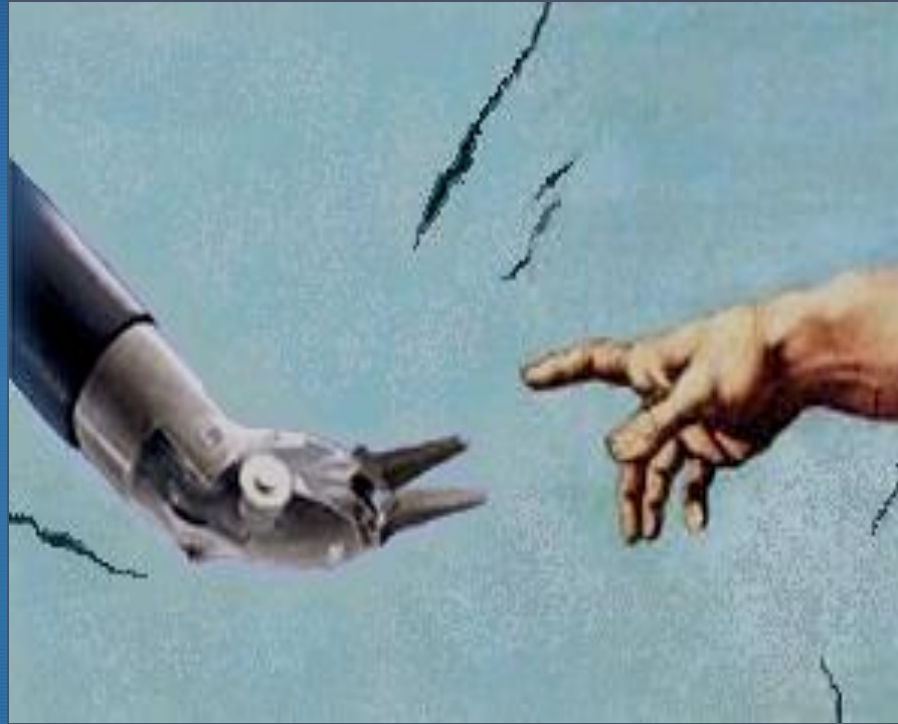


# Robotics in Surgery



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# Definition of a Robot

- ◆ Machine that resembles a **human** and does mechanical, routine tasks on command
- ◆ Any mechanical device that operates automatically with **human-like** skill
- ◆ “A robot is **not** a machine....it is an information system with arms”

# Robots: Better Than Humans?



# Types of Robots

- ◆ Passive

- ◆ Retractor system
- ◆ Position the tool and then hold

- ◆ Active

- ◆ Robot would actively move the tool upon the surgeons command

# Surgical Robots

- ◆ AESOP (Automated Endoscopic System for Optimal Positioning)
  - Voice activated mechanical arm
  - Steadier than human, never tires
- ◆ daVinci
  - FDA approval in late 2001
  - Laparoscopic instrumentation controlled by the surgeon positioned remotely at a console

# Development of daVinci

- ◆ Defense Advanced Research Projects Agency (DARPA) for military research of remote battlefield surgery
- ◆ Cholecystectomy performed remotely via telesurgery from 300 miles away
- ◆ Intuitive Surgical created in 1999 after acquiring patent rights from military
- ◆ First robotic prostatectomy performed in 2001

# “Operation Lindberg”: Remote Transatlantic Telesurgery



# Operation Lindberg

- ◆ Sept. 7, 2001
- ◆ French surgeons in New York operated on a patient in Strasbourg, France
- ◆ Cholecystectomy
- ◆ Performed by Zeus surgical system
- ◆ Bought by Intuitive surgical and no longer sold

# Advantages of Laparoscopic Surgery

- ◆ Shorter hospital stay
- ◆ Less pain
- ◆ Less risk of infection
- ◆ Less blood loss and transfusions
- ◆ Less scarring
- ◆ Faster recovery
- ◆ Quicker return to normal activities

# Challenges of Laparoscopic Prostatectomy

- ◆ Prostate located in fixed confines of pelvis
- ◆ Laparoscopic instruments limited in articulated movements
- ◆ Approximation of bladder-urethral anastomosis difficult to suture
- ◆ French experience: >300 cases reported, learning curve >100
- ◆ Early Oklahoma experience: 1 case, 19 hours, patient died

