"Is Interventional Cardiology taking over Cardiac Surgery Specialty?

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Cardiovascular surgery

is the surgery on the heart or great vessels performed by cardiac surgeons. Frequently, it is done to treat complications of ischemic heart disease (like, CABG), correct congenital heart disease, or treat valvular heart disease from various causes including endocarditis, rheumatic heart disease and atherosclerosis …etc. It also includes heart transplantation.
A cardiac surgeon is a physician who performs operative procedures on the heart and great vessels. Cardiac surgeons repair or replace heart valves, widen clogged arteries like repairing aortic aneurysms and perform heart bypass surgery (CABG), repair congenital heart lesions, putting patients on ECMO, Assist devices and heart transplants.

Interventional cardiologists perform minimally invasive procedures that relay on catheters and small incisions instead of traditional surgery. These procedures include balloon angioplasty to open blocked arteries, balloon valvuloplasty to widen a stiff or narrowed heart valve, implantation of coronary stents to hold open previously blocked coronary arteries and trans-catheter valve implantation (TAVI, TCPVI).
Surgery and other procedures involving the Heart (ICD-9, ICD-10)
(Book)

Valve repair · Valvotomy · Mitral valve repair · Valvuloplasty (aortic · mitral) Valve replacement · Aortic valve repair · Aortic valve replacement (Ross procedure · Percutaneous aortic valve replacement) Mitral valve replacement

**production of septal defect in heart:**
- enlargement of existing septal defect (Atrial septostomy · Balloon septostomy) · creation of septal defect in heart (Blalock–Hanlon) shunt from heart chamber to blood vessel: atrium to pulmonary artery (Fontan procedure) · left ventricle to aorta (Rastelli procedure)
  right ventricle to pulmonary artery (Sano shunt)

**compound procedures:** for transposition of great vessels (Jatene procedure · Mustard procedure) for univentricular defect (Norwood procedure · Kawashima procedure) shunt from blood vessel to blood vessel: systemic circulation to pulmonary artery shunt (Blalock–Taussig shunt). SVC to the right PA (Glenn procedure)

**Cardiac vessels**

CHD: Angioplasty · Bypass/Coronary artery bypass (MIDCAB · Off-pump CAB · TECAB) Coronary stent: Bare-metal stent · Drug-eluting stent Bentall procedure · Valve-sparing aortic root replacement Pericardium: Pericardiocentesis · Pericardial window · Pericardiectomy Myocardium: Cardiomyoplasty · Dor procedure · Septal myectomy · Ventricular reduction · Alcohol septal ablation Conduction system: Maze procedure (Cox maze and minimaze) · Catheter ablation (Cryoablation · Radiofrequency ablation) · Pacemaker insertion Left atrial appendage occlusion · Cardiotomy Heart transplantation
The mandate of the cardiac surgery is to practice the open interventions only when it is necessary.

Yet though, because of the known principle that the smaller the cut, the less the pain, possible infection and complications, the CS practice is evolving through innovative techniques.

Nowadays a full operation can be done with a very small slit, thanks to robotic, minimally invasive and laser techniques.

It is not an issue of debating which practice is taking over. It is the patient’s care that is in the verge.

Cardiac surgery practice is not diminishing but actually more operations are being done by newly developed techniques for patients who were inoperable before. Yet, the practice is getting handier (TAVI,TVPVI). and needs more skilled professionals.
Minimally invasive heart surgery without robotics has been used as an alternative to traditional surgery for the following procedures:

- Coronary artery bypass (Off-Pump CABG (OPCAB), McGinn Technique).
- Mitral valve repair/replacement
- Aortic valve replacement/trans apical aortic valve implant, limited access.
- Totally endoscopic pulmonary vein isolation for the treatment of atrial fibrillation
- Aortic aneurysmal disease repair by thoracic endografting
- Atrial septal defects
- Hybrid coronary revascularization
Minimally invasive heart surgery isn't an option for everyone, but it offers many advantages in those for whom it's appropriate.

