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Training & Credentialing in Robotic Cardiac Surgery: Current Perspectives in India

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Though the advent and attempt of robotic cardiac surgery (RCS) began on May 7, 1998 at Broussais Hospital in Paris when Carpentier and Loulmet completed successfully the first robotic mitral repair by Mona-DaVinci prototype[1], its acceptance and uptake have been slow but fruitful in the Indian subcontinent.

obotic surgery has challenged the notorious Halstedian teaching adage of "See one, do one, teach one"This was acceptable during the advent of RCS but with a more widespread uptake it is imperative to form and put in place a structure for training and credentialing to ensure robust standards of patient care and safety.

As developing any new program, it is essential to introduce and educate the technology at the grass root level. The already existing cardiac surgery programs recognized under NMC and NBE in centres with available robotic programs are a great platform to start the introduction to training in RCS in India.

The government institute with DaVinci system are limited at present and are as follow.

1. All India Institute of Medical Sciences New Delhi
2. Safdarjung Hospital New Delhi
3. SGPGI Lucknow PGIMER Chandigarh
4. All India Institute of Medical Sciences Rishikesh
5. All India Institute of Medical Sciences Jodhpur

Along with a few corporate and private institutes.

This articles aims at reviewing the current available training programs and their structure and inturn reflect at the present Indian scenario and pathway

I. INTRODUCTION

Though the advent and attempt of robotic cardiac surgery (RCS) began on May 7,1998 at Broussais Hospital in Paris when Carpentier and Loulmet completed successfully the first robotic mitral repair by Mona-DaVinci prototype[1], its acceptance and uptake have been slow but fruitful in the Indian subcontinent.

This could be attributed to a steep learning curve to acquire the skill along with no available structure or curriculum for training in RCS. The development and growth are mostly laid on the shoulders of initial pioneers in the field with experience in minimally invasive cardiac surgery and their capability to pass down the experience & techniques without a structured curriculum. Robotic surgery has challenged the notorious Halstedian teaching adage of "See one, do one, teach one"

This was acceptable during the advent of RCS but with widespread uptake of the technology across the world and as well as becoming the preferred choice of approach for many procedures, also the procedural expansion into standard clinical practice now includes robotic-assisted mitral valve replacement, benign cardiac tumor excision, atrial septal defect closure, tricuspid valve operations, cryothermic Cox Maze ablation, and more recently in specific centers, septal myectomy, aortic valve replacement (AVR), and repair of anomalous pulmonary venous connection, it is imperative to form and put in place a structure for training and credentialing to ensure robust standards of patient care and safety. It will also help cardiac surgeons to find a pathway for learning and contributing to the field of RCS.

A comprehensive RCS training programme needs a curriculum-based progression from functional knowledge of robotic systems, Observation and case assisting,acquisition of basic robotic skills in dry and wet labs,, modular console training, Case supervision and finally independent case. Such modules help trainees learn& tackle barriers in a safe and controlled environment ensuring patient safety[2]

This articles aims at reviewing the current available training programs and their structure and inturn reflect at the present Indian scenario and pathway.

STRUCTURE

Robotic cardiac surgery training program can be structured into 3 aspects and levels with a promotion of candidates according to evaluation based on knowledge,skills acquired and proficiency. All the abovelevels to be supervised and evaluated by the appointed program director.

Classroom (level 1)	Console (level 2)	Clinical (level 3)
Robotic technology & Functions	Dry Lab	Patient positioning
Basic troubleshooting & limitations	Wet Lab	Port placement
Individual procedure planning 1. patient selection 2. procedure indication 3. Preoperative workup	Virtual reality simulators	Assistance and working port maneuvers
		Operating with supervision
		Individual case

Robotic technology & functioning

As basic introduction of robotic surgical technology is still considered to be recent advances with little to no exposure in south-east Asia surgical training it's important to address and start the training program with introduction to detailed outlook towards the robotic technology & functioning. The vendor of robotic – intuitive surgical[reg] have online tutorial on the fundamentals of the da Vinci Robot and with certification of these modules. Certification in these modules is essential and considered a prerequisite in most of the centers.

Patient Selection,Indication and workup

Every cardiac surgery patient is generally dealt with an extensive preoperative workup for evaluating the given diagnosis and to plan a required intervention for the same.

