



Thoracic surgery in Israel

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Abstract: During the past 74 years since its establishment, Israel has evolved into a modernized country with well-established and effective public health care system. Thoracic surgeons in Israel play a central role in the diagnosis and treatment of patients with diseases of the chest wall, diaphragm, mediastinum, airways, Lung, and esophagus as well as taking part in designated trauma teams. Between 2,500–3,000 cases are being performed in 16 designated thoracic surgical units and departments across the country annually, the majority of them being performed in a minimally invasive fashion. Lung cancer is the leading cause of cancer related mortality in Israel and the second most common cancer in Israel. All types of thoracic oncologic cases are being presented routinely during designated multi-disciplinary conferences and treatment plans are designed according to the most up to date international guidelines. Each surgeon undergoes at least 6 years of formal training, followed by certifying exams. Advanced training is usually obtained overseas in centers of excellence. Israeli thoracic surgeons are part of an international societies and are actively involved in academic research. Despite the advancement of the Israeli health care system, thoracic surgeons in Israel are still facing few challenges that are limiting the early diagnosis of thoracic surgical malignancies such as lack of established national lung cancer screening program in Israel although a pilot program is being tested during these days. Tasked with taking care of diseases of the chest, and in order to remain at the forefront of diagnosis and treatment similar to our colleagues across the globe, Thoracic surgeons in Israel are continuously seeking to learn and evolve in order to improve and provide better care to our patients.

Keywords: Thoracic surgery; esophageal surgery; mesothelioma surgery; chest wall surgery; Israel

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Introduction

Israel is a small country situated at the eastern border of the Mediterranean Sea, bordered by Lebanon at the north, Syria at northeast, Jordan at east and Egypt in the southwest. Israel size is 22,072 km² (including east Jerusalem and Golan heights, excluding Gaza strip and

West Bank), placing Israel as the 152nd country in the world by size (1).

By 2020, Israel's population had reached 9.2 million residents (74% Jews, 21% Arabs). Although only 11% of Israel's population is older than 65 years, its population is ageing rapidly (2).

There were 44,537 deaths in Israel in 2018. The leading

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cause of death in Israel amongst both men and women since 1999 was cancer (with lung cancer being the most prevalent cancer related death) followed by heart diseases as the second most frequent cause of death (3)

During the past 74 years since the establishment of the state of Israel, thoracic surgery in Israel has developed rapidly and currently provides an up-to date, modernized service to the growing population of Israel. Treatments for benign as well malignant disease of the chest, lung transplantations, urgent and emergent thoracic surgery, as well palliative surgery are being performed daily in 16 designated thoracic surgical departments and units across the country. Thoracic surgeons are involved in residents' education and academic surgery and participate in multiple international collaborations. In the following review, we provide an insight into the framework of thoracic surgery training and practice in Israel. We discuss the major diseases thoracic surgeons in Israel are tasked with along with the major challenges that thoracic surgeons in Israel are facing these days.

Overview of Israel health care system

Since its independence in 1948, Israel has built a strong, modernized and efficient public health care system providing an extensive array of high-quality services and technologies, which are available to all residents largely free at point of service under 1994 national health insurance law (NHIL). In 2017, Israel spent 7.4% of its gross domestic product on health (4).

The NHIL mandates that all legal residents of Israel receive health services on the basis of a legally defined basket of health services (including a very broad basket of medications, technologies, investigations and medical services), under the responsibility of the state and provided by four competing not-for-profit health plans (Leumit, Maccabi, Meuhedet and Clalit). Each patient has a great deal of freedom in choosing their physician in most specialties and in across most areas of the country (5). Premiums are calculated by income only, with emergency medical services provided unconditionally to each citizen in need. Each citizen can opt for additional, complimentary private insurance and private care provisions.

The health care system is financed from general taxes and health related payroll tax collected from each adult above the age of 18 by the National Insurance Institute (Bituah-Leumi).

