ORIGINAL ARTICLE

Skin preparation in the hand surgery clinic: A survey of Canadian plastic surgeons and a pilot study of a new technique

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ABSTRACT

Background: Preparation of a patient's skin by application of an antiseptic solution is performed prior to hand surgery as a standard procedure; this study surveyed current practice and examined conversion to a new technique.

Methods: Part 1: an electronic survey was sent to members of the Canadian Society of Plastic Surgeons; Part 2: the current standard technique of nurse-applied antiseptic solution (Povidone 10% w/v (Lernapharm Inc, Saint-Laurent, QC, Canada); Part 3: patients applied their own antiseptic solution (Avagard™ CHG - (Chlorhexidine Gluconate 1% Solution and Ethyl Alcohol 61%, w/w) 3M London, ON, Canada) under nursing supervision; time to complete, cost estimates, and infection rates were compared. Study participants for parts 2 and 3 included a consecutive sample of patients presenting for hand surgery.

Results: 32% of Canadian Plastic Surgeons responded to the survey. 81% did not require patients to wash their hands; 82% indicated that the surgeon applied the prep solution; 78% utilized alcohol/chlorhexidine; 82% used a prep kit; no respondents used a technique of patient-applied solution.

In the clinical study, 21 patients underwent the standard technique, 24 patients utilized the patient-applied technique. The standard technique averaged 131 seconds, the modified technique 47 seconds, significantly quicker ($p<0.0001$). No surgical site infections occurred in either group.

Conclusions: Changing technique resulted in a significant time savings, allowing for 1 additional procedure to be performed in an average clinic day. Processing and waste from use of the prep kits was eliminated, institutional costs were marginally decreased, and the rate of surgical site infections was not altered.

KEYWORDS:
Surgery; ambulatory clinic; skin preparation

INTRODUCTION

The objective of the preparation of a patient's skin prior to surgery is to reduce the incidence of surgical site infections (SSIs). This is thought to be achieved by reducing the bacterial burden resident on the patient's skin prior to making a surgical incision. Two cornerstones of this preparation include a pre-operative wash with soap or an antiseptic agent, and the application of an antiseptic solution to the patient's skin by a member of the healthcare team. Although the effectiveness of the pre-operative wash is not without controversy, it is recommended to be performed prior to the making of a surgical incision by many organizations, including the Canadian Patient Safety Institute [1]. At our institution, Sault Area Hospital (SAH) in Sault Ste. Marie, ON, Canada, washing with soap followed by the application of an antiseptic solution by a nurse is the current standard of care prior to the performance of outpatient hand surgery.

As the efficacy of the pre-operative wash is unclear [2], the first objective of this study was to determine current skin preparation techniques in use in Canadian ambulatory clinics performing hand surgery. The second and third parts of this study were designed as a proof of concept study; the purpose was to observe parameters of the current technique of nurse-applied antiseptic solution used at our institution, followed by observing the same parameters with changing to a patient-applied antiseptic solution.

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We investigated if the change in technique conferred any advantages and whether or not it adversely affected SSI incidence.

METHODS

All parts of this research study were approved by the Joint Group Health Centre/Sault Area Hospital Research Ethics Board, in accordance with the Tri-Council Policy Statement 2 issued by the Panel for Research Ethics for the Government of Canada.

Part 1

An electronic survey was sent out via email to all members of the Canadian Society of Plastic Surgeons in 2015, followed up by two further invitations to participate at 1 week and 1 month. The survey was designed to sample current patient skin preparation practices by Canadian plastic surgeons in the ambulatory care hand clinic. Surgeons were requested to answer 4 questions pertaining to their practice in the ambulatory hand clinic (Appendix A).

Part 2

This portion of the study was performed in the ambulatory hand surgery clinic of our community hospital, SAH in Sault Ste. Marie, Ontario Canada. We utilized a quasi-experimental design in which patients presenting on days 1 and 2 were enrolled in Part 2, and patients presenting on days 3 and 4 were enrolled in Part 3. Potential participants were all patients presenting to the clinic for surgery on the study days; all patients were scheduled to receive either carpal tunnel release or stenosing flexor tenosynovitis release surgery. Inclusion criteria were fluency in the English language, being physically able to participate in the study (i.e., possessing 2 functional hands) and possessing competence to follow instructions from the nurse. Exclusion criteria were a history of diabetes mellitus or any immunocompromising illness. Every patient attending clinic on the study days was screened for eligibility, and all eligible patients were invited to participate. Informed consent was obtained from all individual participants included in the study.