**Advantages may include:**
- Less blood loss
- Lower risk of infection
- Reduced trauma and pain & Improvement of postoperative pulmonary function.
- Shorter time in the ICU & the hospital, faster recovery and quicker return to normal activities
- Smaller, less noticeable scars & Greatly improved cosmetic result
- Reduced post-operative discomfort & Improved quality of life
- No splitting of the breast bone, eliminating the possibility for deep sternal wound infection / sternal non-union
Heart nanotechnology
is the “Engineering of functional systems at the molecular scale”

- Minimally invasive heart
- Surgery Tissue-Engineered Heart Valve & gold nanowires are placed and woven into the damaged parts of the heart, essentially replacing the non-functioning or dead tissues. The nanoparticles would be carrying objects such as “stem cells, growth factors, drugs and other therapeutic compounds, then the nanoparticles would release the compounds and inject them into the damaged heart tissue, this would theoretically lead to the regeneration of the tissue, insert the cells into the inoperable parts of the heart and to get them working in unison with the tissues that were still working properly ("Popular Science").
- Stem-cell- based heart patch ("Popular Science").
- Tissue scaffolds with the nanowires

Nanoparticles with the nanowires, nanoburrs are targeted to a certain structure, known as the basement membrane; this membrane lines the arterial walls and is only present if the area is damaged.
Adult
Coronary artery bypass grafting (CABG)
Coronary artery bypass grafting + Ross procedure
Types of valves
gun shot wound
Heart Transplantation

Schematic of a transplanted heart with native lungs and the great vessels.
Resection of sub-aortic membrane
Sub-aortic membrane
ECMO in Adult

Extracorporeal Membrane Oxygenation
ECMO & Artificial heart in adolescence

Artificial heart

ECMO
Artificial heart
A left ventricular assist device (LVAD) pumping blood from the left ventricle to the aorta, connected to an externally worn control unit and battery pack.
Interventional Cardiology VS Cardiac Surgery
Interventional cardiologists are cardiologists who have done two extra years of fellowship enabling them to perform procedures ranging from an angioplasty to stenting coronaries, insertion of pacemakers and even nowadays with some extra training valve replacements.

Cardiothoracic surgeons on the other hand are called in to “crack” a person’s chest open and perform much more complex congenital heart repair procedures or CABG + valve replacement or heart tear repair, heart transplant and gun shot wound to the chest among many other procedures.
Impact of Advances in Invasive Cardiology on Cardiac Surgery

Ahmed A. Alsaddique

**Background:**
There is a noticeable decline in the number of patients who undergo coronary artery revascularization procedures. The change is definite as it is reported by many centers around the world. This trend is of great concern to cardiac surgeons because of its impact on their practice, its adverse effect on training and the degree of uncertainty it throws into future of the specialty.

The cardiac catheterization laboratory data at the King Fahad Cardiac Center for the period between August 1986 and December 2006 was examined.

The aim was to analyze the pattern of disposition of patients following cardiac catheter and any subsequent interventions.

The total number of coronary angiograms performed over this period of time is 14814.

In the early years, angioplasty was attempted in around 10% of patients leaving the rest for surgical consideration or medical therapy.
Currently **only 15% of patients** who undergo selective coronary angiography are **referred for surgery**. The majority are offered **angioplasty and stenting**. The trend is towards more **catheter-based interventions** and less towards surgery.

**Conclusions:**

Our findings are in agreement with the general consensus about the specialty. Cardiac surgeons should perhaps consider acquiring **new skills** which may be **outside the operating room**. Adding catheter based intervention particularly in valves to cardiac surgery training would be a bonus for the future surgeons that will give them the necessary edge to meet the new challenges (Hybrid O.R).

**It is incumbent on the leaders in the field to establish a clear strategy for the future.**
The problem is multifaceted and the approach should be with that understanding.

• One of the major problems is that cardiac surgeons practice as end of the line referral-based. Surgeons should have their input early on so that the patient becomes well informed and can make an intelligent choice.

• Even though cardiac surgeons are also general thoracic surgeons by training but they have given up all of thoracic surgery and some have even in the care of their patients in the ICU for the ICU doctors.

In the heydays of cardiac surgery during the 70`s cardiac surgeons gave away pacemakers. In the 80s & 90s, Automatic Implantable Cardiovert. Defibrillator (AICD) had the same fate.

• A more rational approach is called for before making such decisions, as it is not an easy task regaining lost territories.
Despite that 2-5 year 80% success rate of a stent with antiplatelet treatment, versus a more than 90%, 15-20 year patency rate of LIMA-LAD without any drugs in a low risk patient, most cardiologist, and patients would opt for the stent.

Surgeons should come up with a truly minimally invasive CABG for example.

Another approach is perhaps the hybrid myocardial revascularization.

It is based on the assumption that drug eluting stents (DES) are as good as vein grafts for type A or B coronary artery lesions; but not as good as LIMA to the LAD.

