The Future Surgeon, the Future Surgeries, and How it has Evolved

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Thank You
Objective

• Discuss the history of surgery and how we got here and what the future holds
18th Century

First successful laparotomy performed longitudinally

Ephraim McDowell 1771 - 1830
19th Century

First transverse laparotomy

Johannes Pfannenstiel 1862-1909
ABDOMINAL WOUND DEHISCENCE AFTER C-SECTION (vertical vs. Pfannenstiel)

<table>
<thead>
<tr>
<th></th>
<th>Vertical</th>
<th>Transverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>1635</td>
<td>540</td>
</tr>
<tr>
<td>Dehiscence</td>
<td>48</td>
<td>2</td>
</tr>
<tr>
<td>Rate</td>
<td>2.94 %</td>
<td>0.37 %</td>
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Bozzini’s Lichleiter

William P. Didush Center for Urologic History
20th Century

Laparoscopy

Dr. Hans Christian Jacobeus 1910
Dr. George Kelling 1910
Dr. Raoul Palmer 1940
Dr. Kurt Semm 1960
With camera attached, the surgeon's head and body are 4" to 6" farther away from his instruments: surgical reach is awkward.
The role of TV and video devices: referred to as “teaching attachments”

Dr. Perci peering through a teaching attachment in 1977.
Looking to the Future

Beginning of Videosurgery

Dr Camran Nezhat, in the early 1980’s
Another 100 years!?  

Limitations

Skill and experience of the surgeon

Availability of proper instrumentation
Two major limitations

2-D vision

Suturing
Ajit Shah, PhD co-inventor of the da Vinci robot at Stanford Research Institute and Camran Nezhat, MD
Bulky Size and Limited Access
The Atanasoff–Berry Computer (ABC) was the first electronic digital computing device. Conceived in 1937, the machine was capable of solving up to 29 simultaneous linear equations and was successfully tested, though its input/output mechanism was still unreliable in 1942 when its inventors left Iowa State College for World War II assignments. John Vincent Atanasoff's and Clifford Berry's computer work was not widely known until rediscovered in the 1960s, amidst conflicting claims about the first instance of an electronic computer. The ENIAC computer is usually considered to be the first computer in the modern sense, but in 1973 a U.S. District Court invalidated the ENIAC patent and concluded that the ABC was the first "computer"
Newest Technology
Telesurgery

The Future of Surgery
Future Surgeries

- Customizable
- Replicable

With computer enhanced technology and robots this goal is achievable.
In medicine, when we order a medication like 500 mg of amoxicillin, everybody around the world receives the same thing.
Surgery is different.

It depends on

• The surgeon
• Surgical team
• Instruments
• And many other factors.
Options Present Today

1. Open Surgery
2. Minimally Invasive with and without robot assistance
3. Natural orifice surgery
4. Image guided surgery
5. Medical and Chemotherapy
Medical and Chemotherapy

- PPIs for gastric ulcer
- Methotrexate for ectopic pregnancy
- Chemotherapy for ovarian and testicular cancer
- Etc.
Image-guided Surgery

Hybrid Operating Room
Magnetic Resonance Guided Focused Ultrasound Surgery (MRgFUS)
Self-Propelling Gastrointestinal Endoscope Core functions

- Core capsule systems
- Diagnostic system
- Therapeutic Biopsy System
- Locomotion System
Hanson Robotics
Micro-robots

DARPA

Open Manufacturing Program

Magnetically actuated micro-robots for advanced manufacturing applications

SRI International
Hyperspectral Analysis and Motion Control Automatic Milking Machine

- Hyper spectral identifies udder and teats
- Near-infrared for geometry
- ToF for distance, position
- Closed loop control for cup guidance
- Robotic Arms for placement

Hogan H. Improving the picture of Food Production. Photonics Spectra Nov 2010:28-30
Humanoid Robot for Rescue Operations