Skin preparation was twofold. First, all patients washed their hands with soap and water. Second, the operative hand was held out over a side table by the patient, and the surgical nurse assistant applied povidone 10% w/v prep solution (Lernapharm Inc, Saint-Laurent, QC, Canada) using the standard prep kit supplied by the hospital's sterile processing department, with the povidone solution poured into a sterile medicine cup provided in the kit. The solution was painted onto the patient's skin to just proximal to the wrist, then sterile towels were applied to create the sterile field for surgery. The time for the second part of the procedure was recorded by the research assistant observing from a sitting position at the side of the room. Start time was determined as the time the nurse assistant commenced opening the prep kit; stop time was determined as the time when the sterile towel application was completed.

Part 3

This portion of the study was conducted in the exact same setting of the community hospital ambulatory hand surgery clinic, with the exact same nursing staff. Patients were screened for participation and informed consent obtained in the same fashion as Part 2. The first stage of the patient washing their hands with soap and water was repeated - the second stage was altered to a patient-applied hand antiseptic solution. Specifically, the patient was instructed how to apply the solution (Avagard™ CHG - (Chlorhexidine Gluconate 1% Solution and Ethyl Alcohol 61%, w/w) 3M London, ON, Canada) by the clinic nurse, who proceeded to observe the patient apply 1 pump (2 mL) of the solution from the hands-free applicator, and coached them on application to all surfaces of their operative hand by their contralateral hand, up to the wrist. The nurse then applied sterile towels to create the sterile field for surgery. The time for Part 3 was defined as starting when the clinic nurse commenced explanation of the procedure to the study patient, and ended when the sterile towel application was completed. Recording by the research assistant was in identical fashion to Part 2.

All patients in Parts 2 and 3 of the study were followed and assessed for SSI according to the Center for Disease Control standard Surgical Site Infection criteria for 30 days [3]. This was done in person by the senior author (TJB) at day 14 or 15; at that visit, the signs and symptoms of infection were reviewed with the patients, and they were requested to contact the surgeon if any of those developed up to day 30.

RESULTS

Part 1

32% of the surveyed members of the Canadian Society of Plastic Surgeons responded with a completed survey (n = 130) (Figures 1-4).

FIGURE 1: Survey response from Question 1: Are patients required to wash their hands prior to the procedure?

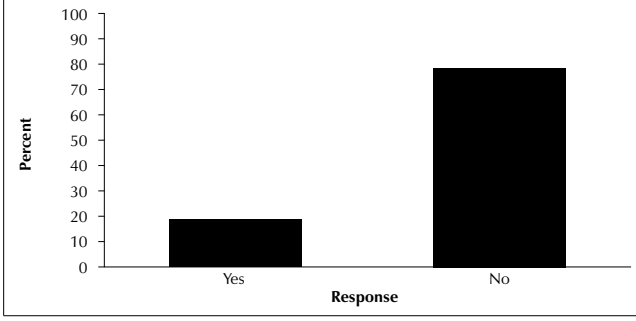


FIGURE 2: Survey response from Question 2: Who applies the skin prep solution?