Overview of thoracic surgery in Israel

Thoracic surgery in Israel is included in the basic basket of health care provided to the Israeli population. It is overwhelmingly provided in public hospitals either in designated departments of general thoracic surgery, or in others as parts of separate units within departments of cardiothoracic surgery. There are a few hospitals that provide these services in independent units without additional cardiac surgical specialties. Over the years, there was no strict ministerial regulation to the number of units and departments of thoracic surgery which has led to a concentration of several units and departments in a small geographical region, thus increasing competition and limiting growth potential and increasing volume of surgery. Some of the major thoracic surgery departments in Israel are regarded as tertiary referral centers and are accepting referrals from hospitals lacking thoracic surgery services, or from smaller units that are lacking the expertise in certain type of surgeries (for example, mesothelioma or esophageal surgery).

In addition to the public sector, there is a flourishing private medical sector, primarily three large private hospitals that provide these services as well. Patients opting to receive their care in these settings do so by activating their private medical insurance plans.

Thoracic surgeons in Israel are responsible for the operative and perioperative care of patients with wide variety of surgical diseases of the chest, excluding cardiac surgery.

The main pathologies being treated are benign and malignant lung tumors, mediastinal tumors, chest wall tumors and disorders, chest wall deformities (such as pectus excavatum and carinatum), primary and secondary pleural diseases [such as pneumothoraxes, empyema and malignant pleural mesothelioma (MPM)], bullous disease of the chest (as well as emphysema and end stage lung disease) and both benign and malignant esophageal diseases. Primarily, thoracic surgeons are treating isolated thoracic trauma while multi-trauma casualties are treated by acute care surgery-based trauma teams with the help of thoracic surgeons. All thoracic surgeons in Israel are contributing to trauma surgery in their centers. In cases where there is no thoracic surgery coverage, the patient is first stabilized and treated by the general surgery trauma care teams and then transferred to a center where thoracic surgery service is available. Lung transplants are performed at two large academic hospitals, with the second hospital beginning its

program amid the most recent COVID epidemic. Presently, there is no national database reporting on general thoracic surgical procedure, thus limiting knowledge on the exact number of procedures being performed nationally. All thoracic surgical malignancy decision making is carried out within multi-disciplinary tumor conferences incorporating the relevant medical disciplines relating to the specific pathology. This quality control measure is a standard of care and it is crucial to quality assurance and decision-making and planning based on current practice guidelines assuring the patient receive the best medical care. Within the public sector, all units are affiliated academically to university medical schools, thus achieving academic recognition and appointments for their medical staff.

Approximately, between 2,500–3,000 thoracic surgical procedures are performed annually in Israel. These procedures are carried out exclusively by board certified thoracic surgeons as opposed to the USA for example, where general surgeons perform significant portion of thoracic surgeries around the country (6). On average, each thoracic surgeon in Israel is performing between 100–200 cases per year.

Overwhelmingly, thoracic surgery in Israel is performed in a minimally invasive fashion, with thoracoscopic anatomical lung resections for lung cancer being the most prevalent elective operation. Currently, limited number of centers perform robotic surgery for lung, mediastinal and esophageal pathology. The main limitation in adoption of the robotic approach has been financial, as there is no designated reimbursement for these procedures, making it economically unattractive to centers of low volumes of surgery. Reimbursement for thoracic surgery is on a diagnosis related group (DRG) basis pricelist determined by the health maintenance groups. With adoption of minimally invasive techniques and shorter lengths of stay, these procedures have proven to be lucrative for the hospitals.

Thoracic surgery training in Israel

Post medical school specialty training is governed and supervised by a professional organization—the Israel Medical Council which is part of the Israel Medical Association. This body oversees medical education, training, examination, and certification of all medical specialties in Israel. Each professional society establishes its own syllabus and requirement for board certification and issues certificates of specialization upon successful completion of residency programs. As to date, there are no requirements

for recertification in Israel and a continuing medical examination (CME) program is not universally mandated. Current discussions are held by the Israeli scientific council to establish a dedicated CME and recertification programs among the different specialties in Israel.

Thoracic surgical training begins upon completion of a year of rotating internship at the end of medical school.

The length of training is 6 years of which 4 years in general thoracic surgery, 6-months of cardiac surgery, 6-months general surgery, 3-months intensive care medicine or anesthesia, 3-month pulmonary medicine, 6-months basic science research. There is a written board certification examination that is required and following successful completion of the written exam an oral examination is administered at the end of the residency training. A detailed list of surgical procedures—operative logbook has also been established and requires performance of a minimum number of bedside procedures and thoracic surgical index cases for successful certification. The operative syllabus is constantly being modified to achieve a high level of modern training specifically—exposure to new surgical techniques and technologies that have flourished our profession in the past decade (i.e., minimally invasive—thoracoscopic and robotic surgeries).

