Will Newer Technology And Platforms Lead To More Widespread Use Of Vascular Robotics: What Is On The Horizon And Beyond

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- IP on aortic branch grafts, Cook Medical
- None related to robot companies

Definition Robot

- A robot is a programmable machine capable of carrying out a complex series of actions automatically with the use of AI and machine learning

Vascular Robotics

- 2 platforms
  - Laparoscopic
  - Endovascular

Laparoscopic platforms

AMSTERDAM HANDS ON OPEN VASCULAR SURGERY COURSE 2020
Laparoscopic Robots

• Better optical working axis
• "wrist": 6-9 degrees of freedom
• Inversion and scaling eliminated
• Better ergonomics
• Tremor filtered

Laparoscopic robotic platforms

Intuitive
CMR
Transenteric
Verb
Surgibot
Titan Medical
Medtronic
Activ medical
Activ medical

Intuitive Surgical, Da Vinci platform

31 patients, AIOD
• ABF or
• endarterectomy
Results

- Conversion to minilaparotomy in 3 pts
- Mortality 1 patient, severe bleeding
- Minor complications 9%

Kaplan Meyer patencies

- 89% ± 0.5%
- 91% ± 0.5%

Intuitive Surgical Da Vinci platform

- Market leader (monopolist) for almost 2 decades
- Thousands of units sold worldwide
- >7000 peer-reviewed journal article
- Published experiences in vascular surgery just a handful, most recent in 2015 by Petr Stadler in Prague describing 350 cases, both occlusive and AAA. Clamp times 37 and 94 minutes respectively. Blood loss 320 ml and 1210 ml, respectively

Risk of bleeding and lack of tactile feedback

Calcified aorta
It’s feasible  
Is it safe?  
Do we need it?

- 1,415 injuries  
- 8,650 device failures  
- 2.3 million procedures

BadRobotSurgery.com

Intuitive Surgical  
Da Vinci platform

Amsterdam robotic program was suspended years ago mainly due to:  
- safety concerns (bleeding)  
- lack of suitable cases: almost all occlusive aortic disease is treated endovascularly.

Intuitive Surgical  
Da Vinci platform

Laparoscopic robotic platforms

Intuitive  
CMR  
Transenterix
Medtronic  
Activ medical
Surgibot  
Single-Port Robotic Surgery
Activ medical
Titan Medical  
True robots
Verb

CMR, Versius robotic system

- Separate robotic arms  
- Easy to move around  
- Open console: surgeon part of the team  
- Cost?  
- First robot sold in India last month
- Single port system
- Denied FDA approval in 2016
- Company then bought the Italian ALF-X system and put Surgibot in the freezer

Transenterix, Surgibot system

- Separate robotic arm units
- Multi-port
- Haptic feedback
- Eye-tracking software

Transenterix, Senhance (formerly ALF-X)

- 15 units sold in 2018, first year on the market
- Since then 1 unit in Germany and 1 in Taiwan
- Recently reimbursement in Japan

Transenterix, Senhance
Titan Medical
- Single port technology
- Presented in January 2018
- Production halted, financial reasons
- Planning to make a 510(k)

Medtronic, the Hugo RAS
- Separate patient units
- Open console
- Cost-effective
- Applying for CE and IDE in 2021

WHAT’S BEYOND THE HORIZON?
- Computer vision, artificial intelligence, analytics and machine learning to enhance a surgeon’s intra-operative decision making.
- **ActivSight** (the company’s first planned commercial launch in fall 2020) activates any installed base of surgical visualization and robotics system to provide real-time intraoperative visual data and images not currently available to surgeons through existing technologies.

Verb
Johnson & Johnson and Google
- 20 million operations per year worldwide
- <5% with the help of robotics
- Goal: innovation without worrying about funding
- Digital surgery
- Big data of thousands of operations are shared and integrated in current operations
- Automated suturing in vitro
- Planning on putting a device on the market within several years

Nanobots
Conclusions

• None of the current laparoscopic robotic systems on the market are in fact robots
• The term robot is a smart marketing tool used by the industry, hospitals and surgeons alike
• The benefit of robotic aortic surgery compared to open surgery is marginal, especially for AAA
• Considerable risks of bleeding and organ damage due to lack of tactile feed back and exposure

Conclusions

• With the rise of endovascular surgery there is little use for the current laparoscopic robotic platforms
• Platforms that deliver AI, machine learning, and tactile feed back at acceptable costs are years away