

How to set up a minimally invasive cardiac surgery program?

Minimal invaziv kalp cerrahisi programı nasıl kurulur?

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“We went bankrupt slowly...slowly...then SUDDENLY” (Ernest Hemingway)

Skill acquisition and resource optimization are essential to ensure survival in the medical world, specifically the surgical field. Resources at our disposal include funding, space and the most precious human resource -right people for the right job. Skill is about looking within oneself- for a modification (enhancement) in our portfolio, a move beyond the comfort zone and a modification in patient selection criteria. This might even bring about corresponding changes in remuneration. The current state of median sternotomy -our comfort zone- as much as its time-proven reliability as an access to the heart, might become an alternative to the new change, if not the new gold standard.

It is imperative to develop the desire to learn and the ability to focus. This is especially so in the highly demanding cardiac surgeon's day with little or no time left for other things. In this situation of time constraint, commitment to learn is key. Not everybody is privileged to undergo training in an established MICS programme such as OLV Ziekenhuis, Aalst, Belgium (program established by Prof. Hugo Vanermen), National University Heart Centre, Singapore (NUHCS) in Singapore or Herzzentrum Leipzig, Universitätsklinik, Klinik für Herzchirurgie, Leipzig, Germany (program established by Prof. Friedrich Mohr), all of which have an extremely “well-oiled” program. For most of those who are not in the best fertile soil to grow, they must be inspired to continuously expose ourselves to develop to

the highest standards of these remarkable programmes. These programmes are exceptional examples where most of us do not get the luxury of. From the experience of coaching in other centres, success is directly proportional to the hunger (inner desire) of talented young surgeons who are skillful and exposed to a wide breadth of heart surgeries.

Leadership helmed by the “superior boss” who does not embrace change, who relishes in the current state, may not provide the ideal environment for change. He who leads from the high chair of power and insecurity will not entertain the idea of change that will inevitably bring about progress. The constant fear of being rendered irrelevant with the progress of his junior surgeons is the tenet in this top-down ruling style that impedes change. The three programmes above are the exact opposite of such leadership style. The desire to see progress as a surgical field has led them to train their own teams, expanding to the rest of the world.

HOW TO DO IT/STEP BY STEP

Lets model our approach after our own experience and programme in Singapore, which is neither first - (as there were pioneers before us), nor is it the highest volume in the world, however, we do present here our humble experience over the past decade. Over the years, we strived to make a complete, all-encompassing programme amidst tough conditions of competition and intense scrutiny by the country and the region.

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Do's and Don'ts

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|--|---|
| Do focus | Don't hesitate as this stalls progression |
| Do persuade by alignment of objectives and incentives | Don't delay |
| Do garner support by Chief of department and hospital board | Don't be swayed by cynics |
| Do self-reflect, self-assess to bring about self-improvement | Don't isolate and hoard skills |
| Do structure a phased approach to training | |
| Do engage a proctor/mentor/coach (Figure 1) | |
| Do apply an appropriate selection criteria and start cases | |
| Do stay unwavering and motivated in the face of challenges and competition | |
| Do share skills and success stories | |

During this period of adopting change in an intense and demanding surgical field, we have developed a few do's and don'ts that we share:

It is all-natural as humans to want to demarcate one's territory so as to achieve preservation and protection of turf. This however impedes progress of the specialty. Motivation is what gets you started. Habit is what you going. It is important as a first step to embrace change, be motivated and adopt this technology as a habit. Initial phases are always challenging, beyond the comfort zone, in the areas of preoperative preparation, anesthesia, operative set-up, new equipment both for the surgery and for perfusion. It will therefore be of immense help to continuously motivate and lead a team of dedicated people-nurses, perfusionists, surgeons, anesthetists and intensivists. In the face of adopting a new access, a new technique, it is not a bed of roses, especially in the beginning. Complications, consequences have to be accepted and adequately reflected upon. This will bring about collective increment of judgement and skills as a team to create a robust programme where everyone will reap in the bountiful harvest of benefits.

TOOLS/INSTRUMENTS & DEVICES

All that has been discussed are key enablers of a successful programme. To improve one's skills and to bring the derived benefits to our patients is the reason for our existence. With dedication and discipline, the education process can begin once the mind is set-to find out what others are doing, how they do it, what books/write-ups can help bridge the knowledge gap, what courses are available to increase core competency. Always be inquisitive, this is key. The Internet-Journal subscriptions (Innovations, ISMICS), CTSnetwork for videos and contacts - is a great resource at your disposal.

With the mind and resources right-sited, support within the institution is important - hospital CEO, boss(es), fellow surgeons, anesthetists, intensivists, administrative staff, nurses, perfusionists, allied health and the cardiologists. All are equally if not more important than the acquisition of a set of skills to ensure sustainability of a programme. Co-ownership of this new programme empowers all members of the team to contribute ideas and concepts that can exponentially improve outcomes.

