A CLEANING AND PREPARATION OF THE DISC-OXYGENATOR AND ITS ACCESSORIES

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THE status of present day open-heart surgery demands that the extra-corporeal circulation be carried out with utmost precautions to insure adequate circulation and oxygenation and minimum morbidity. This can be accomplished only by the experienced teamwork of a group of skilled and knowledgeable individuals. Each member should be inquisitive, diligent, and meticulous in learning and testing new procedures and equipment and refining and improving old methods. It is the purpose of this discussion to present the techniques used at Brooke General Hospital during the years 1960-1965.

The surgeon must have complete confidence in the team's ability to function under duress and that each member performs his duties promptly and competently. The safety of the patient depends on the conscientiousness of the team.

A successful functioning cardio-pulmonary laboratory is essential. A pyrogen-free, low hemolysis pump run is facilitated by careful pre-operative cleaning and siliconization procedures. Human error is eliminated by careful and conscientious immediate pre-operative assembly of the pump and mechanical error by frequent maintenance checks.

PREPARATION AND MAINTENANCE OF EQUIPMENT

Hemolysis is prevented by the favorable hemodynamics of the tubing, reservoirs, connectors and siliconized surfaces. Dead spaces at connections or internal scratches should be avoided as they form potential areas for fibrin and platelet formations due to eddy currents. All blood-contact surfaces are polished and have precise radii designed to give minimal turbulence.

Silastic precision wall tubing is recommended for roller pump head use. Its hemolysis dynamics are exceptionally low and it may be sterilized by steam or gas. It insures the proper degree of occlusion.

Tygon tubing may be sterilized by steam, gas (ethylene oxide) or chemicals. It should be stored in its original carton in a dry, dust-free area.

A good alkaline detergent (Alconox Hemo-Solution, etc.) is used to scrub each disc and metals, glass and connectors to remove fat, fibrin, blood and protein deposits immediately after use.

Potassium hydroxide is used to remove previous silicone. It is heated to 100° F. to shorten processing time.

Organic matter and protein deposits are removed with nitric acid as detergents alone will not remove all of the deposits.

A well ventilated room with hood is recommended for working with toxic agents as well as acid resistant gloves, face protection, and adequate water supply.

Sterile distilled water aids in removing pyrogens left by the tap water rinses. Pyrogen-free water (water-for-injection) is used as an extra step to produce a pyrogen-free run with minimal hemolysis.

Siliconization is accomplished with Siliclad (Clay-Adams Inc. Catalog No. J-600) which decreased hemolysis. It is a water soluble silicone which makes the surface easier to clean and produces a water-repellant film which resists soils and stains. The resultant smooth, hard surface makes nontraumatic contact with the blood and its inertness contributes to its efficacy. It has a limited tank life and should be destroyed after four hours of use. It is our recommendation that resiliconization should be performed after each case.

Dow Corning Anti-Foam A is used in any of the chambers where foaming may develop but with caution as emboli have been reported with its excessive use.

Specific

A. Metal and Glass
1. Processing
a. Metal

Step I: Alkaline Detergent (Alconox Hemo-Solution).

1. Disassemble each chamber into its single parts and soak for 30 minutes.
2. Gently scrub each part with a surgical scrub brush and clean each nipple inlet and outlet with a cotton tip applicator. An extra long pipe cleaner is used with the Brown-Harrison Heat Exchanger.
3. Rinse thoroughly in tap water.

Step II: 5% Potassium Hydroxide

1. Soak for 30 minutes.
2. Rinse thoroughly in tap water.

Step III: Nitric Acid (HNO_3 approximately 70% Analytical Reagent).

1. Immerse each part one minute.
2. Rinse thoroughly in tap water.
3. Rinse in sterile distilled water to remove pyrogens.

4. Rinse in pyrogen-free water as an extra precaution. Keep ungloved hands out of distilled and pyrogen-free water.

b. Glass Cylinders

Step I: Alkaline Detergent

1. Clean each cylinder thoroughly with a long handled, soft bristled brush.
2. Rinse in tap water.

Step II: 5% Potassium Hydroxide

1. Soak for 15 minutes.
2. Rinse thoroughly in tap water.
3. Rinse in sterile distilled water.
4. Rinse in pyrogen-free water. Avoid contact with inside of cylinders with gloved or ungloved hand.

2. Siliconization

a. Re-assemble each chamber.
b. Plug inlet and outlet nipples using a rubber push-on cover.
c. Mix 50 cc. Siliclad per 1000 cc. sterile distilled water.
d. Fill each chamber and let set for 20 minutes.
e. Empty and rinse with distilled water.
f. Rinse in pyrogen-free water.
g. Dry in hot air oven for one hour at 150° F. (frees monomolecular layer).

3. Sterilization

a. Allow chambers to cool. All chambers must be dried well before gas sterilization.

b. Steam

Each nipple is covered with four thickness surgical gauze and placed in a perforated CMS tray. Breakage is prevented by appropriate towel packing and the tray double-wrapped in muslin. The oxygenator is wrapped individually. They are autoclaved for 45 minutes at 250° F. at 20 pounds pressure with a drying period of 1½ hours. The door is then opened three inches and heat from the steam filled jacket will dry the condensate in 3½ hours.

c. Gas (Ethylene Oxide)

1. Sterilization time varies with autoclave instructions.
2. The chambers must aerate for 24-72 hours before use.

B. Tubing

1. Processing (Silastic, Tygon and Vinyl)

a. Tap water flush—12 hours.
b. Flush with sterile distilled water.
c. Flush with pyrogen-free water.
d. Blow dry with compressed air.
e. Store in dust-free location.

2. Packaging (Steam sterilization)
Tubing precut to needs of case and placed in CMS perforated tray. Individual layers of tubing are separated with single thickness surgical gauze. Avoid kinking or depressions in the tubing which become permanent with autoclaving and make tubing unusable. Double-wrap tray in muslin.

3. Sterilization

a. Steam

1. Autoclave for 30 minutes at 250° F. at 20 pounds pressure and dry for one hour. Then open door three inches and heat from the steam filled jacket will dry the tubing in three hours allowing it to resume its natural clear color.
2. The jacket steam is turned off and the door is opened 12 inches to allow slow cooling. This prevents retention of moisture and consequent opaqueness.

b. Gas

Same as Glass and Metal.

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Q and A

QUESTION: *I have long been curious about the most popular concoctions used in hemodilution—also, how widespread is the use of hemodilution?*

ANSWER: From the Society files came the results of a survey conducted during the 1967 national meeting in Montreal (60% of the attending technologists responding). The two most popular base solutions were Lactated Ringer's (35%) and Dextran 40 (18%). Of these reporting, 8% used no dilution whatsoever and, of the 92% who used some dilution, 29% favored 20% dilution.

(It would be of interest to hear about the various priming formulae used and the thinking behind them.—Ed. note)