

A view from above: my life in thoracic surgery

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I started my training in cardiothoracic surgery in 1973 having spent 3 years in the generality of surgery. At that time, a few general surgeons were performing a tiny minority of pulmonary resections. Having seen a few such operations I decided to specialize in thoracic surgery to learn how to do this surgery properly! Despite a stated focus on the thoracic aspects of our speciality, the major commitment for all trainees at that time had to be on cardiac surgery as the numbers of such cases were increasing rapidly with the advent of coronary revascularisation. However, for 1 year out of the training programme I was able to arrange a period as a specialist in Durban, South Africa, where Professor Le Roux allowed me to indulge my priority in thoracic surgery practice. I was lucky enough to be appointed as a thoracic surgeon to the Brompton Hospital in 1979.

Progress in the surgical treatment of lung cancer over the past 45 years has mainly been through a large number of small incremental improvements interspersed with a few major advances. It is not my intention to list all of these steps but to emphasise how they summate to provide the patients with this disease today a very much better experience than previously.

Let us start by looking at the lung cancer patient journey back in the early 1970s. The patient usually presented with symptoms. The occasional chest radiograph abnormality found incidentally was often tuberculosis or one of the three types of tumour: carcinoids, cylindroma and mucoepidermoid, grouped together under the term “bronchial adenoma”. This misleading term gave the impression that these tumours were benign, which even at that time was known not always to be the case. Incidentally discovered lung cancer was unusual. He, for the vast majority were men, would have been a smoker in his late 50s or early 60s. The age cut point of 70 was rigidly applied

as a contra-indication for pulmonary resection, using age as a surrogate for co-morbidity. It was so rare to find a case of lung cancer in a non-smoker that anyone claiming never to have smoked would be doubted. Smoking history was not documented, certainly not quantified in pack-years. Biopsy was obtained by bronchoscopy, using the rigid instrument under general anaesthesia, and, as the great majority of cancers were squamous in type and centrally located, this had a high diagnostic rate. If bronchoscopy was negative but there was a strong suspicion of cancer on clinical and radiographic grounds, one usually proceeded to thoracotomy without further attempts at establishing a diagnosis. Assessment of patient fitness relied upon the patient’s reported activity level; in borderline cases supplemented by a stair climbing test, which was highly subjective and had no clear parameters. Assessment of “resectability” relied heavily on clinical history and examination, features on a chest radiograph (postero-anterior and lateral) and bronchoscopic appearances. Recent onset of neurological symptoms or bone pain, the finding of hepatomegaly or unexplained weight loss suggesting metastatic spread could be followed by radio-isotopic scintigraphy of bones, brain or liver (1) but such tests caused delays in treatment, lacked high sensitivity and specificity and were used infrequently. A careful examination for cervical lymphadenopathy was performed in all cases and as a young surgeon I was surprised at the sensitivity with which malignant nodes as small as 1 cm in diameter could be palpated by experienced hands. Gross mediastinal involvement was suggested by features such as mediastinal widening on the chest radiograph, superior vena caval obstruction, recurrent laryngeal or phrenic nerve involvement or widening of the carina on bronchoscopy. However, the surgeon would often have to make a

judgement call if mediastinal involvement was less certain on the chest radiograph. In the unit at which I worked, it was the task of the duty registrar each evening to perform a barium swallow examination on each patient scheduled for surgery the next day to exclude compression or deviation of the oesophagus by enlarged sub-carinal nodes. I know of no study to show the sensitivity or specificity of such an examination.

Thoracotomy the next day would involve a muscle cutting incision from the vertebra prominens to below the nipple or breast. A rib was excised or its neck divided. There was no systematic evaluation of the extent of the cancer. The primary tumour and intrapulmonary nodes were resected, by pneumonectomy in almost half of the cases. Large nodes in the mediastinum would usually be resected, if that were feasible. It was not unusual for gross residual tumour to remain in unresectable nodes or at resection margins. The concept of “complete resection” rarely troubled surgeons, pathologists or the patients. Unsurprisingly, with such crude pre-operative evaluation, as many as 1 in 4 thoracotomies proved to be “open and close” cases in which no resection was performed.

