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TRANSPORT SUCTION APPARATUS AND ABSORPTION MATERIALS EVALUATION

K648 1054

PRINCIPAL INVESTIGATOR:	Debra T. Krupa
CO-INVESTIGATORS:	John Gosbee, M.D.
FLIGHT DATES:	March 28, 1990 April 19, 1990

TEST OBJECTIVE:

Evaluate the function of a battery powered apparatus, a manually powered apparatus, and various types of materials for the containment of bodily secretions in microgravity.

TEST DESCRIPTION:

The specific objectives of the experiment were:

- to evaluate the effectiveness and function of the hand held, manually powered v-vac for suction during micrgravity
- to evaluate the function of the battery powered laerdal suction unit in microgravity
- to compare the two units in control of various types of simulated bodily fluids
- evaluation of various types of tubing and attachments required to control the collection o bodily fluids during transport
- evaluation of various materials for absorption of simulated bodily
- identification of potential problem areas for waste management and containment of secretions and fluids during transport

STRUCTURAL LOAD ANALYSIS:

See memo from NASA structures for HMF glove box

ELECTRICAL LOAD ANALYSIS: no electrical power required

INFLIGHT TEST PROCEDURES (CHECKLIST FORMAT):

All procedures were completed within the closed environment of the glove box.

1. **Deploy the suction devices and fluids in containers**

   - fluids suctioned included water, milk, pudding, and canine blood
   - each fluid was placed inside the glove box in a separate container for the type of fluid
   - the containers were 60cc catheter tip syringes which allowed for containment of the fluid, and easy deployment of the contents within the box for attempts at suctioning
   - each container was restrained to the inner floor of the glove box by tape until needed for deployment within the box

2. **Attempt suction with the v vac on the various fluids**

   - use large and small bore suction tubing
   - use hard and pliable tip catheters

3. **Attempt suction with the laerdal on the various fluids**

   - utilize large and small bore suction tubing
   - utilize hard and pliable tip catheters

4. **Evaluation of various types and weaves of materials for absorption of fluids:**

   - tight and loose weave guaze
   - blotting and wiping motions
   - sponges, combine dressing, and abd pads

PARABOLA REQUiREMENTS, NUMBER AND SEQUENCING:

No special requirements for intervals and spacing between parabolas.

Parabolas 1-10

- Deploy and secure fluids and suction apparatus within box
- Suction of milk
  - v vac with large and small bore tips
  - v vac with hard and pliable tips
  - laerdal with large small bore tips
  - laerdal with hard and pliable tips

Parabolas 11-20

- Suction of pudding
  - v vac with large bore tips
  - v vac with hard and pliable tips
  - laerdal with large small bore tips
  - laerdal with hard and pliable tips

Parabolas 21-30

- Suction of canine blood
  - v vac with large and small bore tips
  - v vax with hard and pliable tips
  - laerdal with large and small bore tips
  - laerdal with hard and pliable tips

Parabolas 31-40

- Evaluation of absorption of various materials
  - loose weave guaze on blood, milk, and pudding
  - tight weave guaze on blood, milk, and pudding
  - abd pads on blood, milk, and pudding
  - sponges on blood, milk, and pudding
  - combine dressing on blood, and milk
- Evaluation of various methods of blotting and wiping for fluid absorption on blood, water, milk and pudding

- Repeat of any of the previous procedures which need further evaluation

TEST SUPPORT REQUIREMENTS (GROUND AND FLIGHT):

Space required: Full width of KC-135, and 10 feet of length.

Loaded at beginning of flight week: HMF glove box and table

Loaded on flight day:

- video camera
- restraints for investigators
- carry on bag containing waste disposal container, fluids in containers, suction devices, catheter tips, absorption materials,

DATA ACQUISITION SYSTEM:

In flight written check list self report post flight video

MANIFEST: Debra T. Krupa (KRUG)
John Gosbee (KRUG)
Roger Billica (KRUG) flight 1
Perry Bechtle (KRUG) flight 2
Dedicated photographer

PHOTOGRAPHIC REQUIREMENTS:

- Dedicated video photography
- Non-dedicated still photography

HAZARD ANALYSIS/SAFETY:

1. Potential Hazard: Fluids could become dislodged and float freely throughout the cabin

   Response: All fluids were placed within the glove box within their sealed containers before the parabolas began.

No protective covers were to be removed unless within the confines of the glove box.

2. Potential Hazard: Corners of box could scrape or contuse experimeters

   Response: Upper edges of the glove box are padded with foam as required on previous flights for protection of those around box area. See memo from NASA structures on HMF glove box.

