Mechanical Air Drying Of Hands Following Preoperative Scrubbing

By PAUL E. WALKER, M.D.

THERE ARE several possibilities of bacterial contamination inherent in the drying of the hands and forearms following preoperative scrubbing. Contamination by dust-carried airborne bacteria is one of these. The degree of such contamination will vary with the amount of circulating dust, duration of exposure, and moisture content of the air. Since most operating room layouts are similar, these factors will probably be fairly constant among different hospitals. Scrubbing techniques differ somewhat, but the differences are not great enough to allow much variation in the elimination of bacteria. It is in the drying of the hands that the greatest possible opportunities for contamination exist. In the use of sterile towels for drying, these opportunities are the greatest. Improper rotation of the towel during drying, the touching of the scrub suit or of the unscrubbed portions of the upper extremities, all offer great probabilities of gross contamination.

It would seem that simple air drying of the hands would eliminate these probabilities of contamination. Such a method further has the advantage of elimination of more costly methods of drying. However, it is slow, physically uncomfortable, and may cause chapping of the skin. It could be followed by dust-laden air contamination in relatively dry operating rooms.

To overcome all these difficulties, it seemed to us that the mechanical air dryer had definite possibilities. Before accepting such a device for use, however, it had to be determined whether or not the forcing of warm air over the extremities would increase contamination, and whether or not it would be economically practicable. This study was undertaken to determine these two points.

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Operation of Machine

The air dryer was a standard model manufactured by a national manufacturer, and was not modified for this study. It is a blower mechanism mounted in a white enamel chassis, operated by a small 110-volt motor which forces a current of air over an electrically heated grid. This current of air is directed through a nozzle downward or upward over the extremities. The switch is operated by a trip mechanism mounted on the front, which can be activated by the shoulder or elbow. This mechanism allows the motor to operate for 30-second intervals, but the time can be modified without difficulty. The machine was mounted at a convenient height on a door in the scrub room adjacent to the scrub sinks. We considered this location preferable to any other because of the high moisture content of the air and because of its convenience. Installation of the machine was simple and was done easily by the station electrician.

A standard scrub routine was adopted. Duration of scrubbing, scrubbing solution, and cleansing of nails was the same before each sample was taken. To further standardize the procedure, only the first scrub of the day for each individual was used. No sterile or antiseptic washes or solutions were used except a .66-percent hexachlorophene soap.

In the study on sterile towel-drying technique, the subject after scrubbing walked to the adjacent operating room where he was immediately given a sterile towel by the scrub nurse. He dried his hands in his usual manner. With the air dryer the arms were dried for 60 seconds under the jet of warmed air, the hands being rubbed together as drying proceeded. (With one man the drying period had to be 90 seconds because of his size and heavy hair distribution.)

Following either method, the hands were immersed in a sterile basin containing 1,000 cc. of distilled water and agitated freely. In the first series the water was allowed to run down

the elevated forearms into the basin. Since this was thought to be a possible source of contamination from water running over the unscrubbed upper arm, this step was eliminated in the second series.

The laboratory procedure was as follows: A 1-cc. sample was taken from the basin of sterile distilled water and added to 20 cc. of nutrient agar in a sterile flask. This was mixed thoroughly and then poured into a Petri dish. After overnight incubation at 37° C., the number of colonies on each plate were counted and recorded.

Contamination

Air samples for bacterial contamination were taken in two operating rooms and in the scrub room for the first 9 days of the study. Since results were so variable and there was no correlation with the other results, this study was abandoned.

Eleven surgeons and six nurses participated in the first study. The surgeons were mixed staff, residents, and interns. One of the nurses was a novice. As shown in table 1, 77 towel-drying cultures and 77 air-drying cultures were taken from this group.

In this group it is to be noted that if colony counts of 50 or over are considered as gross contamination, then 12 subjects in the towel-drying group were so contaminated and only 3 in the air group. If 100 colonies or over are considered as gross contamination, none of the air-dry group and 9 of the towel-dry group were so contaminated.

