Innovation in Cardiac Surgery

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Innovation in Cardiac Surgery

Background

• History
• Culture differences
• Motivation
• Israel
• My own examples:
  • Cardiogard, VGS, CoreAssist, Novogate
• South Africa
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Past, Present and Future
Roman general surgery $2^{nd}$ century

Figure 1.1. Roman surgical instruments from the 2nd century AD. (Courtesy of the Wellcome Institute Library, London.)
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Roentgen 1895

Figure 1.19. Roentgenogram of the hand of anatomist Rudolph von Kölliker made in the first and only public demonstration of X-rays by Roentgen in 1895. (Courtesy of Jeremy Norman & Co., Inc.)
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First Pacemaker (1951)

Figure 1.20. Lillehei, Cohen and Warden with pacing apparatus.
Culture differences and motivation

- Europe – the Netherlands
- USA
- Israel
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Israel

- Out of the box
- Always unhappy
- Cutting the corners
- Hate bureaucracy
- No strong tradition
- Mixing of cultures

Good for Start-Ups, bad for big organization
Israel and Innovations in Life Science

- No. 1 in patent / capital
- 750 life science companies
- 7.1 million people = Silicon Valley
- 20 x less investment money
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Israel and Innovations in Life Science

Medical patents/capita

BioPharma patents/capita

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<tr>
<th>Country</th>
<th>Medical patents/capita</th>
<th>BioPharma patents/capita</th>
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<td>South Korea</td>
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Israel and Innovations

**ISRAEL’S MISSILE DEFENCE**

How Iron Dome system works

- **Interceptor:** Missiles’ radar seeker guides it towards target
- **Range:** Up to 70km
- **Short-range rockets:** 35mm artillery shells

As Israeli missile is launched from the Iron Dome missile system in response to a rocket launched from the nearby Palestinian Gaza Strip close to the southern Israeli city of Ashkelon.

**Waze**

Outsmarting traffic, together
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Israel and Innovations in Life Science

Pharma Industry
Copaxon, Azilect
Stents
InStent, Nir, Many more
BioSense J&J
EP Mapping
Given Imaging
GI diagnosis
PVT Edwards Saipan
TAVI
My own examples:

- Cardiogard,
- VEST,
- Novogate,
- CoreAssist
- South Africa
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My own examples - Cardiogard
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My own examples – Cardiogard – Status:

- In vitro
- In vivo
- Successful European clinical trial
- Failure in the American trial
- 5 publications
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My own examples - VEST

Venous External STENT
Vein Graft Failure is a **Key Limitation** to the Long Term Clinical Outcome of CABG:

>20% Failure at 1 year  
>40% Failure at 5 years  
>60% Failure at 10 years
VEIN GRAFT FAILURE - PER VEIN GRAFT
There are two distinct phases of remodeling:

1. **SHEAR INDUCED REMODELING**
   An early pattern dominated by luminal enlargement

2. **WALL TENSION INDUCED REMODEL**
   A later phase dominated by wall thickening (intimal hyperplasia) and stiffening

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[Christopher D Owens et al.: Lower Extremity Vein Graft Failure; a Translational Approach; *Vascular Medicine* 2008;13:63-64.]
DEVELOPMENT OF VEIN GRAFT DISEASE