# Advantages of daVinci Robot

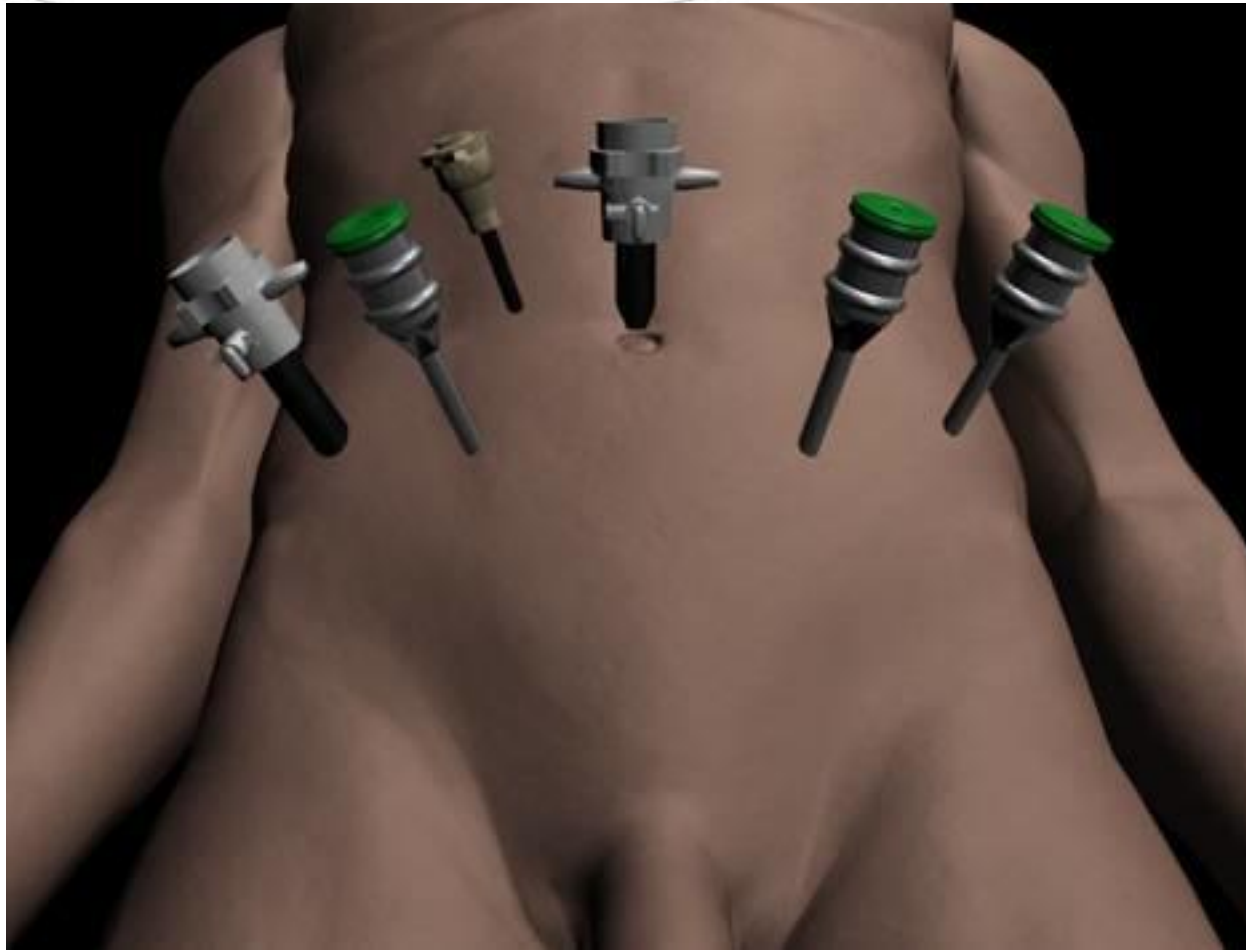
- ◆ Magnified (12x), stereoscopic 3-D vision
- ◆ Robotic wrist with **6** degrees of freedom
- ◆ Movements are scaled, filtered, translated