There is additional information required in the workup of a patient being prepped for a RCS,which involves knowing the pulmonary status,femoral and iliac vessels sizing and anatomy to aid peripheral bypass. It's important to train an RCS trainee in recognizing the potential candidates who would benefit from robotic intervention from the OPD. A dedicated protocol to working up the patient with general and procedure specific preoperative requirements. It's also important to know the limitations of RCS and accordingly rule out a patient who doesn't fit in the spectrum with appropriate counselling of the patient looking for a robotic intervention.

Dry lab

The first step in hands-on training on the robotic system generally starts in a dry lab as it is cost-effective and can reliably simulate real-time challenges. The already laid training program for fundamentals of laparoscopic surgery is used in robotic general and urology surgery training. The laproscopic instruments are usually replaced with the da Vinci robotic limbs. The fundamentals of robotic surgery involvecamera movement and clutching, transferring, Endo wrist manipulation, needle control, needle driving, suturing and intracorporeal knot tying.

This can be assessed with the model Robotic Objective Structured Assessment of Technical Skills (R-OSATS), It's an assessment tool that uses 5 drills: 'tower transfer', 'roller coaster', 'Big Dipper', 'train tracks' and 'figure-of-eight'. The proctor monitors and assesses the candidates in four categories (1) accuracy, (2) force/tissue handling, (3) dexterity and (4) efficiency. This is scored from 0 to 20; the minimum passing score is 14[4]

Wet lab

Wet lab training provides a distinct advantage of simulating human tissue consistency and anatomy. *Matthew Valdis et al* assigned and validated trainee with 2 tasks in wet lab during their evaluation of training modalities for robotic cardiac surgery[5].Harvesting a 10-cm-long segment of the ITA pedicle off a porcine chest

wall using robotic Debakey forceps and monopolar spatula cautery.Next,using a porcine heart model of the mitral valve, two 3-0 Ethibond Excel sutures (Ethicon, Cincinnati, Ohio) were passed to the trainee by an assistant and placed through both the posteromedial and anterolateral trigones of the mitral valve. A third suture was given to the trainee and placed through the annulus of the mitral valve and then through a flexible annuloplasty band(St.JudeMedical,St.Paul,Min). Though wet lab training carries the disadvantages of ethical clearance and financial limitations it is considered an essential part of robotic surgery training[6].

Virtual reality simulators

Virtual reality simulators have become the preferred module in many programs because of accurate assessment and evaluation. The simulators not only help train in basic robotic manoeuvres but also procedure-specific steps. There are five leading simulators available currently.

1. Robotic Surgical Simulator (RoSS™; Simulated Surgical Systems, Buffalo, NY)
2. dV-Trainer™ (Mimic Technologies, Inc., Seattle, WA)
3. SEP Robot™ (SimSurgery™, Norway)
4. da Vinci Skills Simulator (Intuitive Surgical, Sunnyvale, CA)
5. Robotix mentor™ (3D systems, formerly Symbionix, Israel)

The western protocol for robotic training used da vinci skills simulator to train and assess candidates in steps and maneuvers required to perform RCS.

Virtualreality simulationexercise	Description	Primaryskilltested
Camera targeting	Traineesgraspsmallobjectsandtransferthemthroughaseriesofplatformsandbasketswhilezoominginandouttofocusthecameraonspecifictargets.	Camera control
Energy switching	Trainees use the pedals to cauterize vessels and tissue with both monopolar and bipolarcautery	Energy control
pegbooard	Trainees removes everal rings from pegs on a board and transfer them between hands to place them on specific pegs on the ground.	Endowrist manipulation
Match board	Trainees must pick up letters and numbers that are scattered around a box with 3lids. Each lid covers a spot where the correct number or letter must be placed without	Endowrist manipulation
Ringwalk	Trainees must move a ring through a rope covered by obstacles, requiring transferring between both hands and a third arm for restraction.	Fourth arm control
Match board	Trainees use the same match board as before, but a second sliding door covers each box, necessitating the use of a third hand for retraction to place each number or letter in side	Fourth arm control
Energy dissection	Traineesarerequiredtousebipolar cautery andscissorstocauterizeandcut6small branchingarteriesoffofalargerartery.	Energy control
Sponge suturing	Traineesaregivenaneedlethattheymustpassbackandforthbetweeninstrumentsandsuturethroughtargetsonaspongebrick,forcingthemtotakeforwardandbackhandbiteswithbothhands.	Needle driving, advanced
Vertical defect suturing	Traineesplaceasimpleinterruptedsutureandplace3squareknotson2verticaldefects.	Needle driving, advance

