

The Effectiveness Of The Hands-Free Technique In Reducing Operating Room Injuries

B.Stringer, Ph.D., C. Infante-Rivard, MD, Ph.D., J. Hanley, Ph.D.

ABSTRACT

Context – Operating room personnel are at a high risk for transmission of blood-borne pathogens when passing sharp instruments. The hands-free technique, whereby a tray or other means are used to eliminate simultaneous handling of sharp instruments by two people, has been recommended.

Objectives – To evaluate the effectiveness of the hands-free technique in reducing the incidence of percutaneous injuries, contaminations and glove tears arising from handling sharp instruments.

Design – Prospective cohort study.

Setting – The main and surgical day care operating rooms of a large urban hospital in Seattle, Washington.

Methods – For each of 3,765 consecutive surgeries over 6 months, circulating nurses and other surgical personnel recorded the proportion of use of the hands-free technique during the surgery, as well as other features of the operation. The hands-free technique, considered used when 75% or more of the passes in a surgery were done in this way, was used in 42% of surgeries.

Measure of effectiveness – Relative rate of incidents (percutaneous injuries, contaminations and glove tears during surgery) in surgeries where the hands-free technique was considered used and not used, with adjustment via multiple logistic regression for the different risk profile of the two types of operations.

Results – A total of 143 incidents (40 percutaneous injuries, 51 contaminations and 52 glove tears) were reported. In surgeries with greater than 100cc bloodloss, the incident rate was 0.04 (18/468) when the hands-free technique was considered used and 0.11 (90/790) when it was not, a reduction of 64%. Adjusted for differences in: type of surgery, length of surgery, emergency status, noise levels, time of day and number of people present for at least 75% of the surgery, the reduction in the rate was 59% (95% CI 23%-72%).

In surgeries with less than 100cc bloodloss, the corresponding rates were 0.01 (15/1036) when the hands-free technique was used and 0.01 (19/1240) when not used,

which was a reduction of 0. When adjusted for differences in risk factors, the reduction in the rate was 1% (95% CI 49%-198%).

Conclusions – The use of the hands-free technique during surgery was effective in surgeries with substantial blood loss.

B. Stringer is a former nurse and adjunct professor at the University of British Columbia in the School of Occupational Hygiene and Environmental Health, Vancouver, British Columbia. C. Infante-Rivard and J. Hanley are professors in the Department of Epidemiology, Biostatistics and Occupational Health, Faculty of Medicine, McGill University, Montreal, Quebec. The principal author wishes to thank the Institut de Recherche en Sante et Securite (IRSST) for three years of support during her Ph.D.



INTRODUCTION

Operating room personnel, especially those directly involved in surgical procedures, are exposed to large quantities of blood, bloody body fluid and other types of biological material such as bone.

Numerous pathogens can be transmitted by exposure to these materials. Of most current concern are the hepatitis B (HBV), hepatitis C (HCV) and human immunodeficiency (HIV) viruses.

The operating room is also the hospital environment with the greatest concentration of sharp instruments and

thus the risk of percutaneous injuries with contaminated sharp objects that can lead to blood-borne disease transmission, is enhanced.

The hands-free technique to transfer sharp instruments has been suggested as a means of reducing the risk of such contamination. It consists of the indirect transfer of instruments between the surgeon(s) and other scrubbed personnel such that only one person touches the same sharp item at any time. Items are usually placed in a designated neutral zone, which can be a section of the surgical field or a con-

tainer, from where they can be retrieved.

Only one previous study evaluated the impact of the hands-free technique, among a number of other factors, on the risk of percutaneous injury during surgery; but it did not demonstrate its effectiveness.

The present study's primary focus was to determine if the hands-free technique would result in fewer incidents, including percutaneous injuries, contaminations and glove tears, during surgery.

OBJECTIVES

To evaluate the effectiveness of the hands-free technique in reducing the

incidence of percutaneous injuries, contaminations and glove tears arising

from handling sharp instruments during surgical procedures.

METHODS

The study took place from 1995-1996 in a 300-bed private teaching hospital in a large U. S. city, where use of the hands-free technique was hospital policy.

Surgeries/personnel included

Same-day and main operating room surgeries with a full-time circulating nurse present were eligible. Events affecting all physicians, nurses, technicians, physicians' assistants, residents and students were included; anaesthesia personnel were excluded.

Data Collection

At the end of each surgery, data were recorded by the circulating nurse using a standardized two-page questionnaire.

In consultation with scrub personnel, she recorded the extent of hands-free technique use, according to the following categories: 0%, approximately 25%, 50%, 75% or 100% of the time.

She also recorded the type and length of surgery, the amount of blood-loss, the time of day, noise levels during surgery, the number of people present for at least 75% of the surgery and whether or not it was an emergency.

Detailed information was recorded when injuries, contaminations and glove tears occurred.

Reliability Study

In 68 surgeries, the proportion of

hands-free passes was rated independently by the principal investigator in order to test the reliability of the observations made by the circulating nurses.

