Developing a Robotic Thoracic Surgery Program

I have been privileged to have been given the opportunity to set up two robotic surgery centres in the last 7 years. In 2013 my chief executive invited me to be part of a multi-specialty group to evaluate robotic-assisted surgery using a new robot that would be bought from funds without having to put together a business case. I had been asked several years before to be part of this revolution but felt that the machine at the time with only 3 arms and rudimentary vision was not sufficient to make any difference between VATS and robotic-assisted thoracic surgery. This time with 4-arm technology, immersive 3DHD biscopic vision and better support we all felt it was appropriate in our different specialties to test out this platform. After a safe start and progression onto robotic lung resections, our group presented to the SCTS in 2015 but there was a general feeling that robotics was the future and would always stay that, to paraphrase a famous US VATS surgeon, but things are changed in 2020 as we stand on the "precipice of a robotic surgery explosion" as John Lazar has stated [1]. Now we are in a completely different environment. When setting up the robotic surgery program at Barts, I was allowed to learn from all my mistakes but also embrace even newer technology. Nearly 40% of thoracic surgery UK and Ireland departments are now doing some form of RATS, and this is set to increase with more centres realising the benefits of this technology. But it is important to understand that this is the beginning of the evolution of robotics in mainstream thoracic surgery and whatever we have now in 2020 will not resemble what will exist in a decade. There has been one main player for years but there is about to be a flood of other companies revealing their products as the market for computer-aided surgery widely opens. I have been fortunate to have been a European proctor since 2016 as this has given me an insight into different thoracic units. To have a successful robotic program there are many factors to consider. but these can be synthesised into 10 points:

1. Ask your colleagues.

Your Trust and department have to agree that it is ready for the robot as it is disruptive technology in more ways than one. Cancer waiting times will still have to be met and block contracts achieved. For this change in practice to happen, your institution will have to recognise that some colleagues will the first to train in robotics. You and others will be taking up the slack pedalling faster to allow a safe and steady progression. Most Trusts will be investing in a multi-specialty robotic program and so working with your colleagues from other specialties will strengthen business plans for purchasing and for planning new roles such as a robot coordinator or a pluripotential first assistant. Shared use means undoubtedly changing theatre days in your own department. Robotic surgery will bring changes in practice, operating, team dynamics and training.

2. The magic number.

It is easier to have more than one surgeon train at the same time but one to be the console surgeon and one to be the first assistant in a staggered way at the inception of the program. This affords some benefits as "buddies" will be able to remind each other of the tips and tricks learned, will make progression faster as a result of this and geeing each other on, and will provide a more robust front. The small downside is having to share training time particularly if the robot is a multi-disciplinary one (which is the commonest situation), but the positives outweigh the negatives.

3. Remember your support.

The robot company is there to help you, not only in choosing your product, but also in determining your realistic trajectory as a robotic program. There are set training pathways for thoracic surgery with online training, VR and tissue simulation, courses, cases observations at established training centres, and proctored support. There is a clearly planned graded training pathway to ensure that the robotic team progresses with the most confidence. The Clinical Sales Representative (CSR) will be your partner in this. Your Trust will need to understand about this pathway, and finance will have to be factored in to allow travel and accommodation.

4. Visit a training centre.

There are 2 UK training centres (Barts and Guys) at the moment with 4th generation robot programs. Others such as Glasgow are ready to open up. These are departments where the whole team should go. Anaesthetists, first assistant and

scrub teams should be included in these case observations as this will be a time for each professional to speak with their corresponding colleague, and the theatre environment viewed as well as the operative procedures.

5. Choose your platform.

Intuitive Surgery have the only robotic platform for Cardiothoracic surgery at the moment, but others will soon follow. Current offerings are the Si, X and Xi. The Si will not have any company support from 2024, but is the only machine with a CEA mark for cardiac surgery. It has a short reach and a high profile user-end meaning that it takes up the most workspace around the operating table. The X and Xi are newer models and are called "4th generation." All three have a CEA mark for thoracic surgery. The Xi comes in from the side of the patient for all types of cases as it has an extendable boom that rotates the arms to wherever they are required. It has built in artificial intelligence leading to quicker set-up due to targeting and automatic positioning and has a very low profile with a resulting very small workspace. The X behaves as a hybrid of the Si and Xi in that it has the same base and arm configuration as the Si but at the instrument end has a lower profile architecture allowing closer port placement than the Si. It has no AI and has an in-between workspace configuration. An important consideration is that for lobectomy the Si and X have to come in from the head-end of the patient +/- 30 degrees. The 4th generation robots have the ability to have surgeon-controlled endo-wristed staplers and useful adjunct software as standard such as Firefly, (fluorescence vision), Tile pro (screen-in-screen capability), camera port-hopping as the camera is small enough to fit all the ports, and surgeon-initiated camera angle change.