INFLIGHT WORKSHEET KC 135 FLIGHT EVALUATION TRANSPORT SUCTION APPARATUS AND ABSORPTION MATERIALS

Principle Investigator:	Debra T. Krupa (DK)
Co-investigators:	John Gosbee (JG) Roger Billica-flight 1 (RB) Perry Bechtle-flight 2 (PB)

PREFLIGHT:

Load equipment onto KC 135 and secure:

- video camera
- restraints for investigators
- waste disposal containers
  - solid, wet, and sharp
- Laerdal suction
  - extra containers
- V Vac
  - extra containers
- suction catheters
  - yankauer
  - pliable small and large
- suction tubing
- absorption materials
- non-sterile gloves
- fluids
  - blood in syringes
- needles

- extra syringes
- chucks pads
- ice chest for syringe containment
- plastic bags for trash
- chicken breast
- duct tape
- scalpel
- needles
- windex
- paper towels

BEFORE PARABOLAS BEGIN:

Deploy suction devices from bags and place within glove box

This was easily accomplished. The laerdal was taped into place with duct tape against the wall of the glove box. The lid was propped open to allow access to the controls. The V Vac was taped to the side of the glove box.

Secure water and blood within glove box for first set of parabolas

The first syringes were placed within the glove box inside of the syringe covers. (See still photo 35939)

Remaining equipment and fluids to be secured to floor within ice chest at base of glove box for easy access within parabolas or at breaks

The syringes were separated by contents and placed within styrofoam boxes. The boxes were taped to the base of the glove box with the lids taped for easy and rapid, yet secure access. The extra attachments were placed within a bag below the glove box. The igloo cooler with the chicken was secured below the glove box also.

Position attachments within glove box for first set of parabolas

The yankauer tips and flexible tips were taped to each side of the box for access by each experimenter. The needles and tips for the syringes were secured to the inside wall of the glove box with double stick duct tape. This allowed the experimenter to acces them when required, and then replace them easily.

Position waste containers

The large trash bags were taped to the side of the aircraft for ease of access.

Recheck video placement

The NASA video camera focus was verified, and positioning checked prior to flight. A detail of what was to be accomplished was provided, with suggestions for camera angles.

BETWEEN SETS OF PARABOLAS:

Change out various fluids in preparation for next set as follows worksheet

As required during the sets of parabolas, as well as between sets, empty syringes were exchanged for new full ones.

Clear fluids out of suction tubing as required with water

This was often accomplished with milk as well as water. It was easy to clear the blood out of the tubing, however the pudding required water and milk to clear. A syringe of water/milk was kept within the glove box on each end for this purpose.

Dispose of used tubing in waste containers

This was accomplished as required.

Turn off laerdal when not in use to conserve battery life and decrease noise level.

This was very important, more for the noise level than for the battery life. The laerdal is very noisy, and, when added to the engine noise and noise created by other experiments, turning it off became mandatory.

KC 135 FLUID EVALUATION RESULTS

SUCTION WITH LAERDAL:

Yankauer tip:

Suctioned out of the cup and off of the wall very well, but a small amount travels up the sides of the catheter. It could not really "grab" globs or streams of blood out of the air.

Flexible tip:

Suctioned out of the cup well. Not as well off of the wall, due to the holes at the end of the catheter are misplaced for non-gravity depended drainage. It was not able to "grab" blood out of the air. It did an outstanding job on suctioning off of the chicken.

Funnel tip:

The blood that was squirted into the funnel stuck onto the inside surface of the funnel, but the suction wasn't powerful enough to remove it off of the funnel and into the suction hose.

SUCTION WITH V VAC:

Yankauer tip:

Fair suction off of the wall and out of the cup. Adequate suction off of the chicken. The experimenters each complained that their hands tired easily with this apparatus with long, slow squeezing; or with short, fast squeezing. The whole assembly was too long to direct the tip accuraely, and to use inside the glove box.

Flexible tip

Fair suction out of the cup. Fait to poor suction off of the wall, again due to poor hole placement on the catheter for zero gravity suction. Fair suction off of the chicken. Again, the hands became tired with long slow squeezing or short, fast squeezing.

Funnel tip

The blood that was squirted into the funnel stuck onto the surface of the funnel, but the suction wasn't powerful enough to remove it from the funnel and into the hose.