Data Analysis

Hands-free variable was re-defined as a binary variable. Surgeries in which the hands-free technique was categorized at "75% of the time" or "100% of the time" were considered to have used the hands-free technique; surgeries where use was "0%", "25%" or "50%", it was considered not used.

In the main analysis, all injuries, contaminations and glove tears were "incidents."

To test a more direct effect of passing and handling sharp instruments, analyses only using an injury or contamination specifically associated with handling and passing sharps and all glove tears were done.

Logistic regression was used to estimate the risk ratios (RR) and to produce 95% confidence levels (CI). Since the frequency of incidents was low, the relative risk of an incident when the hands-free technique was used and was not used, was estimated using odds ratios.

Confounding terms included in the regression model were the length of surgery, noise, number of personnel present, time of day, type of surgery,

and emergency status after interaction was established, in order to create the best unconfounded model.

Surgeries were grouped into four categories: orthopedic surgeries, other surgeries (in which types such as plastics, gynecology, ENT and urology were combined), general surgeries and cardio-thoracic and cerebro-vascular (CVT) surgeries.

Length of surgery was divided into three categories: 1 hour or less, 1-2 hours and greater than 2 hours.

Bloodloss was dichotomized as less than or more than 100ccs.

Noise levels were divided into "quiet and normal" versus "loud."

Shifts were divided into day versus evening and night.

The number of personnel present at least 75% of the time was dichotomized into 1-5 versus 6 or more. Surgeries were also classified as emergency or non-emergency. Effect modifiers included were: blood loss, type of surgery and length of surgery.

The likelihood ratio, comparing the log likelihoods of models with and without the effect modification terms was first calculated; the effect modification term was only retained if $p < 0.10$ for the corresponding likelihood ratio statistic.

RESULTS

There were 5,388 eligible surgeries in the time frame, but hands-free information was not recorded for 1,623 (30%) of surgeries occurring during the study period. The remaining 3,765 (70%) of eligible surgeries were retained for this study. The loss of data occurred mainly in emergency surgeries, non-day shift surgeries, and cardio-vascular surgeries.

Despite hospital policy recommending use of the hands-free technique, a wide range in use occurred during the 3,765 retained surgeries. In the aggregate, 42% of passes were made using the hands-free technique (100% use in 19% of surgeries and 75% use in 23% of surgeries); 58% of passes were made not using the hands-free technique (50% use in 37% of surgeries, 25% use in 13% of surgeries and 0% use in 8% of surgeries).

Use of the hands-free technique was less common in CVT surgery as well as during emergency non-day-surgery, when blood loss was greater than 100cc and when 5 or more persons were present during surgery greater than two hours long (Table 1).

A crude OR=0.41 (95% CI 0.30-0.60) was first calculated using the number of events when the hands-free technique was used and not used (Table 2).

Of the surgeries where events were reported, most reported only single events, however, in one surgery there were three events and in seven there were two events each. Further, in two surgeries two injuries and two glove tears occurred at the same time, while in the other surgeries with more than one event they all occurred at different times.

A full model using all events, and the three effect modification terms, as well as all established potential confounders, was first used in the analysis.

The result showed a statistically significant interaction between hands-free technique and bloodloss.

The final model included the effect modification term, hands-free technique, bloodloss and type of surgery, length of surgery, emergency status, noise level, shift when surgery occurred and number of personnel present.

When blood loss was greater than 100cc, and the hands-free technique was used, risk was reduced by 59%

	Number of Surgeries	Number (%) of events*	Use (%) of hands-free technique
Over-all			
Number	3,765	144 (3.8%)	(42.0%)
Surgical specialty			
General	992	33 (3.3%)	(48.0%)
Other	975	20 (2.1%)	(48.0%)
Orthopedic	1156	14 (1.2%)	(42.0%)
CVT	639	77 (12.1%)	(22.0%)
Number of personnel in operating room			
1-5	2271	47 (2.1%)	(47.0%)
More than 5	1494	97 (6.5%)	(34.0%)
Length of surgery			
1 hr or less	1499	7 (0.5%)	(47.0%)
1-2 hr.	1261	37 (2.9%)	(45.0%)
More than 2 hr.	995	100 (10.1%)	(30.0%)
Bloodloss			
100cc or less	2350	34 (1.4%)	(46.0%)
Greater than 100cc	1391	109 (7.8%)	(36.0%)
Shift			
Days	2989	126 (4.2%)	(45.0%)
Evenings/nights	776	18 (2.3%)	(31.0%)
Emergency non-emergency status			
Emergency	352	4 (3.9%)	(32.0%)
Non-emergency	3334	127 (3.8%)	(43.0%)
Noise level**			
Quiet	1597	58 (3.6%)	(45.0%)
Noisier	2032	83 (4.1%)	(39.0%)

*Numbers do not add up to 144 events for each category because of missing data.
** Judged by circulating nurse

	Event	No Event	Total
HF Used	33 (2.1%)	1512 (97.9%)	1545
HF Not-used	110 (5.1%)	2043 (94.9%)	2153
Total	143 (4.0%)	3555 (96.1%)	3698

(OR=0.41 (95% CI 0.23-0.72). The protective effect of the hands-free technique was not present when bloodloss was less than 100cc (OR=0.99 (95% CI 0.49-1.98).