**Hybrid procedures** are an attractive option for high-risk patients like the obese and those with COPD

- The concept is now >10 years old.
- Implementation was slow, but the surgical part of the procedure can be performed in a totally endoscopic fashion now.
• Cardiac surgeons should be in the **forefront** of the **evolving percutaneous valve procedures**.

• Percutaneous valve procedures require the **expertise** of different specialists (cardiac surgeon, interventional cardiologist, non invasive cardiologist and anesthesiologist) **working as a team**.

• The evidence about the **superiority** of surgical treatment of coronary artery disease compared to **stenting angioplasty** should be effectively **used to spread** the message to the primary care physicians and even cardiologists.

• This was proven after **ten randomized trials** have compared **percutaneous coronary intervention** and coronary artery bypass **grafting**. Survival was rather similar with both interventions but surgery greatly **reduced** the need for further intervention.

• **Cardiology** itself is going through **changes** as the continued development of **non-catheter based coronary imaging** can **radically alter** the cardiologist-cardiac surgeon relationship and makes surgical involvement in the **patient care team essential**.
Hybrid O.R

First reported by Bhatti and colleagues in 1973 (intraoperative stenting of PDA).

Can we combine surgical and interventional approaches to treat valvular disease, heart failure, aortic aneurysms, pacemaker insertion/removal, ventricular assist device/cardiac transplant, minimally invasive cardiac surgery & interventional cardiology (hybrid cardiac surgery) e.g TAVR, mitral valve repair in mitral regurgitation, pericardectomy, paradoxical embolus and percutaneous coronary intervention prior to open thoraco-abdominal or descending thoracic aneurysm repair.
Cardiac surgery is facing major new challenges

• But with the rapid advances in technology, there is great potential for innovation.

• As less invasive surgery gains popularity, surgeons change their role from being end of the line referral-based specialists to active participant in the pre-operative decision-making, the field is poised for a renaissance and this could indeed prove to be an exciting time for heart surgery.
From hospital manager perspectives

The aim to give up cardiac surgery (they think) that:

- less hospital stay, Most procedures can be performed on an outpatient basis
- less invasive procedures.
- less scars & There is little or no incision
- Pain and recovery time are often significantly reduced.
- Reduced hospital acquired infection.
- More room for new patients.
- Much higher survival rate.
- Interventional cardiologists are paid a relatively lower salary than cardiac surgeons.
From the hospital manager’s perspective it is better to have more of Interventional Cardiologists than Cardiac Surgeons. Yet, the new techniques of CS are achieving the same outcomes and many of the open techniques remain indispensable.
Minimally invasive (AVI & PVI)
Minimally invasive (AVI & PVI)
Minimally invasive (PVI)
Trans-aortic valve implantation
Surgical Procedures can not be replaced by trans-catheter in the repair of most of CHD
## How common are critical congenital heart defects?

<table>
<thead>
<tr>
<th>CCHD</th>
<th>Lowest prevalence per 10,000 live births</th>
<th>Highest prevalence per 10,000 live births</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common truncus</td>
<td>0</td>
<td>3.7</td>
</tr>
<tr>
<td>Hypoplastic left heart syndrome (<a href="http://www.cdc.gov/ncbddd/heartdefects/hlhs.html">CDC</a>)</td>
<td>0.7</td>
<td>4.8</td>
</tr>
<tr>
<td>Pulmonary valve atresia and stenosis</td>
<td>0.3</td>
<td>24.6</td>
</tr>
<tr>
<td>Pulmonary valve atresia</td>
<td>0.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Tetralogy of Fallot (<a href="http://www.cdc.gov/ncbddd/heartdefects/tetralogyoffallot.html">CDC</a>)</td>
<td>0.9</td>
<td>6.2</td>
</tr>
<tr>
<td>Total anomalous pulmonary venous return</td>
<td>0.1</td>
<td>2.0</td>
</tr>
<tr>
<td>All transposition of the great arteries (<a href="http://www.cdc.gov/ncbddd/heartdefects/tga.html">CDC</a>)</td>
<td>1.2</td>
<td>6.6</td>
</tr>
<tr>
<td>dextro-transposition of the great arteries</td>
<td>0.5</td>
<td>4.1</td>
</tr>
<tr>
<td>Tricuspid valve atresia and stenosis</td>
<td>0</td>
<td>2.2</td>
</tr>
<tr>
<td>Tricuspid valve atresia</td>
<td>0.1</td>
<td>1.7</td>
</tr>
</tbody>
</table>
Aortic Coarctation & interrupted Aortic arch
Defects with deficient or absent PI rim continue to be challenging for most interventionists and require surgical closure.

