Laser Safety in the Perioperative Environment

A Review of Laser Use

and

the CO_2 Laser

Laser Safety in the Perioperative Environment

This course will review:

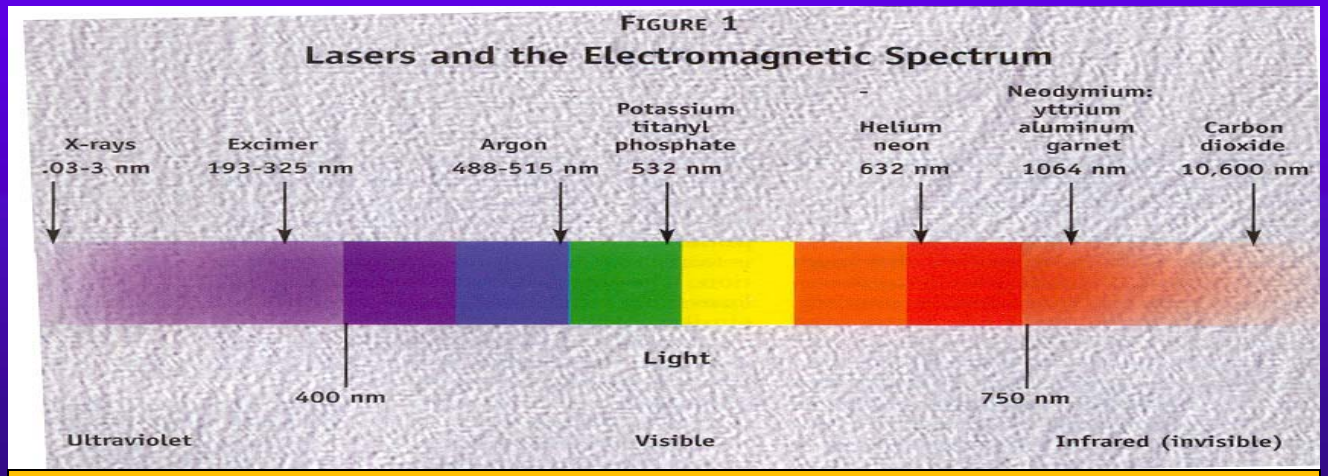
- **Discuss Laser Physiology**
- **Identify Laser Safety & Regulations**
- **Describe St. David's Laser Specific Information**

Laser Safety in the Perioperative Environment

Physiology

LASER Acronym =

Light Amplified by Stimulation Emission of Radiation



St. David's Medical Centers Lasers :

CO_2 10,600 nm

Holmium 2,100 nm

Green Light (KTP) 532 nm

ALL OF OUR LASERS HAVE HELIUM NEON LASER 632 nm (HeNe beam) ADDED FOR VISIBILITY

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- Lasers are named for media creating energy
  - Examples CO_2 – gas, holmium – crystals (YAG = Yttrium Aluminum Garnet)
- Lasers used in Medicine are Class 4
  - By definition, a class 4 laser can burn the skin, or cause devastating and permanent eye damage as a result of direct, diffuse or indirect beam viewing. These lasers may ignite combustible materials, and thus may represent a fire risk
  - Some ophthalmic laser are Class 3 -
    - hazardous if the eye is exposed directly, but diffuse reflections such as those from paper or other matte surfaces are not harmful.

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- 2 basic types of laser
  - Contact - uses a fiber & requires contact with the target tissue –
    - Example: a Holmium laser with a fiber is used for destruction of renal calculi
  - Non-contact – has a specific focal length for pin-point maximum power. As you pull away the laser diffuses & loses power.
    - Example a CO_2 laser with a 125mm hand-piece is used to vaporize venereal warts

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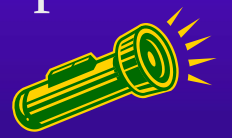
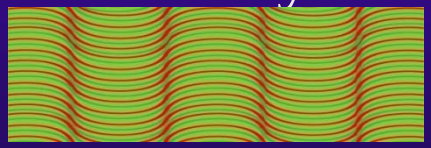
3 Properties of LASER light