# Prostatectomy using the daVinci Robotic System

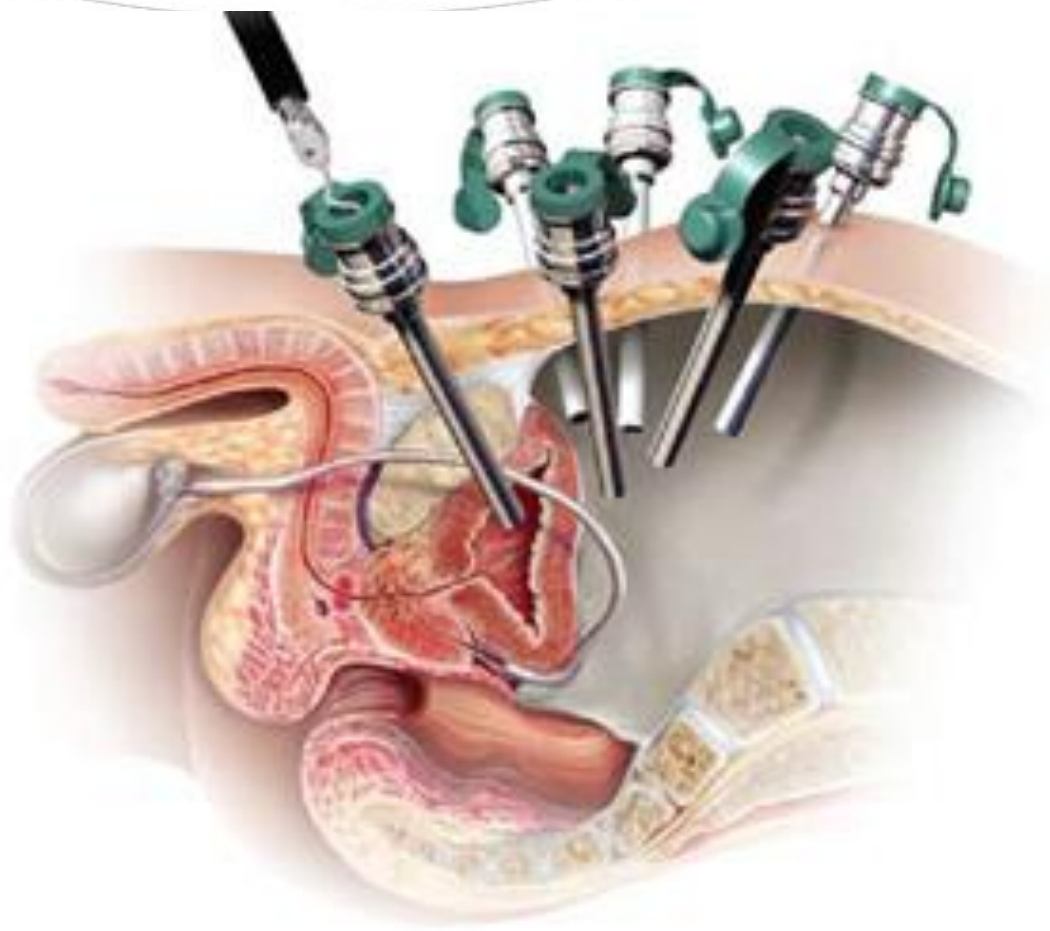


# Port Placement



# daVinci Surgical System





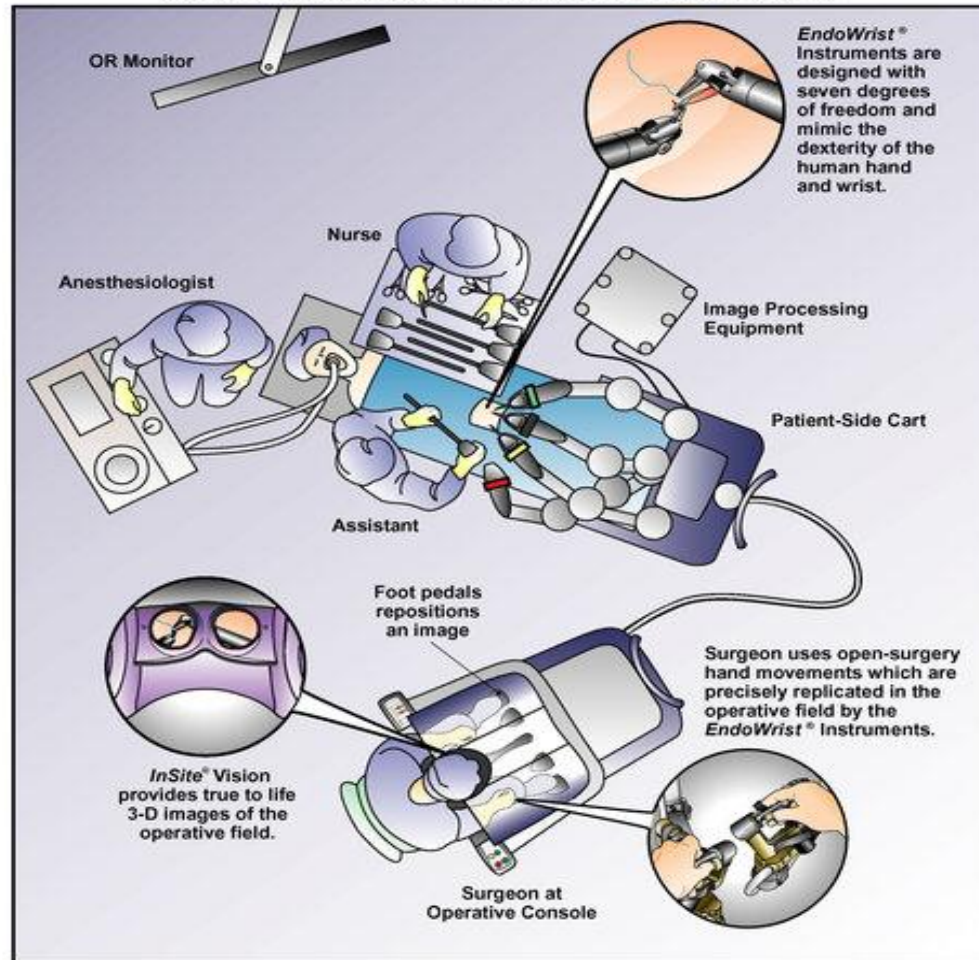
# da Vinci Surgical System





# Robotic Prostatectomy Setup

da Vinci® Surgical System in a Urology Procedure Setting



# OR Setup



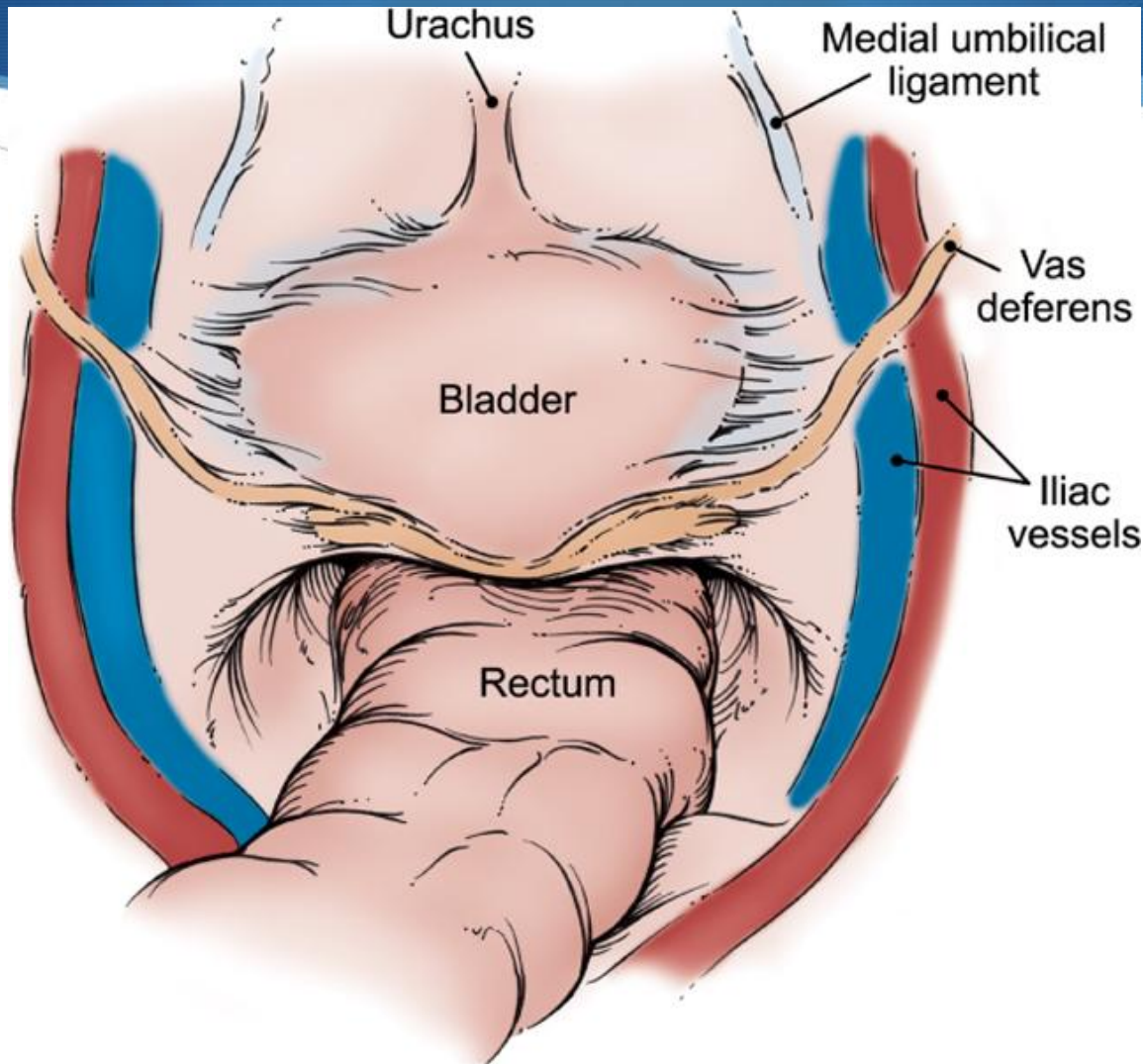