If the post-operative recovery was uninterrupted by complications, such as sputum retention, empyema or broncho-pleural fistula, most patients were discharged in around 10–14 days post-operatively. No effective adjuvant therapy was available although some patients who were known to have residual gross tumour would be offered radiotherapy. One investigator later in the 1970s was experimenting with adjuvant immunotherapy injecting bacillus Calmette-Guérin (BCG) and an “adjuvant” in large quantities into the sub-cutaneous tissues of the thighs. This usually delayed post-operative discharge for several weeks until the resulting discharge had settled, and had no beneficial effect.

It is not difficult to appreciate how far surgical practice has come in the 45 years since the days of this bleak but representative case history. Let us look where those advances had most impact.

Already in 1973, there was one pre-operative investigation that had been shown to greatly improve the pre-operative evaluation of the mediastinum—cervical mediastinoscopy. In 1969, Pearson had shown that the routine use of this surgical procedure could exclude the one third of patients coming to thoracotomy who would be shown to have inoperable mediastinal node involvement, reducing the “open and close” rate to 6% (2). Despite this publication, mediastinoscopy, first introduced 10 years earlier (3), had not

become routine and was largely used to biopsy mediastinal masses, including lymph node masses for diagnostic purposes. On assuming independent practice as a consultant in 1979, mediastinoscopy was used routinely as a pre-operative staging investigation with exactly the impact Pearson had shown on the incidence of futile, open and close thoracotomy. I was fortunate to start my consultant practice in one of the few centres in which whole body computed tomography (CT) scans had become available. I was able to ensure that all of my lung cancer patients received the benefit of pre-operative CT scanning by including them in an investigative protocol to compare the CT evidence of mediastinal nodal disease and invasion with findings at mediastinoscopy, coupled with left anterior mediastinotomy for tumours in the left upper lobe or those tumours extending to the left main bronchus, assessed against the final pathological stage after surgery and mediastinal node dissection. This investigation showed that one could use CT scanning as a selection tool, reserving pre-operative mediastinal exploration for those cases in which nodal enlargement or mediastinal invasion had been suggested on the scan (4). CT was subsequently shown to be useful in detecting asymptomatic metastases in the brain, skeleton and abdomen (5). Mediastinoscopy became safer, more accurate and more easily taught with the introduction of video-mediastinoscopy in 1989 (6). There has since been a proliferation of techniques to extend surgical and endoscopic evaluation of the hilum and mediastinum and multiple imaging modalities using combinations of CT, magnetic resonance imaging (MRI), positron emission tomography (PET) imaging, greatly improving our ability to obtain accurate pre-operative staging.

Proposals for the inclusion of lung cancer within the developing tumour, node and metastasis (TNM) classification were first published by the Union for International Cancer Control (UICC) in a brochure in 1966, and 2 years later were included in the first edition of the “*TNM Classification of Malignant Tumours*”. However, our speciality only began to talk about “staging” as a pre-operative evaluation in lung cancer after the American Joint Committee for Cancer Staging and End Results Reporting (AJC) Task Force, headed by Dr. Mountain, published “*A Clinical Staging System for Lung Cancer*” in 1974 (7). This publication created a separate N category for those cases in which there was involvement of the ipsilateral mediastinal nodes, and the perennial hot topic of the treatment of “N2” disease was born! Separate classifications for residual disease, “R”, post-surgical pathological classification “p” and clinical classification after induction therapy “y” were included in

subsequent iterations. The International Association for the Study of Lung Cancer (IASLC) assumed the responsibility for funding, collecting data and analysis of subsequent iterations of the TNM classification for thoracic cancers in 1996 (8).