Patient safety is a priority.

Specimens of surgically resected multiperforated atrial septal aneurysms (type D) which were judged as unsuitable for trans-catheter closure:

- One aneurysm has multiple smaller perforations (left),
- One has network-like strands (center),
- A third has one large and multiple smaller perforations.

- Defects with deficient or absent PI rim continue to be challenging for most interventionists and require surgical closure.
- Patient safety is a priority.
VSD

Ventricular Septal Defect

Defect

Supracristal

Infracristal

Canal

Muscular
The first operation for blue babies called Tetralogy of Fallot’s was done on November 29, 1944 at Johns Hopkins Hospital in Baltimore, Maryland. The first patient was a girl named Eileen Saxon.
Blalock-Taussig Shunt
Pulmonary atresia with VSD
Truncus Arteriosus

Normal Heart

Truncus Arteriosis

- Aorta
- Pulmonary artery
- Ventricular septal defect
- Right ventricle
- Left ventricle

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Anomalous origin of left coronary artery from pulmonary artery

origin of normal coronary arteries

Anomalous origin LCA
Total anomalous pulmonary venous drainage

Types

- Normal heart
- Supracardiac TAPVC
- Infracardiac TAPVC
- Intracardiac TAPVC
Transposition of Great Arteries
Different Techniques of TGA repair

D-aorta

TGA+CIV+EP
Hypoplastic left heart syndrome

"Telling a mother to terminate her child is the same as ripping her heart out."
Robotic Surgery or Robot-assisted heart surgery
Thoracoscopic surgery
Extracorporeal Membrane Oxygenation (ECMO) is a treatment used for patients with life-threatening heart and/or lung problems. It provides long-term breathing and heart support and is used only when all of the standard treatments for those problems have already been tried. ECMO can support patients for days to weeks while doctors treat their underlying illness.

- **Extracorporeal**: outside the body
- **Membrane**: a type of artificial lung
- **Oxygenation**: the process of getting oxygen into the blood
Baby on Artificial heart
First Cardiac Transplant 1986
Congenital Heart Diseases Surgical Outcome
We innovate in cardiac surgery methods to reach the same aim that the interventionists want to reach, like e.g.

- Small incision for more complex surgery,
- Less hospital stay,
- Less infection

This is why we do:

- Minimally invasive surgery
- Robotic surgery
- Magic knife usage
- TAVI
- TVPVI ………..etc.
“I take great pride in being a member of a team that can handle the most complex patient situation, regardless of the time, whether day or night, circumstances, effort or the nature of the problem.”

Dr. Leonard N. Girardi

The importance of a shared commitment to excellence, not only by cardiac surgeons, but also by Cardiologist, anesthesiologist, nurses, and critical care staff, which helps to ensure a cardiac patient’s positive outcome.

“Half the battle is in the operating room and half the battle is in the postoperative period, so

Cardiac surgery is very much a team effort,”
Cardiac Surgery (CS)

(Cardiac surgery is evolving and is irreplaceable)

• Its true that some CS operations are abandoned for being replaced by Interventional techniques, yet:
  • New minimally invasive techniques are increasing the volume of the already practiced operations.
  • There are operations that remain irreplaceable.
  • Interventional approaches will always need the backup of the Cardiac Surgery.
  • New Hybrid techniques are evolving to utilize the best of each approach.
Cardiac Surgery (CS)

(Cardiac surgery is evolving and is irreplaceable)

IS a Passion and a Fine Art like drawing or sculpture.

IS only for skillfully talented people, if you have the skill and love for art then this is what you need to do,

Definitely the practice will need less cardiac surgeons in the future but being scarce only make it more Sophisticated.

CS is abandoning all the procedures that does not need an artful touch, if you are not that artful then the Elite club of CS is not for you.
Ferrari business Model cars (fine piece of art)
CS like the Chinese fine art too much complicated to be done by machine.

It is scarce & irreplacable.
Wood carving sunflower (hand craft fine art)
The Surgeon feeding every body in the team including the cardiologist
And whoever saves a life, it would be as if he had saved the life of all mankind…. Holy Quran
Do all the good you can
By all the means you can
In all the ways you can
In all the places you can
At all times you can
To all the people you can
As long as you can
Thank you