# Console



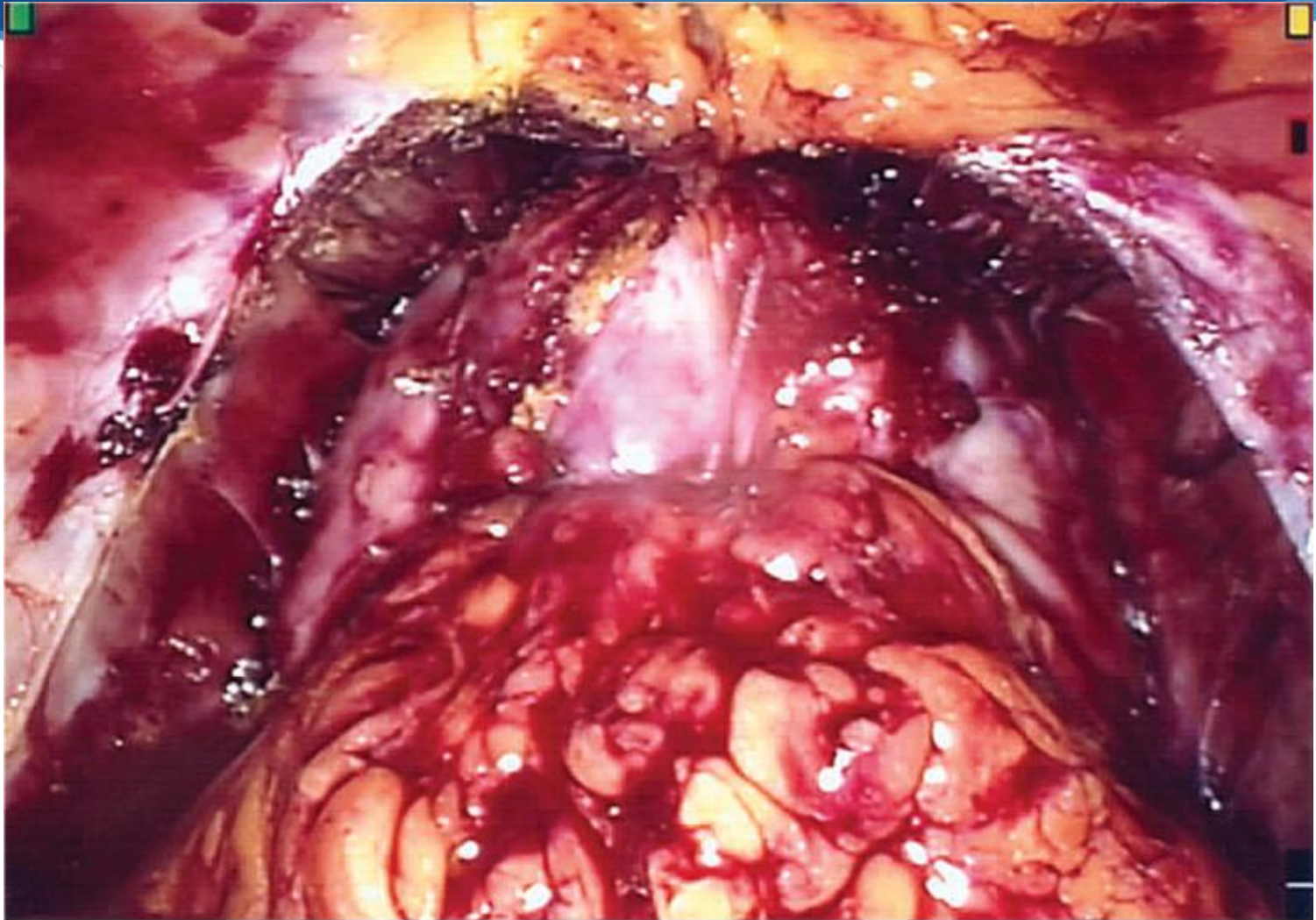
# Console



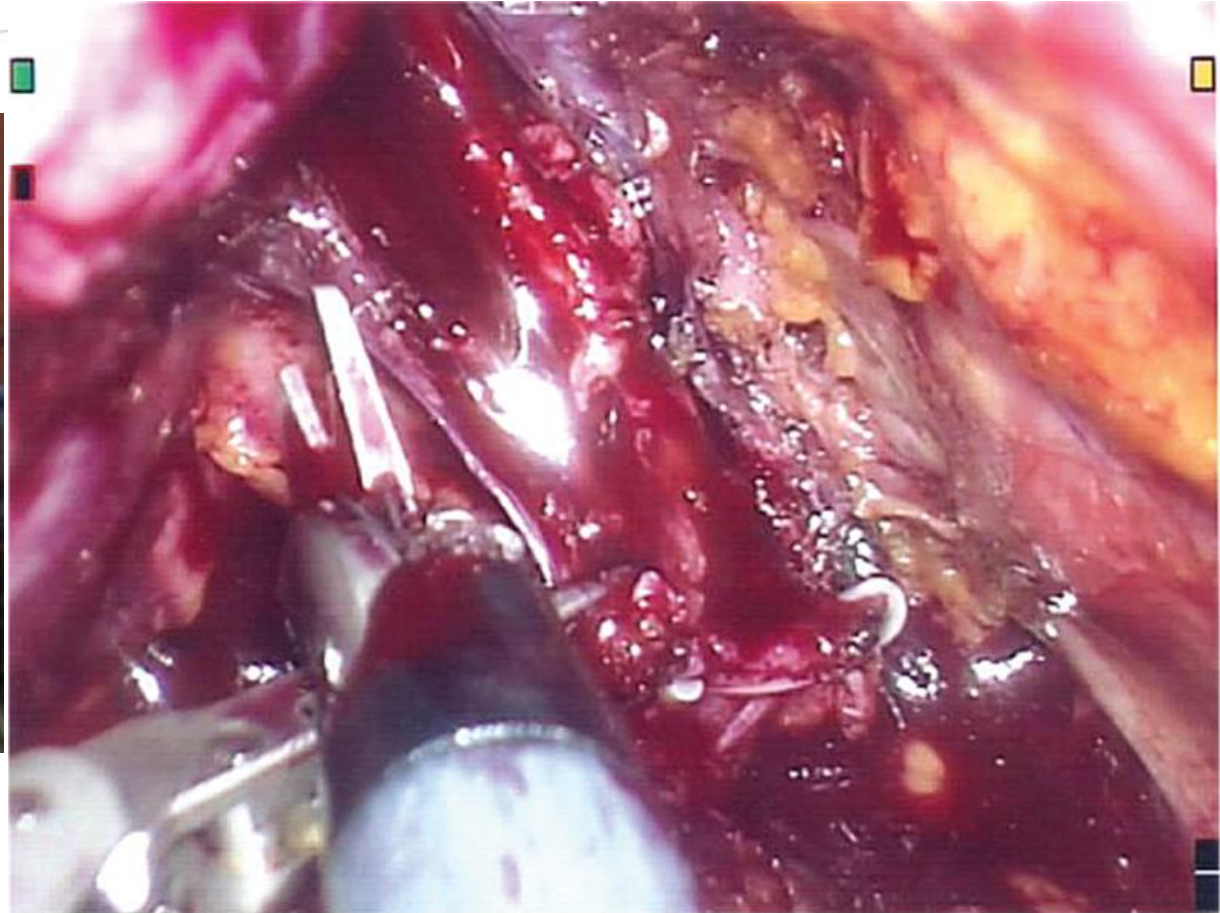
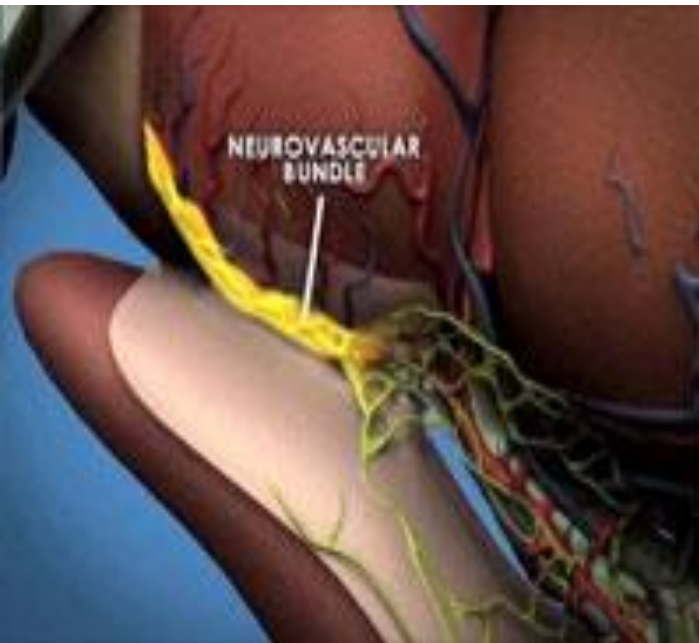
# Pelvic Anatomy



# Prostatectomy



# Neurovascular Bundle



daVinci Video

# Disadvantages of daVinci Robot

- ◆ Expensive
  - \$1.2 - 1.4 million cost for machine
  - \$120,000 annual maintenance contract
  - Disposable instruments \$2000+/case
  - Hospital reimbursement same DRG
- ◆ Steep surgical learning curve
- ◆ Increased staff training/competance
- ◆ Increased OR set-up/turnover time

# Robotic Disbelievers

- ◆ “ Long term data emerging”
  - Margin positive rates equivalent
  - No difference in risk for incontinence and erectile dysfunction
- ◆ “Loss of tactile feedback”
  - Improved vision
  - Haptic feedback: visual resistance
- ◆ ENABLER: same operation, new tool

# daVinci Robotic Prostatectomy

	<u>Open</u>	<u>Robotic</u>
OR time	3 hrs	2-4 hrs
Hospital stay	2- 3 days	24 hrs
Foley catheter	14 days	7-10 days
Blood loss	600 ml	<100ml
Recovery	4-6 wks	2-3 wks