Upon completion of residency training, post residency fellowships in advanced training are encouraged and pursued abroad at centers of excellence.

There exists a working group in thoracic surgery that is part of the Israel society of cardiothoracic surgery. This group holds biannual scientific meetings presenting the experience of the various centers across the country. This working group is also responsible for overseeing all professional issues-education, syllabus, competency measures and academic research. Currently, a task force of this working group is tasked to change the syllabus and training paradigm of thoracic surgery in Israel.

Lung cancer surgery in Israel

Epidemiology of lung cancer in Israel

The Israeli ministry of health, updates cancer statistic annually. last update was published on November 2021 (7). In 2018, a total of 2,693 new lung cancer cases were diagnosed in Israel. Among them 1,658 (61.1%) males and 1,035 females. These statistics place lung cancer as the second commonest cancer (excluding non-melanoma skin cancers) in males and third in females. Age-adjusted lung

cancer incidence rates to 100,000 was 26.7 for Jewish males, 16 for Jewish females, 41.7 for Arabic males and 7.6 for Arabic females.

During the last 23 years [1996–2018] a significant and moderate decrease in the incidence of lung cancer in Jewish men was observed with annual percentage change (APC) of 0.5%, while in Jewish women a significant increase was observed in lung cancer incidence until 2014 (APC 2.1%) and from 2014 onwards, no significant change was recorded. In Arabs, men and women, incidence rates were stable throughout the last 23 years period and no change was observed at all.

The greatest risk of disease was observed in patients over the age of 55 in all population and sex groups, and the incidence rates were higher in men compared to women, and highest in Arab men in general.

Lung cancer is the leading cause of cancer death globally as well as in Israel. Overall, 1,908 deaths from lung cancer were recorded in 2018, accounted for 16.6% of deaths from all cancers. Most mortality was observed over age 75 in all population and sex groups, and mortality rates were higher in men compared to women and the highest in Arab men in general.

As of December 31, 2018, there were 5,637 people living in Israel with lung cancer, diagnosed during the five years between 2014–2018 and who have recovered or are still dealing with the disease.

Lung cancer is the most common cause for cancer related death in Israel, accounts for 21.1% of cancer related mortality in Israeli males and 11.8% in Israeli females.

Among the 185 regional and national cancer registries reported to the WHO, Israel is in 42nd place in terms of Incidence and in 66th place in terms of mortality from lung cancer.

Lung cancer screening in Israel

Starting in 1998, lung cancer screening was performed in Israel at Hadassah Medical Center in Jerusalem, which is a member of the International-Early-Lung-Cancer-Action-Program (8), and currently being selectively performed by additional centers in Israel and being paid out of pocket by the patients. The Israeli ministry of health appointed multidisciplinary steering committee in 2017 tasked to establish National lung cancer screening program. The current main obstacle to start the nationally Israeli lung cancer program is reimbursement. Based on the steering committee recommendations, the Ministry of Health

initiated a 3 years pilot program in selected institutes for early detection of lung cancer for a portion of the eligible population in late 2020.

Surgery for lung cancer in Israel

About 800 lung resections for lung cancer are performed each year in 16 different medical centers in Israel. Lung resection for lung cancer includes wedge resection, segmentectomy, lobectomy, sleeve resection and, rarely, pneumonectomy. The accepted standard of lung cancer resection is lobectomy with formal mediastinal lymph node dissection.

Most of the lung resections in Israel are done thoroscopically using either the multi-portal approach or the uniportal approach. As many as 40 robotic assisted lobectomies for lung cancer were performed using the da Vinci robotic system in 2018, with increased number of robotic assisted resections annually as more hospitals acquire robotic systems.

Lung resection through thoracotomies is reserved for complicated resections such as post neoadjuvant treatment, centrally located tumors, and large tumors. Sub-lobar resections (wedge and segmentectomy with lymph node dissection) is usually performed in cases of early-stage lung cancer, usually with ground glass opacification nodules less than 2 cm, or in cases of patients with low respiratory reserves or significant comorbidities.