- Monochromatic–one of colors of light spectrum-red, orange, yellow, green, blue, indigo and violet – this is opposite sunlight which is a mixture of colors
- Collimated – rays are parallel – which is opposite of a flashlight with a funnel shaped beam



- Coherent – rays travel in phase – which is opposite of a light bulb with aberrant rays



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4 Deliverable qualities of LASER energy

- Transmission
  - Example: light of a flash light going thru glass
  - Therapeutically - certain laser transmit through water
- Reflection
  - Example: Using a mirror as signal
  - Therapeutically - can use mirrored instruments to reflect beam to target tissue
- Absorbed
  - Focused energy – Example: vaporizing verruca with a microscope
  - Therapeutically - use of laser fibers or laser focal accessories for target tissue to absorb energy
- Scatter
  - Defocus – spreads out power – Example: “painting” a de-nuded area with lasers
  - Therapeutically defocus beam to “paint” target tissue with laser beam

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3 Tissue Effects

- Cut - Denature Protein
  - Continuous waveform heats cell water to point of denaturing cell protein and burst cell wall
- Coag - Drying
  - Adds nano-seconds of non-activation of waveform - heats cell water then allows it to dry (lasers typically do not have a great deal of coagulation ability)
- Vaporize – Boil & Burst
  - Heats cell water up so hot cells burst & creates steam, evaporation & cellular destruction

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- Regulating Agencies
  - American National Standards Institute (ANSI)
  - Radiation Safety Board (Texas Radiation Board)
  - OSHA
  - National Institute of Occupational Safety & Health (NIOSH)
  - American Society of Laser Safety in Medicine
  - Laser Institute of America
  - AORN

Laser Safety in the Perioperative Environment

Safety

- Education "Competency = Knowledge + Skill + Demonstration"
  - **Medical staff**
    - **INITIAL APPLICATION:** Training documentation from: Initial Certificate or Residency Program & Minimum of 6-8 hours of observation and hands-on instruction in use of lasers with concentration on safety.
    - **REAPPOINTMENT APPLICATION:** 2 Cases per year or Documentation of Laser Safety Training
    - **REINSTATED PRIVILEGES (after a lapse):** 1 Proctored Procedure by an appropriately privileged Medical Staff member
  - **Nursing Staff** – Knowledge, Safety & Skill Demonstration - During Orientation & Annually

Laser Safety in the Perioperative Environment

- Safety con't
  - Eye Protection
    - Nominal Hazard Zone NHZ- space in which the level of direct, reflected. or scattered radiation during laser operation exceeds the maximal permissible exposure and can cause injury
      - Our policy at St. David's - NHZ is OR suite where laser is in use
    - Eye wear specific to laser for example CO_2= 10,600nm with OD 5
      - Eye Protection must state wavelength & have side shields
      - Patients awake or asleep – wet eye pads, wet towel, goggles, and/or corneal shields
      - Goggles on each OR door entering the suite where laser is used
      - Water based ointment in patient's eyes
      - Eye protection is documented in OR record
    - Where is your nearest fire extinguisher?
      - Fire extinguisher should be immediately available

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- Safety con't
  - Fire/Thermal Safety
    - Open procedures –surround operative area with wet towels
    - Vaginal/rectal procedures – wet towels & insertion of wet rectal pack to prevent ignition of methane gas
    - Facial procedures - patient instructed not to wear hair spray
    - Alcohol based preps must dry before laser use – i.e. Duraprep & Chloraprep
      - Also benzoin, collodian, etc. not used until laser off
    - Water or saline on the field & laparoscopic procedures require irrigation set up
    - Instruments – ebonized or matte (those near and on laser site) including back stops

