SECOND EDITION

Introduction to Flexible Bronchoscopy

Fluoroscopy Synopsis

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FLUOROSCOPY

SYNOPSIS

The purpose of this synopsis is to provide the reader with a brief overview of fluoroscopy as it might apply to flexible bronchoscopy. It is assumed that institutions and practitioners have different biases and regulations. Herein a short summary is provided so that beginner bronchoscopists might acquire at least some of the elements necessary for a safe procedure. Readers are encouraged to follow guidelines and protocols established in their own institutions. Students are urged to read the Syllabus on Fluoroscopy and Radiation Protection created by the California Department of Health Services, which is downloadable from http://www.cdph.ca.gov/pubsforms/Guidelines/Documents/RHB-FluoroSyllabus.pdf

Definitions and consequences

- Refraction is the bending of light rays as they pass from a medium of one density to a medium of a different density. Brightness improves visual acuity
    - O If the fluoroscopic image is not bright enough to be of good quality, it cannot be improved by prolonged observation.
- Visual acuity is the ability of the eye to recognized differences between two sources of light stimulus, and thus to perceive fine detail.
    - O Night vision is best when the eye scans a scene (moving the fluoroscopic image).
- The eye retains any image it receives for a fraction of a second after the image is removed.
    - O Frame rates of 24 frames per second (still frames as for television), will thus appear continuous, as in a movie).
- Fluoroscopy images are electromagnetic radiation waves traveling at the speed of light (186,000 miles/second). Photons have energy that is directly proportional to the frequency or inversely proportional to the wavelength of the radiation.
    - O Increasing voltage increases energy and shortens the wavelength, making a more energetic and penetrating beam. The intensity of the radiation beam is influenced by current (milliAmperes mA).
- Radiation, like all energy, can be primary, scattered, or remnant. Interactions with tissues continue until all energies are spent.
    - O Primary is the radiation emitted directly towards the patient, scattered is what happens when the energy collides with matter (the patient), remnant is the energy that pass through the patient and strikes the image detector.
- Scatter increases if tissue density or thickness increases, or when voltage and milliAmperage increase.
    - O Compton scatter results from colliding electrons that lose their energy, as photons are scattered in all directions at low energies. Usually this is associated with increased voltage, and will diminish the quality of the fluoroscopic image. This causes quantum mottle (a grainy appearance in the image)

- Resolution, Distortion, and Lag time
    - O Definitions provided below. Move fluoroscope slowly while scanning. Keep image centered, and use highest lines/mm monitor (screen) possible.

Reducing patient exposure

- Collimate (focus) the radiation beam to the target of interest
- Use last image hold technique of fluoroscopy rather than continuous applications
- Keep patient to image intensifier (image to detector) distance as short as possible. Moving image intensifier away from the patient increases patient radiation dose.
- Use highest voltage and lowest milliAmperage as possible
- Use largest image intensifier mode (with non magnification) if possible
- Target to tabletop distance never less than 12 inches (30 cm), and should be at least 18 inches (45 cm) because patient dose decreases with increasing distance
- Use low absorption tabletops (made of aluminum, Bakelite, or carbon fiber) that do not attenuate the radiation beam.
- Use "dead-man" exposure switch (pedal) that terminates the radiation exposure when the foot is removed from the pedal. Do not provide continuous exposure.
- Doubling exposure time doubles radiation dose to both operator and patient.
- Do not use magnification mode unless absolutely necessary.

Improving visibility

- Adjust brightness and contrast settings on the screen
- Darken the procedure room lighting
- Avoid changing settings such as milliAmperage or voltage. It is better to adjust room lighting and screen properties.
- Changing the brightness setting on the screen will not improve quality of original image.
- Changing the contrast mode on the screen should be set so that bright objects of interest do not completely saturate (white out). It may be necessary to modify brightness after changing contrast modes.

Patient and operator shielding and monitoring

- Gonad shields, Thyroid shields
- Lead curtains, Body aprons
- Personal radiation film badges should be worn at collar height above the protective apron or on top of the protective apron itself.
- Badges should be checked periodically to record exposure and measure accumulated exposure over a specified period of time

Special precautions for pregnant patient and health care providers

- There is always a potential for adverse biological effects after exposure to radiation.
- Examinations should not be postponed if deemed clinically necessary, but appropriate shielding precautions should be followed.
- There is no "safe" period" for the real or potential embryo/fetus or future fertilized ovum
- Therapeutic abortion is never justified because of radiation dose to embryo/fetus during a diagnostic fluoroscopic examination
- Effects are proportional to absorbed radiation dose
- The first three months of pregnancy are when the embryo-fetus is most sensitive to radiation.
- Pregnant or potentially pregnant health care providers should not assist in fluoroscopic procedures.

Resolution, Distortion, Scattered radiation, and Lag

- Limited by screen capabilities (525 to 1000 lines/mm)
- Defined as the ability of the imaging system to differentiate small objects as separate images when they are close together.

- Distortion effects size and shape, and can be greatest at the periphery of the image.
- Lag time, and thus blurring of the image as the fluoroscope is moved, occurs because it takes a certain amount of time for the image to build on the screen.
- Scattered radiation is increased in case of high voltage, large field size and thick body parts (obesity.
- The fluoroscopist and assistants should stand as far away from the patient as possible.
- The dose of radiation received from scattered radiation by the fluoroscopist and assistants is directly proportional to the patient radiation dose.
- Preferably a 0.5 mm protective apron should be worn (transmitted exposure reduction is thus 99.9 percent, as compared to 97% reduction for a 0.25 mm apron). Aprons cover only 80% of active bone marrow of the body.

Basic operational procedures

- Use short looks rather than continuous observation. Because the recognition time of the human eye is 0.2 seconds, a short look will accomplish the same as continuous observation.
- Use a resettable timer that will alarm when a maximum of 5 minutes exposure time is reached.
- Use best contrast (lowest milliAmperage) and highest peak voltage possible.
- Keep target area small and focused, but without magnification mode.
- Maintain radiation dose as low as possible (should be less than 5 rads per minute)
- Use last frame hold strategy to keep an image on screen without additional radiation exposure.
- Place image intensifier as close to the patient as possible.
- Prevent patient motion by giving clear instructions.
- Reduce extraneous light in procedure room.
- Use gonad shields and protective aprons of at least 0.25 mm lead equivalent.
- Use audible indicator (beeper alert) when fluoroscopy is on.
- Use personal radiation dose monitoring devices (radiation badge) according to institutional guidelines.

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