The analysis using only a restricted number of events (all glove tears and only those injuries and contaminations more directly related to passing sharp instruments) found that when blood loss was greater than 100cc, and the hands-

free technique was used, risk was reduced by 57% (OR=0.43 (95% CI 0.21-0.86). The protective effect of the hands-free technique was not present when bloodloss was less than 100cc (OR=1.49 (95% CI 0.68-3.31).

The reliability study between the principal investigator and the circulating nurses resulted in inter-rater agreement of 0.72 [95% CI 0.54-0.90] based on SE=.09.

COMMENT

The primary goal of this study was to assess the effect of a recommended surgical work practice, the hands-free technique, on the rate of injuries, contaminations and glove tears that can potentially lead to transmission of blood-borne diseases between patients and operating room personnel. Results showed that when blood loss during surgery was greater than 100 cc, use of the hand-free technique was protective by approximately 60%.

The underlying assumption is that the hands-free technique, used approximately 40% of the time during this study, goes beyond simply passing sharps indirectly; it is, in fact, part of a system of regularizing operating room work practices by establishing a common routine among a diverse group of skilled workers, who may or may not regularly work together.

This study addressed the reduction of blood and body-fluid related events during surgery, including all glove tears, contaminations and injuries. These events increase the risk of transmission of blood-borne pathogens. Interestingly, these events were related and rose and fell in concert for all risk factors of interest except during non-day shift surgeries, when the rate of tears and contaminations was lower rather than higher as expected, while the rate of injury did not change. This may be explained by a reluctance to report "minor" occurrences on evening and night shifts, when staff numbers were reduced and when staff frequently worked overtime.

This study has limitations. Although it is unknown whether such variables as personnel age, gender and experience of the surgical team, may be associated with utilization of the hands-free technique, it is unlikely that these would have biased the results of the study. For example, the hands-free technique was hospital policy, not a work practice that was likely disseminated by medical or nursing schools and primarily attributable to

younger surgeons or nurses. Use of the technique was therefore an individual decision influenced by hospital policy not thought to be related to schooling. Even if younger surgeons were more likely to use the hands-free technique, those same surgeons, because of their relative inexperience, could also have been expected to have more events than surgeons with greater experience.

The response rate for CVT surgeries was almost 10% less than average and during CVT surgery the hands-free technique was used approximately 23% of the time compared to 40% in surgeries as a whole; the event rate in CVT surgeries was approximately 12% compared to 4% of over-all surgeries. Questionnaires were filled out for approximately 61% of all CVT surgeries versus the over-all response rate of 70%. If there was a different event rate in non-responders compared to responders, this may have been a source of bias.

The evaluation of hands-free use was made at the end of surgery, after any possible injuries, contaminations or glove tears. If estimation of the amount of use of the hands-free technique (higher or lower proportion) was affected by the occurrence of an event, this may also have resulted in bias; however we think that the risk for this bias was minimized because hands-free classification was usually the result of consultation between those closer to the surgical site, together with the circulating nurse who recorded events. In addition, the reliability study found that the level of concordance between the circulating nurses and the principal investigator was considered to be very good.

Risk to patients from operating room personnel may also be significant. The operating room is a place where transmission of blood-borne pathogens to patients is always possible.

The use of the hands-free technique, in so far as it reduces the number of operating room accidents during which a

surgeon or other personnel could potentially contaminate a patient, could be used as an additional measure to make surgery safer.

Despite recommendations from professional bodies, the hands-free technique is not widely used. The reasons for this can only be speculated upon, although some surgeons who did not use the hands-free technique during this study, commented that picking up sharp instruments from a field or basin would make them remove their eyes from the surgical site for brief moments or might result in longer surgeries. Surgeons who did use the hands-free technique though, did not perceive any deterioration in technique or over-all patient care.

If an element in surgeons' resistance to change their practice has been a lack of evidence of the hands-free technique's effectiveness, the results of this study may lead to change.

Operating room nurses have shown more of an interest in the hands-free technique as demonstrated by their early recommendations and publications on the subject.

This study may provide the evidence required to improve chances of having the practice implemented by them and further evaluated.

As well, hospital administrators may, as a result, be more likely to implement the hands-free technique as a hospital policy.

This study could apply to most hospitals in North America.

Although the hospital in which the study was carried out was privately funded, it is located near the downtown core of a large American city, and accepted uninsured patients.

Hospital surgeons carried out complex as well as routine surgery and the majority of surgeons who worked in this hospital carried out surgery in more than one facility.

RECOMMENDATIONS

In so far as operating room work practices in this facility are typical of surgeries in other hospitals, this study lends weight to recommendations made by vari-

ous professional bodies that the hands-free technique be employed as a safety measure. However more definitive evidence should come from an experimental study.

For more information contact:
Bernadette Stringer, 2736 Cambridge

Street, Vancouver B.C. V5K-1L7,
Canada **Telephone:** (604) 254-4296

Fax: (604) 254-4251
Email: bstringer@home.com