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- Safety con't
  - Airway
    - 0_2 levels below 30-40%.
    - Use laser ET tube (wrapped) with blue saline for balloon when laser used in the airway (blue dye alerts practioners that balloon integrity compromised.
    - Wet cottonoids available
    - May want *Difficult Intubation Cart* available
    - Saline or water on field – syringe ready with fluid to flush operative area
  - Laser Air Way Fire
    - Anesthesia Provider turns off O_2.
    - Scrub floods burning area with saline or water if absence of O_2 has not extinguished fire. (This is controversial)
    - Anesthesia Provider extubates patient & prepares immediately to re-intubate with back up ET tube. Trach set available.
    - Bronchoscopy performed, any burned material removed, injury assessed.
    - Patient to ICU – intubated. Bronchoscopy later to evaluate injury

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- Safety con't
  - Smoke
    - Smoke –In smoke are: Viable Organisms (i.e. HPV), Carcinogens, Toxic Chemicals – Must be evacuated
    - Exposure to 1 gm of vaporized tissue = smoking 6 cigarettes
    - Mask should filter at least 0.1 micron particles- laser masks do this
    - Open procedures require active smoke evacuation – smoke evacuator
    - Laparoscopic procedures require plume filters – Carbon Monoxide combines with Hemoglobin causing Oxygen Dissociation Curve
  - Electrical
    - Cords & Electrical Load of OR suite
      - Electrical Cords intact
      - Avoid trips & falls
      - Avoid over loading circuits

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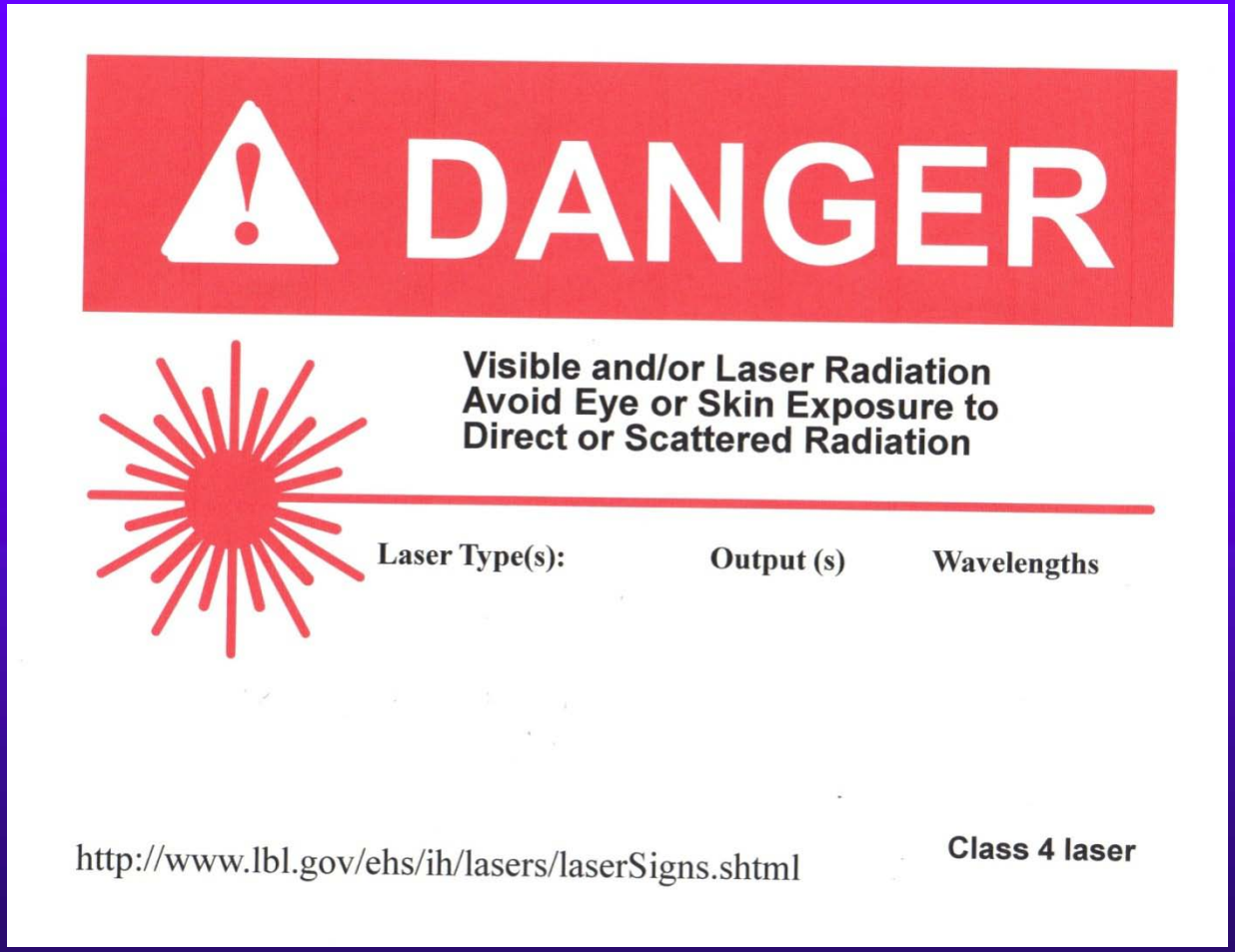
- Other
  - Signs –
    - Laser Signs Must State -*Danger, Laser symbol, visible & non-visible radiation, wavelength & maximum wattage for each laser, class, eye protection required (example next slide)* – must be on every door to OR when laser is in use
  - Key control
    - Stored in location away from laser
    - Never left in laser when laser unattended
  - Emergency shut down
    - Shuts laser down immediately in *Emergency*
  - Laser Assistant not circulator or scrub
    - Must have completed competency in each laser wavelength
  - Foot pedal control – only one foot pedal available to surgeon