# Margin Positivity

<u>Series</u>		<u>% Positive margins</u>
Soloway	(Open)	28 %
Lepor	(Open)	26 %
Abbou	(Laparoscopic)	20%
Rassweiler	(Laparoscopic)	24 %
Turk	(Laparoscopic)	26 %
Menon	(Robotic)	26%, 17%, 6%
Ahlering	(Robotic)	17%

# Continence Data

Surgeon		3 mo	6 mo	12 mo
Walsh(Open)		54 %	80%	93%
Abbou	(Laparoscopic)	58%	69%	78%
Guillonneau	(Laparoscopic)	N/A	N/A	85%
Menon	(Robotic)	N/A	96%	N/A
Ahlering	(Robotic)	76%	91%	94%
Lee	(Robotic)	60%	82%	N/A

# Potency Data

<u>Author</u>		<u>Capable of Intercourse</u>
Walsh (age 60 to 67)	(Open)	75%
Catalona (60's/70's)	(Open)	60% / 47%
Abbou	(Laparoscopic)	54%
Turk	(Laparoscopic)	59%
Menon	(Robotic)	64%
Ahlering	(Robotic)	65%

# daVinci Clinical Applications

- ◆ Urology: **radical prostatectomy**, dismembered pyeloplasty, radical cystectomy, cyst decortication, ureteral reimplantation, nephrectomy (partial and total), pyelolithotomy
- ◆ Cardiac: mitral and aortic valve replacement, aorto-iliac bypass, off-pump synchronized bypass
- ◆ GYN: hysterectomy, prolapse repair, tubal reversals, fistula repair, myomectomy
- ◆ General: gastric bypass, Nissen

# daVinci Clinical Limitations

- ◆ No advantage over standard laparoscopic approach for cholecystectomy, splenectomy, colectomy
- ◆ Increased operative time observed
- ◆ Precise dissection not necessary
- ◆ Open space: limitations with broad sweeping motions

# daVinci vs. Laparoscopy

- ◆ Laparoscopic surgical fellow at Stanford
- ◆ First 50 Roux-en-Y procedures randomized laparoscopic or robotic with DaVinci
- ◆ Both surgery with hand-sewn anastomosis
- ◆ OR time: 149 min (lap) vs 131 min (robot)
- ◆ No difference for complications, LOS, EBL
- ◆ Conclusion: Robot is an ENABLER

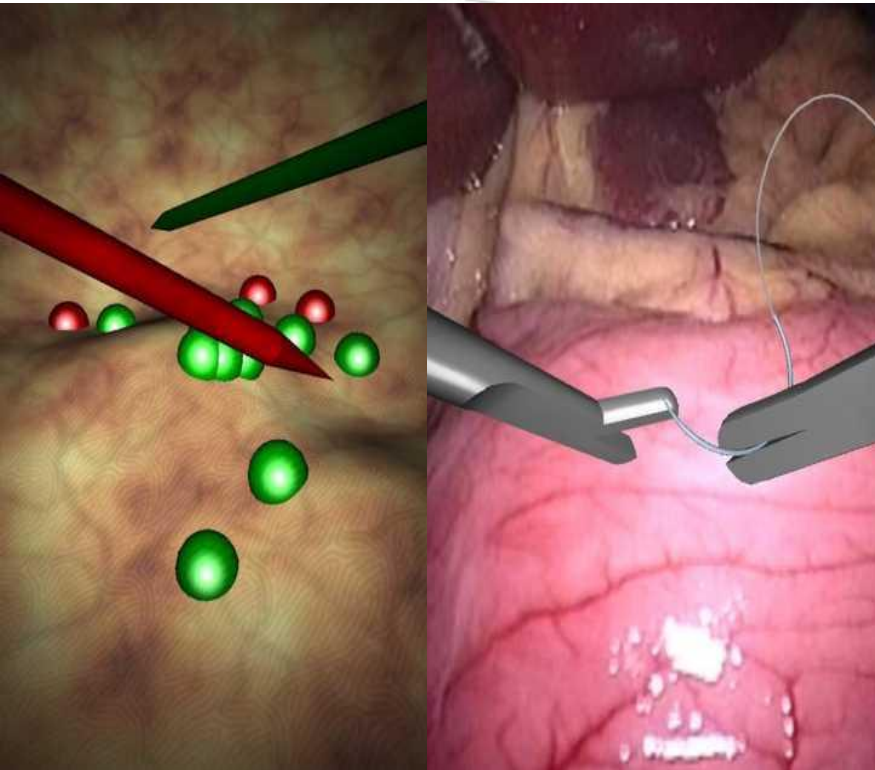
# Off-pump CABG

- ◆ 30 patients, 2.6 grafts/patient
- ◆ Majority: IMA to LAD
- ◆ 15/30 discharged <24 hours
- ◆ Complications:
  - 2 return to OR for bleeding
  - 1 converted to open
  - 2 readmits: pleural effusion, wound infection
- ◆ No mortality

