Minimally invasive surgery – Maximally interactive teamwork Evolution of heart procedures – Evolution of (TAVI) teams

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The result of technological evolution is always a more compact, costumer friendly, safer, aesthetic or more effective product. In surgery this evolution is reflected in the trend of minimally invasive techniques. The evolution towards minimally invasive heart surgery is basically described by the introduction of off-pump and minimal access surgery [1,2]. With this progress it is paramount to survey outcome, safety and long term durability. Changing the team constitution and interaction is answering this need.

Evolution in heart procedures lead to different team skills or responsibilities

By changing the operation from an arrested heart to an off-pump procedure, surgical manipulation of the beating heart to expose the operation field can instantaneously influence the haemodynamic condition of the patient. Intense communication and interaction between the cardiothoracic surgeon and the cardiothoracic anaesthesiologist becomes indispensable.

In the evolution towards minimal access surgery, the direct view on the heart is hindered. Team members have to rely on indirect visualization modalities to obtain an accurate surgical view and monitoring, to provide a safe procedure. Surgeons are trained to work with long shafted instruments, looking at a 2D restricted operation field on the screen. The surgical overview of the heart, providing a one eye shot-feedback of the haemodynamic monitoring is substituted by invasive monitoring and transoesophageal echocardiography (TOE). The advantage of the screen projection of the operation field is that all team members can share in the operation technique, which is stimulating for team interaction. Robot-assisted procedures, e.g. midCAB, introduced 3D visualization. Consequently to the evolution of minimal access surgery, teams are trained to switch the access of cardiopulmonary bypass (CPB) from central to peripheral cannulation.

Evolution in heart procedures lead to a new team constitution

With the introduction of hybrid procedures cardiac electrophysiologists and interventional cardiologists are joining the operating team during hybrid treatment of atrial fibrillation and hybrid revascularization procedures. The combination of the surgical (epicardial) and endovascular (endocardial) access provides complementary interventions to complete the treatment and to control the operative result by left atrial mapping or coronary angiography [3,4]. To provide high quality fluoroscopic imaging the team is moved from the operating room to the hybrid room, which offers operating room facilities (large space, laminar airflow and wall connections for CPB and anaesthesia), combined with cath lab equipment (high quality C-arm and data storage systems).

Minimally invasive off-pump treatment of heart valves is the next challenge in the evolution of heart procedures. These heart valve interventions (balloons, transcatheter valves and clips) are catheter-based, guided and monitored by fluoroscopy and high quality echocardiographic imaging (2D or 3D TOE or intra-cardiac echocardiography). The combination of the expertise of the cardiothoracic surgeon, the interventional cardiologist, the cardiothoracic anaesthesiologist and the imaging specialist (echocardiographist) are mandatory to provide the best environment for an effective and safe procedure. Since transcatheter aortic valve implantation is used to treat patients with aortic stenosis who are considered too high a risk for surgical aortic valve replacement, most of these patients have severe comorbidities, for which new specialists (e.g. pulmonologists and geriatricians) are joining the heart team. Radiologists become part of the team in the pre-operative assessment of the aortic annulus and the screening of vascular access by multislice computed tomography (MSCT), advising the surgical team in their choice of procedural access and transcatheter valve size [5]. Radiation specialists are involved to establish the radiation exposure of the team members in this new operative setting and to advise in radiation protection [6].

Evolution in heart procedures is challenging the evolution in imaging modalities

To reduce radiation dose, engineers are involved in developing new imaging modalities to provide a real-time three dimensional view of intracardiac structures in the beating heart. Transapical cardioscopy and real-time magnetic resonance imaging (MRI) are studied [7,8]. When imaging is based on a combination of different modalities (multimodal imaging), we are entering the world of virtual reality. By assessing real-time tissue deformation secondary to the procedure and physiologic motion, by monitoring the interventional tools in 3D and by providing real time update information about the pathophysiology of the targeted tissue, one can expect that the range of minimally invasive cardiac interventions is expanding [9].

By using MRI-based catheter tracking [10] and MRI-guided robotic technology [11] one can imagine that procedures can be carried out from a distance (telesurgery) [12]. Telesurgery will eliminate geographical constraints and make surgical expertise available throughout the world, improving patient treatment and surgical training. Specialists in Information and Communication Technology and counsels, specialized in medicolegal data transport will be involved.

Conclusion

The evolution of cardiac procedures is guided by the technological evolution, the further improvement of imaging and the development of image-based steerable guidewire navigation, combined with robotic technology. To guarantee the safety, durability and efficacy of new procedures the operating teams have to change. The communication, the responsibilities and skills of the team members are adopting to new operating settings; new specialties are joining the team when new imaging modalities and techniques are explored; and different teams all over the world will interact to improve treatment and training, when technology is providing tools for safe treatment from a distance.

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