In the second series, as shown in table 2, three doctors and two nurses were used, each of whom had 15 air-dry and 15 towel-dry cultures. The technique was modified in this group, as mentioned heretofore, in that the hands only were immersed in the solution.

In the second series group the differences are not so great because the subjects were selected and more experienced personnel whose technique might be expected to remain the same from day to day. Here again, however, if 50 colonies per cc. or over is considered gross contamination, the ratio of towel to air is 11 to 4; in cultures showing 100 or more colonies the ratio is 1 to 0.

If presented somewhat differently and combined as in table 3, the differences are more significant. If colonies showing 50 or more are taken, the ratio of contamination of towel to air is 23 to 7. If colony counts of over 100 are

Table 1. Series I

Subject	Number of cultures		Average number colonies		Difference	Number of cultures over 50 colonies	
	Towel	Air	Towel	Air		Towel	Air
Surgeon No:							
1	5	5	11	7	4	0	0
2	1	1	5	0	5	0	0
3	5	5	6	10	[1] −4	0	0
4	5	5	64	18	56	3	0
5	5	5	13	18	−5	0	0
6	5	5	54	18	36	3	1
7	5	5	0.8	5	[1] −4.2	0	0
8	3	3	18	1	17	0	0
9	5	5	6	50	[1] −44	0	2
10	5	5	20	0.4	19.6	1	0
11	4	8	5	7	[1] −2	0	0
Nurse No.:							
1	7	6	28	5	23	1	0
2	4	1	3	9	[1] −6	0	0
3	5	5	13	6	7	0	0
4	3	2	67	3	64	1	0
5	5	6	39	9	30	2	0
6	5	5	36	22	14	1	0

[1] Minus sign used to show instances of larger number of colonies by air drying.

Table 2. Series II

Subject	Number of cultures		Average number colonies		Difference	Number of cultures over 50 colonies	
	Towel	Air	Towel	Air		Towel	Air
Surgeon No.:							
1	15	15	23	24	[1] −1	2	3
2	15	15	0. 6	1. 6	[1] −1	0	0
3	15	15	40	19	21	5	1
Nurse No.:							
1	15	15	15	10	5	2	0
2	15	15	16	3	13	2	0

[1] Minus sign used to show instances of larger number of colonies by air drying.

taken, the ratio is 10 to 0. It is believed that these figures are probably significant and indicate that gross contamination by the mechanical air dryer is apparently less common than by sterile towels.

Cost of Machine

The cost of the machine was $140. Installation cost was negligible and installation was done by station labor. The maintenance cost will probably be negligible for approximately 5 years. On the other hand, we estimated that we used in this hospital yearly an average of 10,000 towels for hand drying alone. Laundering cost was estimated by our laundry superintendent as being about $90 yearly. Replacement due to wear and tear approximates about 100 towels a year at an estimated cost of $20. Adding to this the cost of folding and pack make-up, the saving over a period of 5 years is obvious.

Table 3. Total figures for both series

Number of colonies	Number of cultures	
	Towel dry	Air dry
0–5	77	92
5–10	21	14
10–20	14	18
20–50	17	21
50–100	13	7
Over 100	10	0
Total	152	152

The dryer tested can be used satisfactorily in its present form. For convenience, however, the trip mechanism should be adjusted to 90 seconds. The manufacturer has advised us that this can be done without extra cost. For added convenience a foot-operated mechanism could be built. This, however, would add somewhat to the over-all cost of the machine. We considered at first the installation of a filter in the mechanism, but in the light of our studies we do not consider this feature necessary. It would entail certain technical difficulties and added expense that are probably not indicated. Further studies with a filter, however, would be of interest to see if bacterial counts could be reduced still further.

Conclusions

1. Bacteriological studies of 304 cultures, taken from groups of surgical personnel after use of a standard scrub technique, showed a probably significant reduction of gross contamination of the hands when a mechanical air dryer was used.

2. The mechanical air-drying technique is less expensive than the towel-drying technique.