Prior to surgery, patients with lung cancer are staged accordingly and discussed in multidisciplinary tumor boards on weekly basis. When indicated, mediastinal staging is done by mediastinoscopy by thoracic surgeons or by endobronchial ultrasound (EBUS) by pulmonologists. Patients with stage I NSCLC would be advised to undergo resection only. Those with stage II would undergo resection and adjuvant treatment, and those diagnosed with stage IIIA would primarily receive neoadjuvant treatment followed by restaging and resection. Currently, neoadjuvant treatments involving immunotherapy or biological treatment are usually administered under or within a clinical trial mainly to patients with high risk stage II and above. Like our colleagues across the globe, we hope that the recent large clinical trials will shade new light on the optimal treatment to this unique group of patients.

Only in very rare cases, patients with stage IIIB or stage IV NSCLC would undergo lung resection following radiotherapy or systemic treatment. The encouraging results with the new treatment modalities such as biological

and immunologic therapy, provoke multidisciplinary discussions about expanding the indications for surgical resection in those with advanced stages. For example, significant downstaging of a locally advanced disease would be brought up for discussion to decide whether to offer the patient lobectomy for the minimal residual disease or continue with systemic therapy, etc.

Palliative care for stage IV patients who suffer from symptomatic malignant pleural or pericardial effusion includes invasive procedures done either by a radiologist or a thoracic surgeon. These procedures include talc pleurodesis (thoracoscopic or bedside), indwelling pleural catheter insertion, or pericardial drainage.

Esophageal surgery in Israel

Epidemiology and treatment of esophageal cancer (EC) in Israel

EC is an uncommon disease in Israel, with an incidence of 1.5 cases per 100,000 (9). In 2018, there were 148 new cases of EC in Israel (10). EC is treated in Israel according to the accepted guidelines similar to Western Europe and North America. High volume centers are participating in multicenter studies both for locally-advanced and metastatic disease (11,12). A retrospective analysis of the trends in EC in Israel between 1996 and 2013 found that while EC in Israel share many clinic-pathological features with majority of the western countries, Israeli population noted to have significantly delayed reversal of the two main histopathological subtypes of EC with abundance of squamous cell carcinoma in the distal esophagus (45%) rather than adenocarcinoma compared to the western population, probably representing an intermediate entity between endemic and the western subtypes of EC. Further, there was clear predominance of Ashkenazi Jews, one of the two main Jewish subgroups in EC incidence in Israel (13). Following staging and multidisciplinary tumor conferences, early-stage disease (pTis, pT1a) and high-grade dysplasia are treated with endoscopic resections or ablation. Deeper local disease (T1b, selected low risk T2N0) is treated by esophagectomy, while high risk local and locoregional disease (T2-T4a, N0/+, except T4b or unresectable nodal disease) undergo preoperative chemotherapy or chemoradiation (mainly according to CROSS or FLOT regimens) followed by restaging and esophagectomy.

Surgery for esophageal diseases in Israel

Benign and malignant esophageal diseases are treated in Israel by general surgeons and thoracic surgeons similar to majority of the world. Most common procedures performed are laparoscopic paraesophageal hernia repair, laparoscopic Heller myotomy for achalasia, laparoscopic Nissen fundoplication, Ivor-Lewis esophagectomy and three-field esophagectomy (Mckowen). Most of these procedures are being performed in large academically affiliated public hospitals and few at private hospitals. The first minimally invasive esophagectomy was performed in Israel in 2012. Nowadays, majority of the cases are being performed by minimally invasive surgery, namely laparoscopy and thoracoscopy. Robotic assisted esophageal surgery is also done by a handful of surgeons in Israel (14,15).