GAUZES:

4x8 Surgical Dressing

Stream of blood shot was soaked up to 90%, and the remaining 10% either stayed as a "bead" on the surface, or bounced off the surface of the dressing. Blotting the chicken was adequate, but a bit slow. When moving the dressing away in a "flicking" motion, some of the blood particles scattered in several directions from the surface of the dressing.

"Lap" sponges

No difference from the 4x8 above.

ABD pad

Stream of blood was soaked up to 80%, and the remaining blood beaded up in small globs (less than 1 cm) or bounced off of the pad. Blotting the chicken was unwieldy, and no more efficient than the 4x8 or lap sponges.

Kerlix roll

Excellent at all tasks (streams, blobs, chicken). The roll captured and soaked up the blood readily (very absorbent in microgravity). The roll retained the blood within the Kerlix even when it was forcibly shaken to dislodge the soaked blood.

PHOTOGRAPHY:

Video:

Dedicated NASA video was taken on both of these flights. At the time of the presentation of this report, neither video has been received for review.

Stills:

The number and quality of stills for both of these flight was below average.

S90-35931
DK is blotting with the kerlix as PB squirts the blood.

S90-35932
DK is preparing to blot the chicken as PB prepares the needle to simulate a bleeding wound.

S90-35935
JG is suctioning with the V Vac as PB simulates blood flow with the needle in the chicken.

S90-35937
JG is suctioning with the V Vac and the pliable catheter off of the wall of the glove box where PB has squirted blood.

S90-35938
PB is holding the cup of blood for JG to suction with the V Vac and yankauer tip.

S90-35939
JG is simulating blood flow through the chicken while PB suctions it with the laerdal and the pliable tip catheter. Note the manner of containment of the additional syringes along the inside of the wall of the glove box.

S90-33952
JG is squirting the pudding for RB to suction with the V Vac and the yankauer. DK is watching from over the glove box.

S90-33985
JG has squirted pudding on the wall of the glove box for RB to suction with the tip of the V Vac.

S90-33986
Same as 33985

CONCLUSIONS:

V Vac:

The V Vac was very tiring on the arm and hand. It required quite a bit of pumping to keep up with the laerdal. When the air port of the V Vac became wet, it would leak fluid out of the sides. This is unacceptable. There should be some method for delayed deployment of suction.

Laerdal:

The laerdal functioned as it did in one gravity as a pump. The difficulty was with the tips placed within or next to the fluid for suctioning.

Yankauer:

The tip tended to accumulate fluid around it. Fluid would travel up the sides of the catheter as well as up into it.

Pliable:

This catheter functioned well. It will benefit with different design for tips. This tip was unable to suction the pudding, and would not do well for thick tenacious bodily secretions (mucus). There should be further investigation into how we will do this in space station. This is a serious concern for suction of a patient on a ventilator.

Gauzes:

The kerlix roll worked by far the best of all types of material. It was able to absorb all fluids, and did not dislodge any fluid capture. Wiping tended to push the fluid along front of the material.

ADDITIONAL COMMENTS:

The chicken breast worked well for simulated flow, and did not smell too badly. The canine blood also worked well, and did not smell. The pudding was quite adequate at simulation of various bodily secretions.

We were able to instill water down at ETT very easily. However, this required the entire ETT being filled with fluid prior to any drainage of fluid out of the distal end. This should be repeated with a bag valve mask.

RECOMMENDATIONS:

1. The gloves attached to the box are very thick and difficult to work with. It would be much more useful if a thinner glove could be changed for the present ones. Also, there was some difficulty in reaching across the box due to the length of the gloves. Longer ones would work much better.

2. The difficulty with suction in microgravity is related to the type of tip placed within the medium to be suctioned. New approaches to design of catheters is required. Possible areas for examination include: large bore catheter tips, funnel tips of various sizes, catheters with numerous holes up the side (as in abdominal surgical suction). This area of investigation is crucial to our ability to adequately provide airway management, surgical capabilities, and wound management. It should be followed up upon with new approaches to design of the tips which come into contact with the fluids.

3. A question was raised as to suction of a patient on a ventilator. A flight to examine different tips for this purpose will be required. Doubt as to the ability of present catheters to remove tenacious secretions is very strong. This should be examined with application of fluid instillation, and bag-valve-mask force applied to the tube.

4. The laerdal is easily used for suction in microgravity. Modifications to solve the EMI and battery problems should be pursured.

5. The V Vac functions adequately in microgravity. Modifications are possible to pursue development of this tool. This would require: a) ease of energy required to pump, b) a method for delay of presentation of the suction for use on slow suction situations, c) prevention of leakage of the fluid out of the air port when it becomes wet.