The core deliverable is patient outcome. Patients will be given an attractive alternative (which in time will become gold standard) to a less invasive surgery with better, faster improvement back to functional independence. This is the focus and subsequent benefits will follow. Incentives in both financial and non-financial for the entire team will soon be apparent. The



Figure 1. Proctoring in a live-case setup on site remains the single best method to help a new program on its feet. Here, teaching local surgeons on a case in Taiwan.

(<https://www.nuhcs.com.sg/Heart-Health/Documents/Pages/Magazines/Pulse30.pdf>)

CEO will see value in this new programme. Value-driven outcomes (VDOs) are important here. A robust database for the programme will show clinical benefits that can be directly translated into VDO advantage. Younger surgeons in the team see this program as advancement in personal skillset, in training and in their careers. Our data for the past decade show convincing VDO advantage of MICS mitral valve surgery as compared to median sternotomy. Increasing experience brings about an increasing impact of this effect with divergence of the outcome curves between median sternotomy and MICS.

There are occasions where the bureaucratic channel tends to impede such a change despite institutional buy-in. Sometimes, new policies and budget reallocation by the local government authorities present a significant show-stopper. The authors' team, during the years of coaching, has experienced these issues in developing countries in the region and we would like to share some strategies that these colleagues have devised to their advantage. Resource limitation is at times an insignificant obstacle to curb an undying hunger to progress. Some surgeons save to purchase their personal instruments, this is particularly seen in the private entity. Other surgeons broker deals with strong industry support to obtain huge discounts so as to kick-start the programme. This is very largely driven by the desire to provide patients with access to state-of-the art surgical technology, highly admirable. Other institutions have sought for donations and/or endowments to fund the program (our MICS simulation centre is an example).

When starting this program, the full suite of equipment is not needed all at once. We recommend having a minimal set that can apply for most MICS mitral valve replacements (MVRs) and aortic valve replacements (AVRs) before progressing to MICS coronary artery bypass graft (CABG) that can incur a high cost. A phased model of instrument acquisition can be considered as such:

- Level 1: Manual-direct vision
- Level 2: Manual-camera-assisted
- Level 3: Endoscopic/Robotic
- Level 4: Hybrid/Trans-catheter

Level 1, if done judiciously, will bring about the benefits of MICS without much complication if any at all. Very importantly, there is maximal cost-savings for the program. The author has seen many novices visiting highly established MICS centres which are at the league of Levels 3 and 4. They then return to their institutions feeling daunted and discouraged and

lose the will to start the MICS program. Hence our recommendation is to start small, start simple.

These are the basic instruments to start with:

- Shafted tools Geister (Geister Medizintechnik GmbH, Tuttlingen, Germany), Delacroix Chevalier (Paris, France), Fehling (Fehling Instruments GmbH & Co. KG Karlstein am Main, Germany),
- Femoral cannulas (Edwards, Medtronic, etc.) and long Cardioplegia cannula
- Left atrial retractor
- LA retractor holder
- Aortic crossclamp Chitwood clamp (Scanlan International, Minneapolis, MN, USA), Cygnet (Novare Surgical Systems Inc., Cupertino, CA, USA)
- Adequately-sized rib spreader with blades of different sizes or specialised wound retractors

To shorten the learning curve, these instruments can be considered:

- Knot-tying instruments, eg knot pusher, CorKnot® (LSI Solutions, Victor, NY, USA)
- Camera, Tower

Good quality instruments and cannulae do make a difference but they are not essential items that make or break a program. This is especially so if start-up budget doesn't permit. Sometimes, we can tap on other programs, other brands, or borrow from Thoracic Surgeons who do video-assisted thoracic surgery (VATS). In most developing countries, we come across innovations and adaptations which are no far worse than the specialised equipment, eg Castro-Viejo needle holders, any needle holders, 9- and 11-inch DeBakey forceps, not necessarily going for the shafted needle holders or forceps. Whilst world-class established MICS centres serve as a source of inspiration and education to acquire this skill, versatility and adaptability are key enablers to starting a program.

PERIOPERATIVE CONSIDERATIONS

We have dedicated the above paragraphs to be strategic in nature—from honing the mind, to convincing and persuasion and finally forming a team with its armamentarium. In any surgical program, especially so for MICS, one of the main key enablers is human resource. It is a highly skill-intense program that needs to be helmed and staffed by the best people who are driven, committed and ever-hungry for continuous improvement.

This team comprising surgeons, anesthetists, perfusionists and scrub nurses have to be motivated and co-own the program. The surgeon, being the lead, will have to bring everyone together in harmony and synergy to train together and achieve progress as a team. Far from being an individualist, he has to be a team-player, always providing opportunities for all members of the team. Ideally, he should be the one who is well networked for proctorship and preceptorship sponsors to bring the team to the next level. A well-rounded proctorship program should have an all-encompassing syllabus, providing emphasis on all aspects where surgeons, anesthetists, perfusionists and scrub nurses have specific roles to play.