GEARS

The Global Evaluative Assessment of Robotic Skills is a tool developed by deconstructing the fundamental elements of robotic surgical procedures in consultation with expert robotic surgeons. This is an additional assessment tool used to in many training program which can be modified and used for RCS training[7]

Patient Positioning and Port placement

It's important to maintain to ergonomics for adequate spatial configuration between patient cart of the robot and the target organ. It also important to learn procedure specific port triangulation to avoid extra & extracorporeal instrument clashes. The training enables adequate access for the surgical team (patient side assistant, scrub nurse,anaesthetist). The module should also include docking, undocking and instrument switch at required moment.

The training for the same can be learnt patient side while observing senior surgeons along with port placement in mannequins.

Scenario in India

As developing any new program, it is essential to introduce and educate the technology at the grass root level. The already existing cardiac surgery programs recognized under NMC and NBE in centres with available robotic programs are a great platform to start the introduction to training in RCS in India.

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The brady – vattikuti foundation has partnered with several hospitals worldwide to create a network of institutes. In India, the Vattikuti Foundation has partnered with several multi-speciality hospitals and created its network and non-network hospitals [Table 2] to develop independent centres within their main campuses[8]

Available fellowships[9]

Name	Institute	Link
STS/TSF Advanced Robotic Cardiac Surgery Fellowship	Society of Thoracic Surgeons The Thoracic Surgery Foundation	https://thoracicsurgeryfoundation.org/ roboticcardiacfellowship/
AATS Foundation Cardiac Surgical Robotic Fellowship	AATS foundation	ttps://www.aats.org/aatsimis/AATSWeb/Foundation/ Programs/Programs/Cardiac_Surgical_Robotics_Program/ Cardiac_Surgical_Robotics_Program.aspx
Advanced Robotic Cardiac Surgery Fellowship	Division of Cardiothoracic Surgery, Emory University School of Medicine, GA, USA	http://www.surgery.emory.edu/training/ct-surgery-residency-fellowships/advanced-robotic-cardiac-surgery-fellowship. html
Minimally Invasive CT Surgery Fellowship	Department of Cardiovascular and Thoracic Surgery, West Virginia University, WV, USA	https://medicine.hsc.wvu.edu/cardiovascular-and-thoracic-surgery/fellowships/cardiothoracic-surgery-residency/ minimally-invasive-ct-surgery-fellowship/
Resident Robotic Surgery Training	Department of Cardiothoracic Surgery, Weill Cornell Medicine, NY, USA	https://ctsurgery.weillcornell.org/education/resident-robotic-surgery-training
STS Workshop on Robotic Cardiac Surgery	Society of Thoracic Surgeons Annual event	https://www.sts.org/meetings/live-courses/2020-sts- workshop-robotic-cardiac-surgery-agenda
Robotic Training Courses at ORSI Academy	ORSI Academy, Belgium Throughout the year	https://www.orsi-online.com/en/training
(ICRS) Robotic Surgery course	International College of Robotic Surgeons, World Laparoscopy Hospital	https://www.laparoscopyhospital.com/ roboticsurgerytraining.html

Conclusion

In conclusion, the advent of robotic cardiac surgery has revolutionized the landscape of cardiac interventions in India, with an increasing number of institutes adopting this technology. However, the mere presence of robotic systems is insufficient to ensure optimal patient outcomes. As underscored by this research, the absence of standardized training and credentialing protocols poses significant challenges to the safe and effective adoption of robotic cardiac surgery[10].

Addressing this gap requires the development and implementation of a comprehensive curriculum specifically tailored to robotic cardiac surgery training. Such a curriculum should encompass both theoretical knowledge and practical skills, ensuring that surgeons are proficient in robotic techniques and capable of delivering high-quality care to patients. Moreover, credentialing processes must be established to validate surgeons' competence and ensure adherence to established standards of practice.

By establishing a structured training and credentialing framework, we can not only enhance patient safety and outcomes but also foster the widespread adoption of robotic cardiac surgery across India. This will not only benefit individual patients but also contribute to advancing the field of cardiac surgery as a whole, Ppositioning India at the forefront of innovative surgical techniques. Therefore, it is imperative for stakeholders, including medical institutions, regulatory bodies, and professional societies, to collaborate in developing and implementing such a curriculum, thereby paving the way for a brighter future in robotic cardiac surgery in India.

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