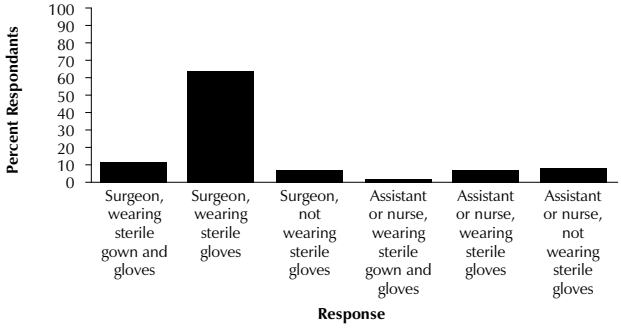
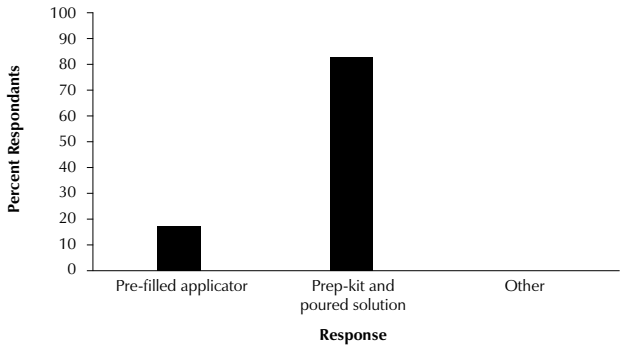


FIGURE 3: Survey response from Question 3: What skin prep solution is routinely used?

FIGURE 4: Survey response from Question 4: What type of product do you use?



Parts 2 and 3

Patients were enrolled in the study over 4 consecutive days of hand surgery clinic. All patients meeting the inclusion criteria were offered participation in the study, and all eligible patients over those 4 days decided to participate. 21 patients were enrolled in Group 1 over days 1 and 2, 24 patients were enrolled in Group 2 over days 3 and 4 (Table 1). No patients were taking any immunosuppressive therapy.

TABLE 1: Time to complete pre-surgical hand preparation.

	Group 1	Group 2
Number	21	24
Mean Time (s)	130.9 +/- 46.2	46.7 +/- 17.2

DISCUSSION

Results from the survey of members of the Canadian Society of Plastic Surgeons revealed that the majority (82%) of respondents did not require their patients to wash their hands prior to the procedure (Figure 1). This does not follow the recommendations of the Canadian Patient Safety Institute (CPSI) to include a "pre-op wash with soap or antiseptic agent" [1]. It is not clear if this was an accurate representation, or if a greater percentage of patients did wash their hands than was reported but the surgeons involved were unaware of that practice (perhaps handwashing occurred as part of the admission process but the surgeon was unaware). A 2015 Cochrane Review concluded there was no evidence to support this practice [2]. Nevertheless, it raises the possibility that there is the opportunity to increase compliance with the CPSI recommendations to include a "pre-op wash with soap or antiseptic agent" to potentially reduce the incidence of SSIs in this setting [1].

Most survey respondents indicated that the prep solution application was performed by the surgeon wearing sterile gloves (Figure 2). Both the Canadian and American Operating Room Nurses Associations publish guidelines on this issue, directing that application of the antiseptic solution for surgical skin preparation be done by "non-scrubbed personnel" [4, 5]. However, no literature support for this recommendation is found in their publications, nor could the authors find a similar recommendation in any of the cited references in this publication. It is unclear if compliance with this guideline would reduce the incidence of SSIs in this setting.

The agent used for the prep solution was an alcohol/chlorhexidine solution for 78% of survey respondents (Figure 3). The CPSI does not specify the exact agent for "skin cleansing", i.e. the skin prep [1]. The Society for Healthcare Epidemiology of America gives firmer recommendations with respect to agent to use, noting high quality evidence exists for the use of alcohol, but conflicting evidence exists on whether combining alcohol with povidone-iodine or chlorhexidine is better [6]. The 2015 Cochrane Review on the topic notes 1 poor quality study reporting lower infection rates following clean surgery when chlorhexidine-alcohol was used for skin prep as opposed to alcohol-based povidone iodine, so no conclusion on which agent was recommended for routine use was reached [7]. Most recently, the World Health Organization issued Global Guidelines for the Prevention of Surgical Site Infection and stated that "despite current knowledge of the antimicrobial activity of many antiseptic agents and application techniques, it remains unclear what is the best approach to surgical site preparation" [8]. In summary, current recommendations cited conclude at this time that both chlorhexidine-alcohol and povidone-alcohol are effective surgical site prep solutions in the prevention of SSIs.

The final survey question explored materials used for the application of the prep solution. 82% of surgeons utilized a prep kit and poured solution, and none reported patients self-applying prep solution to their skin (Figure 4).