The anesthetist will possess skills for single-lung ventilation and intraoperative transesophageal echocardiography expertise. The nurse will be adept at handling new surgical equipment-ranging from retractors with different-sized blades to optimise surgical exposure to forceps of different lengths and grip strengths for different purposes. The perfusionist will possess knowledge of specialised femoral cannulae, endo-clamps and specific myocardial protection strategies. With the appropriate knowledge, and the team-based practice in-silico (in simulation), this well-equipped team will be the next-generation to be the forerunner in this technique (Figure 2).

What remains a testament to the success of a MICS team is a patient who walks away happy-free of complications as much as possible. There is nothing better for the MICS program than a database showing comparative advantage over conventional median sternotomy. The path to this outcome is one that hinges upon self-awareness, self-reflection,

constant improvement and one cannot appreciate more the importance of working smart.

Do not make this program more challenging by starting with high-risk, difficult or controversial cases. This tough road does not need further surprises. Patient selection is key. Friends and foes around you can be bought in by good initial results in straightforward cases. In weekly preoperative department discussions, always humbly seek support. First successes and failures are best co-owned. The concept of under-promise and over-deliver is the tenet to patient satisfaction. One cannot put more emphasis on the importance of a well-taken and clearly documented preoperative consenting process. There is always the patient who will pose the toughest question to answer: "How many of these have you done??" Here, honesty is key. The lack of experience is nothing dishonourable. In the first few cases, a proctor is important and this is on top of a preceding fellowship in a high-volume established MICS centre.

It is wise to avoid flat-chested patients whose verticalized heart can be seen on a preoperative CT scan. Severe obese patients often have high-riding diaphragms, presenting a challenge even to the experienced MICS surgeon. Patients with poor ejection fraction, severe pulmonary hypertension and severely impaired right ventricular function are inherently high risk even for conventional median sternotomy. In such patients, MICS will not be the best option, especially at the start of the program. Combined pathology for novices are best approached through the most familiar access. Lastly, it is important to always bear in mind that MICS, being heart surgery first, should never prioritise access over outcomes (eg quality of MV repair or quality of a distal anastomosis in CABG).

ALTERNATIVE APPROACHES

In the emergence of a new technique, in this case a minimally invasive approach, it is evitable to face large amount of criticisms and cynics. This is not the first nor will it be the last. General surgeons were criticised during the birth of laparoscopic surgery some 30 years ago. Birth of VATS in thoracic surgery was faced with many naysayers who challenge this concept some 15 years ago that has now become gold standard. Skepticism always exists in this road to technological advancement. It takes immense courage, perseverance and dedication to see this through. In fact with the introduction of more advanced percutaneous valvular and coronary techniques in the cardiology field, we can

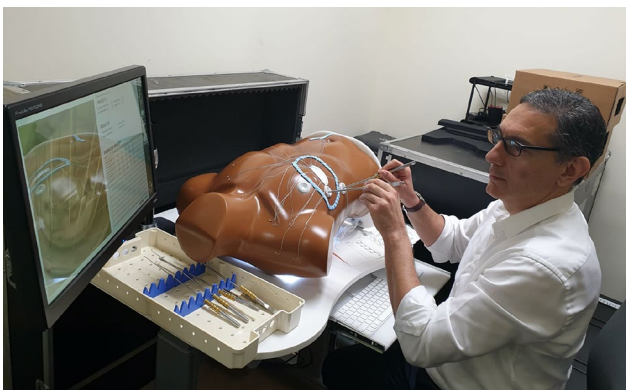


Figure 2. From *in-situ* towards in-silico: Simulation training will play an increasing role in establishing successful programs at the lowest possible cost in complications, and will help shorten learning curves. Here: self-training on the Maastricht Mitral Valve Digital Simulator.

expect a new age of hybrid procedures where MICS will soon be established as the staple of a cardiac surgeon's portfolio.

CAVEATS & CONTROVERSIES

One question that does not have a simple answer is when should one be ready to start MICS. Is the number of beating heart CABG or open mitral valve surgeries the number to determine the cutoff to transit into MICS? There is no definite answer as we are faced with a whole host of confounding variables. This list is non-exhaustive:

- Local geopolitical circumstances
- Culture of the existing department and program
- Surgeon's operative experience
- Surgeon's talent and learning ability
- Nature of practice-volume and construct (governmental versus private institution)

It is therefore important to understand the key components of a successful MICS program.

Conclusions

A good surgeon who can deal with complications effectively is usually one who eases into a transition to this less invasive platform. And many a times, he will usually do it more easily than he originally thought. The fear of the unknown can be overcome with a dedicated team that is self-aware and that is able to self-reflect. This paradigm shift into a minimally invasive cardiac surgery program provides a great opportunity for our already-challenging profession. It presents to us an edge for our healthcare system and synergizes to deliver excellent value-driven outcomes. It forges closer collaboration with our cardiologist colleagues, the gatekeepers. With this multidisciplinary team and customized surgical treatment for our patients, the MICS program will open new pathways for this specialty.