We now have a unified, internationally accepted TNM Classification for Lung Cancer and other thoracic malignancies and the ability to compare results across the globe for closely defined sub-groups, pre-operatively and post-operatively. We have all come to appreciate the importance of careful pre-operative staging, intra-operative evaluation—especially of nodal extent, and diligent pathological evaluation of resection specimens and nodes removed separately for examination. One benefit following from this has been our ability to conduct large, multi-centre, international studies of induction and adjuvant therapies (9). Such persistence has now established a role for adjuvant chemotherapy in sub-sets of patients after complete resection, and there are many ongoing trials of the role of such multimodality treatment in advanced cases in an induction and adjuvant setting. Ironically, immunotherapy has now been shown to be effective in advanced cases but not yet in the adjuvant setting proposed 40 years ago!

Long before the introduction of video-assisted thoracic surgery (VATS) and the concept of “minimally invasive surgery”, thoracic surgeons were working to reduce the extent of chest wall injury required to undertake pulmonary resections safely. Muscle-sparing incisions were developed and all surgeons were finding that it was possible to operate safely through shorter incisions with fewer muscles divided. The development of VATS, in all its forms, has undoubtedly hastened this trend and with it the morbidity of resections, the length that chest drains are required and total length of stay. In the UK 38% of resections are now performed using VATS techniques (10). However, it is far from certain that all of these beneficial trends are solely due to the utilisation of minimally invasive techniques. Cultural changes undoubtedly have played a part as well as techniques to control air leak, better management of chest drains and better pain control. Alongside this trend, there has been a resurgence of interest in sub-lobar resection as a result of changes in the epidemiology of lung cancer and improved detection methods. This has brought challenges to the primacy of surgical resection in the management of small tumours from modalities such as radio-frequency ablation (RFA) and stereotactic body radiation therapy (SBRT) focussed radiotherapy. As lung cancer rates in the West have fallen due to tobacco control measures and smoking

cessation programmes, other changes have been noticed in the types of cancer found in the lung. The predominant cell type has become adenocarcinoma; peripheral cancers, even squamous cell types, are far more common than central tumours; the incidence in women has risen as that in men has fallen steadily; and the age at presentation has increased slowly. Peak incidence age at diagnosis in the UK is 75–79 years for men and women. Many more early stage tumours are being found now that low-dose CT screening has been shown to be effective. However, the cost of such programmes is beyond the means of many health care systems and the many small non-malignant and pre-malignant nodules discovered on screening require a well-developed protocol for management including careful surveillance and repeated scans if unnecessary invasive procedures are to be kept to a minimum. Along the way, we have learnt much of the genetic basis of carcinogenesis and developed tailored agents to block the driver mutations, greatly extending the life of patients with such targetable pathways. When further mutation allow cancers to by-pass the pathway block, newer drugs can be rapidly developed to provide effective 2nd and 3rd line treatments.

All of these changes and advances have combined to vastly change the patient journey from that of the case described at the beginning of this article. All patients now have the benefit of being discussed in a multi-disciplinary setting to ensure that all modalities and combined modalities are considered. The patient going on to be offered surgical treatment has been intensively assessed for mediastinal involvement and possible metastatic spread. Validated fitness tests will have been undertaken in borderline fitness patients to identify high-risk individuals. Three-dimensional imaging provides the surgeon with a “Satnav” view of the route he faces so that deviations can be planned for “road blocks” that may be encountered. With unprecedented certainty, the surgeon can predict ahead of surgery that complete resection will be achieved and the least damaging amount of lung tissue resected. If the pathologic stage is found to be more advanced than predicted, microscopic metastatic disease can be anticipated and hopefully eradicated by adjuvant chemotherapy. Pneumonectomy is now an unusual operation, national figures for the UK showing that pneumonectomy is now performed in only 5% of cases and open and close rates are below 2%! Older patients with more comorbidities are now operated upon with lower mortality—6% for pneumonectomy and below 2% for lobectomy, and far less morbidity (10).

I hope that this overview of the past 4 decades installs a sense of pride in all thoracic surgeons, pride in what has been achieved and a determination to continue to make advances over the length of their careers.

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Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

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