Mesothelioma surgery in Israel

Asbestos has been widely used in Israel for many years, particularly in the manufacturing of asbestos cement products, thermal insulation, and brake lining. Asbestos cement products were used extensively to expand building for immigrant population during the middle of the last century exposing certain population groups to the risk of developing MPM many years later. Following the immigration wave from the former Soviet Union in the early 1990's, Israel noted an increase in the incidence of MPM presumably from previous exposure. As a result of extensive legislation and occupational regulations at workplaces the only brake lining plant in Israel was closed down in 1980 and the only asbestos cement plant in Israel was closed down in 1997. Since then, there was no mining of asbestos in Israel, and the only asbestos that being used is imported (16). During 2018, 43 new cases of MPM were diagnosed in Israel (10). The incidence of MPM in the Jewish population in Israel is consistently significantly higher than in the Arab population presumably from different occupation profile and exposure.

Surgery for mesothelioma in Israel

Because of its being a rare disease and the fact that there is no formal asbestos screening program in Israel, majority of MPM cases are diagnosed in the later stages of the disease, once the patient is symptomatic. Thoracoscopic pleural biopsies and mediastinoscopy are being done by thoracic

surgeons for diagnostic and staging purposes once there is suspicious for MPM. Following multidisciplinary tumor boards, operable surgical cases are mostly done by extended pleurectomy and decortication, with heated intra-pleural chemotherapy. Extrapleural pneumonectomy are being done in selected cases only.

Chest trauma

The incidence of thoracic trauma in Israel is similar to that of other developed countries and constitutes approximately 10–15% of all trauma cases. The mechanism of injury in the majority of cases is blunt chest trauma, i.e., falls, motor vehicle accidents, fighting brawls. Rib fractures are the most common pathology, with increasing prevalence, especially in the elderly population. Most of thoracic blunt trauma patients are treated conservatively, with emphasis of optimal pain management and physical therapy to prevent nosocomial pneumonia. In recent years, surgical stabilization rib fixation systems for treatment of rib fractures with manifestations of flail chest is becoming the treatment of choice in selected cases in few centers in Israel in the interest of prevention of infection, better mobility, and improved rehabilitation potential with reduction of hospital length of stay. Rib fractures still are a major concern in the elderly population, as increased morbidity and mortality rates are not rare in multiple fractures.

Penetrating thoracic trauma, though may constitute a minority of cases, are however a major source of morbidity and mortality. It is these cases, that constitute the major source of Surgical treatment of this form of trauma. These cases comprise of approximately 10–15% of trauma treated surgically.

It is of importance to note, that Israel is an area of armed conflict and the incidence of penetrating wounds to the chest, both by gunfire, explosive and primarily sharp instruments are constantly on the rise, making prompt medical and surgical treatment by trauma teams essential for the successful treatment of these victims.

The Israel Trauma Registry exists and includes all forms and degrees of trauma since 2000. A detailed report is available online and is administered by the Gertner Institute of Health policy.

Its most recent report was recently published summarizing all relevant information from 2000–2019 (17).

Challenges

Thoracic surgeons in Israel face several challenges. The lack of ministerial regulation to the number of units and departments of thoracic surgery over the years, has led to a concentration of several units and departments in a small geographical region, resulted in an increasing competition and limiting the growth potential and the increase in case volume. Constant discussions are being held by the Israeli Medical Council among multiple disciplines (including thoracic surgery) on centralization of major surgeries and services in designated centers of excellence. In spite of the excellent centralized public health system that Israel has established over the years, there is still a relatively long lag time until a diagnosis of suspected lung cancer is established (up-to 8 weeks) and treated. Further, due to the lack of widespread national lung cancer screening program and being a small country, relatively rare diseases such as MPM, EC and even lung cancer sometimes are being diagnosed in later stages limiting the potential ability of surgical treatment and cure. Increased awareness and designated rapid diagnosis teams (including thoracic surgeon, medical and radiation oncologists, pulmonologists or gastroenterologists and radiologists) are promoting national awareness of such diseases with the hope to facilitate rapid diagnostic pathways. Finally, given the relatively small population in Israel and despite the exciting advancement in technology, peri-operative care and surgical techniques—there are limited overall number of surgical cases resulting in limited number of spots for graduating new thoracic surgeons each year which further limits the number of residency spots and applicants eventually.

Conclusions

Although regarded as a relatively small country, during the past 74 years since its establishment, Israel has evolved into a modernized country with modernized and efficient public health care system. Despite existing challenges, thoracic surgeons in Israel are providing extensive array of up-to-date high-quality services utilizing modern minimally invasive methods and technologies to the growing population of Israel.

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