resection but also as therapeutic ablative procedures in non-surgical patients (14). In the future, we could expect that MWA guided by ENB may be a potential solution instead of or in combination with conventional surgery for patients with multiple pulmonary nodules (15).

Surgeons must adapt to a new working environment (hybrid OR, work on dedicated computer software...) (16). These surgical evolutions are part of the multidisciplinary management of patients, which also involves other specialists, including thoracic oncologists, radiotherapists and interventional radiologists and/or pulmonologist.

Education programs and training of junior surgeons already include these coming technologies.

The issue of rare diseases

For some years now, official organisms, in the form of MDTB, have been helping to make decisions on rare diseases. We have chosen two examples: sarcomas and thymic epithelial tumors (TET).

For sarcomas, a network (netsarc.org) gathers 26 reference sarcoma centers with specialized MDTB. It was funded by the French National Cancer Institute to improve the outcome of sarcoma patients. Since 2010, presentation to an MDTB and second pathological review are mandatory for sarcoma patients. Patients' characteristics and follow-up are collected in a database regularly monitored and updated (17).

It has been demonstrated that presentation to an MDTB before treatment was associated with a significantly better compliance to clinical practice guidelines, for example, biopsy before surgery, imaging, quality of initial surgery, and less reoperations. Local relapse-free survival and relapse-free survival are significantly better in patients presented to an MDTB before initiation of treatment. It is now clear that compliance to clinical practice guidelines and relapse-

free survival of sarcoma patients are significantly better when the initial treatment is guided by a pre-therapeutic specialized MDTB.

RYTHMIC was created at the initiative of the INCa to coordinate the management of patients presenting with TET. It is a regional and national network dedicated to the management of TET with specific MDTB where all cases are double checked (even the histological diagnosis) with an additional expert review (18,19). The database includes more than 3,000 patients. The MDTB takes place twice a month and any surgeon who must take a decision of thymectomy or of neoadjuvant or adjuvant therapy is invited to present the patient's case via video conferencing.

Conclusions

Thoracic surgery is recognized in France as a specialty in its own right. The evolution towards minimally invasive techniques, some of which are very demanding in technical and technological respects, could lead to surgeons practicing it exclusively and no longer associated with vascular or cardiac surgery. In the long term, this will raise the issue of a concentration of centers—as in other countries—and of even stricter criteria for authorizations.

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