Laser Safety in the Perioperative Environment



Laser Safety in the Perioperative Environment

- CO_2 – 10,600 nm
  - Non- contact laser
  - Helium Neon Beam coincides with CO_2 beam for visualization
  - Water absorbs CO_2 laser energy
  - St. David's CO_2 lasers
    - Nidek 0.5-50 watts
    - Sharplan 0.5 – 55 watts
  - Penetration depth 0.1-0.2mm
  - Modes of Nidek & Sharplan CO_2 Lasers at St. David's
    - Continuous (Nidek & Sharplan) (Cut & Vaporize)
    - UniPulse- Nidek (Coag)
    - SuperPulse –Sharplan (Coag)
    - SharPulse- Sharplan (Cut & Vaporize)

Laser Safety in the Perioperative Environment

- Beam Coincidence Test
  - Helium- Neon Aiming Beam is used to visualize the invisible CO_2 laser beam
  - Beams of 2 lasers must coincide in a single beam
  - Spot should be pin-point at appropriate focal length
    - Crescent Moon or Double Beam usually is loose fitting of the accessory
  - Place “X” on wet tongue blade then aim the laser at “X”, fire the laser – burn mark should be at designated spot on “X”.

Laser Safety in the Perioperative Environment

- Safety Checklists
  - Nursing Staff completes each time a laser is used
- Documentation
  - Surgeon - Consent & documented procedure must contain “Laser”
  - Nurses - Meditech documentation– see successive slides
- Log
  - Lists patient by account & medical record number, surgeon, procedure, laser number, laser assistant, circulating nurse & who performed laser beam coincidence test

Laser Safety in the Perioperative Environment

These Elements assist in providing Laser Safety for Patient's and the PeriOperative Team.

- Competency Checklists and Laser Safety Training
  - Assists in education and skill development
- St. David's Medical Center Laser Policy
  - Provides guidance for laser use

Laser Safety in the Perioperative Environment

Resources

- AORN Journal, Laser Safety; The Game is On, Aug, 2011pp 152-154
- AORN Journal, Safer Use of Lasers in the Operating Room – What the Perioperative Nurse Should Know, Jan 2004 pp 171-188
- AORN Journal, Laser Technology – A Surgical Tool of the Past Present & Future, Nov. 2003 pp 794-807
- Operation Manuals - Sharplan CO2 Laser, Nidek UniPulse CO2 Laser
- AORN 2011 Recommended Standards, Practices & Guidelines, Laser Safety
- Ball, Kay. Lasers-The Perioperative Challenge