VEIN GRAFTS AT IMPLANTATION

VEIN GRAFTS 1-5 YEARS AFTER IMPLANTATION
VEST - VENOUS EXTERNAL STENT

A KINK RESISTANT, COBALT CHROME EXTERNAL STENT FOR VEIN GRAFTS
**VEST - EU CLINICAL PROGRAM (2012-2016)**

<table>
<thead>
<tr>
<th>1st-in-human</th>
<th>Post Marketing</th>
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<tr>
<td>VEST I (2012-13)</td>
<td>VEST IV (2011-2016)</td>
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<tr>
<td><strong>RCT</strong></td>
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<td>30 patients</td>
<td>21 patients</td>
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<tr>
<td>3 sites</td>
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<td>(UK)</td>
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<tr>
<td>12 months FU</td>
<td>5 year FU</td>
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<tr>
<td>Angiography + IVUS</td>
<td>Angiography + IVUS</td>
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<tr>
<td><strong>Prospective, single arm</strong></td>
<td><strong>RCT</strong></td>
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<tr>
<td>30 patients</td>
<td>184 patients</td>
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<tr>
<td>1 site</td>
<td>15 sites</td>
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<tr>
<td>(UK)</td>
<td>(UK, GER, AU, ISR)</td>
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<tr>
<td>3-6 months FU</td>
<td>24 months FU</td>
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<tr>
<td>CT angiography</td>
<td>Angiography + IVUS</td>
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**5 years follow up** in 15 leading heart centers in Europe
Conclusion:
External stenting resulted in a more **homogeneous** (0.006) and **circular** (0.019) lumen with no thrombus formation.
IMPROVED LUMEN UNIFORMITY

A-D – UNSUPPORTED SVG 1 YEAR AFTER CABG

E-H – VEST SUPPORTED SVG 1 YEAR AFTER CABG

IMPROVED HEMODYNAMICS
Prospective, single center, single arm, 30 patients, VEST to RCA/PDA with CT at 3-6M

86% patency of externally stented SVG to the right coronary territory

A-C. Normal CT-Angio of 3 different patent VEST-supported SVG to the RCA.
D. Normal CT angiogram of unsupported vein graft to the left territory.
Patients scheduled for 3-vessel CABG
14 centers (Germany, UK, Austria, Israel) (N=226)

All pts received LIMA-LAD and vein graft to the LCX AND RCA territory

VEST III RESULTS ARE EXPECTED AT 2019

Within patient Randomization during surgery
After 12 month: 78 pts in each arm (N=156)

SVG VS PTCA RCT in patients
and static/flow driven disease

6 weeks follow up

6 months CT angiography

2 years interventional angiography + IVUS
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My own examples - CoreAssist

Relaxing the Diastolic Heart
Innovative solution for Diastolic Heart Failure

CoreAssist

Systolic Heart Failure
- Less blood pumped out of ventricles
- Weakened heart muscle can’t squeeze as well

Diastolic Heart Failure
- Less blood fills the ventricles
- Stiff heart muscle can’t relax normally
Diastolic Heart Failure preserved Ejection Fraction (HFpEF)

CoreAssist

• 50% of HF patients - *increasing trend*
• 5-year mortality rate 40% - 60% (Almost as HFrEF)
• Costly morbidity (6-month hospitalization rate of 50%)
• Debilitating symptoms
• No good medical or surgical treatment

(Braunwald’s heart disease a textbook of cardiovascular medicine – 10th Edition)
The CORolla® TAA Device

- Trans Apical Approach
- Adjusted to LV shape
- Outward expansion force
- Improved diastolic dynamic and filling performance
- Energy transfer from Systole to Diastole

The CORolla® Stores potential energy during contraction and releases it during diastole

Pressure↓ Relaxation↑
The CORolla® TAA Device
First in Man - Rambam, Israel

Male, 72 y.o. s/p AVR, Severe Diastolic Heart Failure
First in Man - Rambam, Israel

Male, 72 y.o. S/p AVR, Severe Diastolic Heart Failure
Male, 72 y.o. S/p AVR, Severe Diastolic Heart Failure
Male, 72 y.o. S/p AVR, Severe Diastolic Heart Failure
Implantation procedure:
- One device used
- About 1-hour duration

6 min walk test:
- Baseline: 480m
- Discharge: 660m

Safety and AE:
- Arrhythmias (short VT events) following implantation that subsided over time
- Hospitalization due to congestion (m/p due to changes in diuretic doses)
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My own examples - Novogate,

• Trans Apical Closure Device
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My own examples - Novogate,
My own examples - Novogate,
My own examples – Novogate

- In Vitro
- In Vivo
- Chronic animal trial
- First in man within 6 months
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My own examples - South Africa:

SAT Cape town + Novoggate Israel
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SAT Cape town + Novogate Israel
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My own examples - South Africa:

SAT Cape town + Novogate Israel
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Cross Countries

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THE 65TH ANNUAL CONFERENCE OF THE ISRAEL HEART SOCIETY
IN ASSOCIATION WITH THE ISRAEL SOCIETY OF CARDIOTHORACIC SURGERY
Under The Auspices Of The Israel Cardiology Association

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December 31, 2017

The Joint International Session
South Africa- Israel

April 24-25, 2018

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