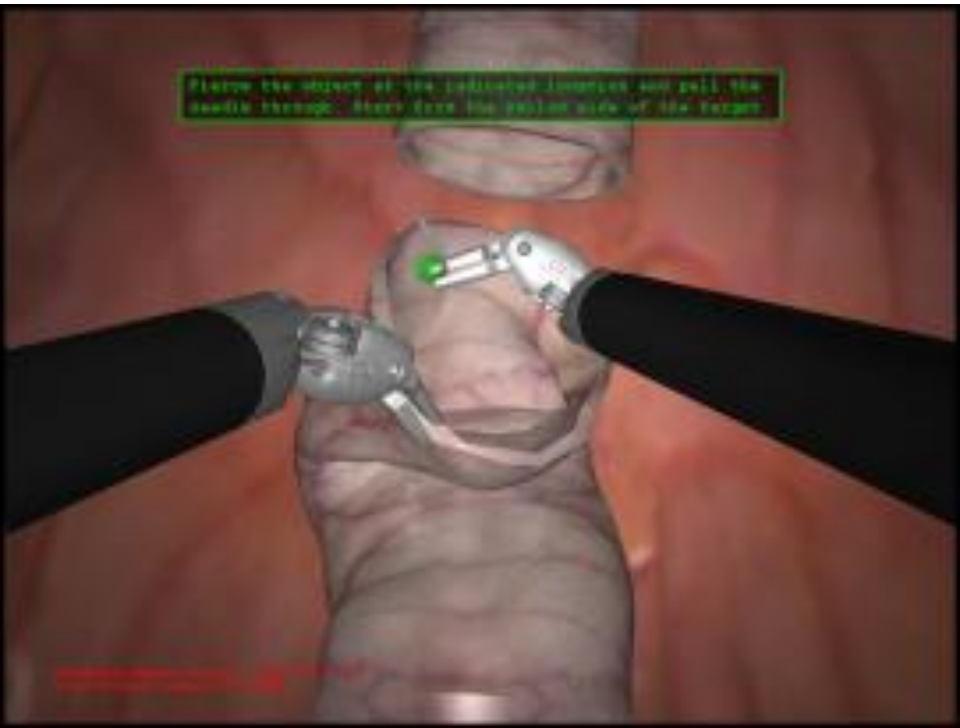
# Climbing the Learning Curve

- ◆ Standard surgery: “see one, do one, teach one”
- ◆ Robotic surgery: “see one, do one, kill one”
- ◆ Requires entirely new skill set beyond traditional surgical and laparoscopic training
- ◆ Training opportunities limited
- ◆ Animal labs helpful
- ◆ Cases require outside proctor to determine competency
- ◆ Credentialing challenges??

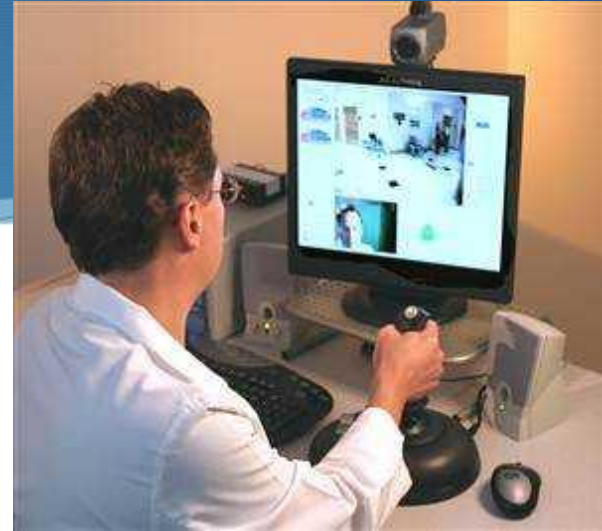
# Surgical Simulation



# Surgical Simulation



# Robotic Rounding



# Robotic Scrub Nurse “Penelope”



# Operating Room of the Future



# Moral Dilemma

- ◆ Technology is neutral - it is neither good or evil
- ◆ It is up to us to breathe the moral and ethical life into these technologies
- ◆ And then apply them with empathy and compassion for each and every patient

# Conclusions

- ◆ The rate of discovery of new technology is outpacing the ability of business, society, and healthcare to integrate and apply
- ◆ Robotic surgery is but one example of such technology that MAY reduce operative morbidity, hospital stay, and recovery, while POTENTIALLY improving clinical outcomes, but at what point do the BENEFITS justify the increased EXPENSE?

# Conclusion



*"Nurse, get on the internet, go to SURGERY.COM, scroll down and click on the 'Are you totally lost?' icon."*