All systems have the ability to be linked into a simulation "backpack." These allow the performance of graded exercises, analytics of performance metrics and trainee assessment and progression. There is also procedural simulation within this.

If your plan is to be a training centre, then serious consideration has to be given to purchasing a 2nd robot console. The advantages of a trainee or observer seeing exactly what you are seeing in immersive 3DHD biscopic vision rather than 2D.

Cost considerations will have a part to play in which system you choose to invest in, but remember your finance director will have the ability to negotiate and the robot company will have several different ways to provide the system to you.

6. Plan your own theatre environment.

Your theatre may be laid out differently to the case observation centre's. You may have a lower ceiling or pendants just where you want to place your robot. So planning with your CSR and/or proctor is paramount. As above, some robots need positioning at the head end of the patient and so careful consideration with your anaesthetist lead is required. Ideally there should be a free space between the console and the table so there is an unencumbered communication channel. Equally there should be a plan for a trolley close to the console for a sterile gown and gloves in case of uncontrolled (true emergency) conversion.

7. Governance for Robotics

If it does not exist already in your Trust , instigate a multi-specialty and multi-disciplinary robotic-users group. This should have terms of reference and a clear governance structure. As such, there should be a way of granting permission to CSRs to come to theatre, and honorary contracts for proctors. It is important to have a list of procedures planned to be performed, a clinical risk log, and a way of progressing new procedures. SCTS has published a Proctoring document [2] which should be adhered to. Each training surgeon should have a robotic training logbook and at the end of training either certification of completion or a letter from the proctor confirming competence to perform robotic surgery independently. There should be an undertaking to video all operations. This is to build up a library, to allow reviewing and editing to show where time-saving can be achieved, to train and to provide a record of what happened in each operation which may be of medico-legal benefit. They may have to be new patient information leaflets and consent forms may need to be devised, including video consent. A strict data-set should be agreed on at the start of the program, which would include key performance indicators (predominantly time-based) and a log of graded complications, reasons for conversion and readmission rates. When a program has a solid governance structure in place and being adhered to, the department is on a professional footing with the Trust, commissioners and fund-givers.

8. Sterilisation

Robot systems have specific sterilisation needs. It is important, when choosing which system to invest in, to know where the nearest sterilisation unit is and whether it can take on the additional capacity needed for your department. Most

sterilisation take place with external contractors and as such contracts should be in place in terms of volume, rate of turnover and safety but a lot of Trusts have in-house units. There are dedicated sterilisation specialists to help with training and planning this.

9. Maintenance

Robotic systems have a maintenance schedule. As part of the negotiation for the purchase, consideration should be given to including a fixed term of annual maintenance.

10. Business Case

The literature provides the evidence for robotic-assisted thoracic surgery having shorter learning curves than non-robotic, and for it to result in less complications, less severe complications and less conversions than VATS [3]. Although surgeons have attempted cost-effectiveness review, the better term is resource implications of this type of surgery [4]. It is clear that we are at the start of an evolution of computer-aided or digital surgery [5]. Part of putting together a structured business case is to look at the obsolescence of current surgery including the robotic platforms currently in use. An approach is to divide up the costs into amortised and non-amortised which would include disposables and maintenance costs. However it is definitely sensible to establish that buying into this digital revolution now means that you will be subscribing to the continual evolution of computer-aided systems as part of the future of surgery.

I have been lecturing in robotic thoracic surgery since 2015 and these points are a central part of my presentation to surgeons wishing to start a successful robotic thoracic surgery program. I hope this is of some help to aspiring departments to structure their application accordingly.

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This is an opportunity to be part of the digital revolution, provide even better care to patients, enhance training for surgeons and work together as a team. Many surgeons I have spoken to are like-minded when they admit that there is clearly now an element of fun in their working life.

References:

1. Envisioning the Future of Robotic Surgery: The Surgeon's Perspective. Lazar J. Thorac Surg. 2018 Feb; 105(2): 343-344

2. Proctoring in Cardiac and Thoracic Surgery. https://scts.org/proctoring-in-cardiac-and-thoracic-surgery/

3. Robotic-Assisted, Video-Assisted Thoracoscopic and Open Lobectomy: Propensity-Matched Analysis of Recent Premier Data. DS, Reddy RM, Gorrepati ML, Mehendale S, Reed MF. Ann Thorac Surg. 2017 Nov;104(5):1733-1740

4. Resource implications of robotic thoracic surgery: what are the wider issues? Stamenkovic S, Slight RD. Ann Cardiothorac Surg. 2019 Mar;8(2):250-254

5. Future of Surgery. https://www.rcseng.ac.uk/standards-and-research/future-of-surgery/