- Rescue Bot – DARPA Robotics Challenge
  - Robotics competition in which teams construct robots who are to complete a series of tasks related to man made or natural disasters

- Tasks include
  - Walking through debris
  - Cutting through a wall
  - Driving an emergency vehicle

- THOR, humanoid robot by a Virginia Tech-led team
Video of THOR
Intelligent Prosthetics

Rheo Bionic knee Ossur, Reykjavik, Iceland

C-leg, Otto Block, Minneapolis, MN
Tissue Engineering

Artificial Ear

J. Vacanti, MD MGH March, 2000
Artificial Blood Vessel

J. Vacanti, MD MGH March, 2000
Tissue-engineered Urinary Bladder

Credit: Anthony Atala, MD  Wake Forest Institute of Regenerative Medicine, 2013
Cell Surgery
Preimplantation Genetic Diagnosis

- Genetically “designed” child

**Five "designer babies" created for stem cells**

17:36 05 May 2004 by Shaoni Bhattacharya

Five healthy babies have been born to provide stem cells for siblings with serious non-heritable conditions. This is the first time "saviour siblings" have been created to treat children whose condition is not genetic, says the medical team.

The five babies were born after a technique called preimplantation genetic diagnosis (PGD) was used to test embryos for a tissue type match to the ailing siblings, reports the team, led by Anver Kuliev at the Reproductive Genetics Institute in Chicago, US.

The aim in these cases was to provide stem cells for transplantation to children who are suffering from leukaemia and a rare condition called Diamond-Blackfan anaemia (DBA).
Preimplantation Genetic Screening

- Genetic screening technology
- RB1 gene
- Eye cancer
Human Cloning

South Korean team demonstrates cloning efficiency for humans similar to pigs, cattle

“One group in the Central South University in Changsa is said to be producing human embryo clones...”
Previvo Genetics Uterine Lavage System

PGS & PGD without *in-vitro* Fertilization

- **Indications:**
  - Multiple Miscarriage
  - Advanced Maternal Age
  - Unexplained Infertility
  - High Risk Genetic Profile
  - Fertility Preservation
Moral and Ethical Issues
Technology will change the future

- The rate of new discovery is accelerating exponentially
- The changes will raise profound fundamental issues
Options for the Future Surgeries

1. Open Surgery
2. Minimally Invasive with and without robot assistance
3. Natural orifice surgery
4. Image guided surgery
5. Intelligent robots performing surgery
Super specialists on specific procedures who perform large volumes of procedures aided by thinking robots who are enabling human surgeons to mass lead and direct the surgeries as a general does for an army of soldiers.

Thinking robots are going to be so precise that the possibility of error is almost none!
Hanging Up the Knife

A novel surgical technique promises to save patients time, money and blood

One Tool, Many Uses

- Appendicitis
- Bowel tumors and adhesions
- Gallstones
- Gynecological problems: fibroid tumors, endometriosis, ectopic pregnancies
- Lung lesions

‘In 20 years, major abdominal surgery will be nearly extinct’: Nezhat

...table, but no one is wielding a knife. In place of the usual seven-inch incision, Dr. Camran Nezhat makes a small puncture in her navel and inserts a baton-size scope equipped with a tiny video camera and a laser. Then, after easing irrigation and grasping instruments through even smaller openings just above her pubic bone, he turns on the camera and sets about his work. Eyes fixed on one of four TV screens, he moves deftly through her abdominal cavity, searing through the webs of scar tissue that have once again mummified several organs and attached her bowel to her abdominal wall. Within about 90 minutes, Martha B. is out of the operating room, having lost teaspoons instead of cups of blood. She'll leave the hospital within hours instead of days, and return to work in one week instead of three. If she's lucky, she may even end up pregnant.

First report: The surgeon who...
Another 100 years!?
6th annual seminar on
Minimally Invasive Gynecologic Surgery
with hands-on workshop on laparoscopic suturing and knot-tying

December 11-12, 2014
The Roosevelt Hotel,
New York City, NY