The clinical portion of this study (Parts 2 and 3) examined the current practice for hand skin preparation prior to surgery at a Canadian community hospital, and compared it to modifying to a patient-applied technique of skin preparation. The study design was a non-randomized interventional clinical trial. These were outpatient surgeries with primary wound closure, classified as clean wounds by the CDC [7]. There are 2 methods available to healthcare personnel to apply antiseptic solution to patients either using a commercially prepared package, which comes sterilized from the manufacturer in a sealed plastic wrap, or using a hospital prepared reusable kit with sterile disposable gauze or cotton balls added to absorb the solution and apply it to the patient's skin. In Part 2, of this study, nurses utilized standard

prep kits provided by our hospital, prepared in the sterile-processing department, including sterile disposable gauze.

For Part 3 (patient-applied hand antisepsis) we chose to use Avagard™ a solution of Chlorhexidine Gluconate 1% Solution and Ethyl Alcohol 61% in an emollient base (3M London, ON, Canada). Although designed for use by surgical personnel rather than for patients, we chose this product for this off-label usage as it is easy to use, was readily available in our clinics, and in its literature reports "over 98% kill of harmful bacteria in 15 seconds" [9]. With respect to the emollient, we did not see any adverse effects on the patient's skin or the surgical wounds, either at the time of surgery or in the follow-up 30 days. It is possible that some patients will experience an irritant or allergic reaction to the product, but that was not seen in this small pilot study. Surveillance for such reactions would be required in clinical use of the product in this application.

Switching from a nurse-applied solution to a patient applied hand rub saved an average of 84.25 seconds per case in this study, a significant time reduction ($p<0.0001$). In the SAH clinic, an average of 16 procedures are performed in a 6 hour day (22.5 min per procedure), resulting in a cumulative time saving of 22.5 minutes – hence allowing 1 more procedure per clinic day to be performed, without extending clinic hours.

It was difficult to determine a true measure of the financial savings switching methods represented, as the hospital was not able to determine a calculation of the cost of preparing, delivering, and reprocessing the prep kits. For this analysis, we substituted the cost of disposable prep kits (our hospital cost $2.33 each). The cost of the two solutions per procedure was 12.5 cents for Avagard™ and 23.4 cents for povidone, giving a material cost savings of $2.45 per case (all costs in Canadian dollars). This represented a small financial savings of marginal significance; perhaps more importantly it meant no cost increase was incurred by switching to the new method. However, more significant savings were found in the reduction of the medical waste, the elimination of the central supply processing of the kits, and eradicating the need to supply and stock the prep kits in the clinic. Lastly, when asked after study completion for comments on the new procedure, the clinic nurses noted contentment with eliminating the 'somewhat tedious' process of skin preparation by their painting of the hand skin (especially all surfaces of the fingers) with antiseptic solution. Nonetheless, they also noted that due either to language, cognitive or physical barriers, some patients will not be able to comply with effectively completing a self-applied surgical skin preparation procedure and the standard procedure needs to remain available for those patients.

Some limitations of this study are that it was not blinded and did not include a control group. Surgery was limited to carpal tunnel release or stenosing flexor tenosynovitis release surgery, performed by a single practitioner. Although no SSIs were noted in either group, or any adverse effect of utilizing the chlorhexidine gluconate/ethyl alcohol with emollient, this proof of concept pre-post study will need to be followed by a larger study to be sure this change in process does not lead to adverse events and that efficiencies are realized.

APPENDIX A:
Ambulatory hand clinic skin prep survey questions.

1. ***Are patients required to wash their hands prior to the procedure?***
   - ◯ Yes
   - ◯ No

2. ***Who applies the skin prep solution?***
   - ◯ Surgeon, wearing sterile gown and gloves
   - ◯ Surgeon, wearing sterile gloves
   - ◯ Surgeon, not wearing sterile gloves
   - ◯ Assistant or nurse, wearing sterile gown and gloves
   - ◯ Assistant or nurse, wearing sterile gloves
   - ◯ Assistant or nurse, not wearing sterile gloves

3. ***What skin prep solution is routinely used?***
   - ◯ Povidone (Iodine)
   - ◯ Chlorhexidine/Alcohol
   - ◯ Other (please specify)

4. ***What type of product do you use?***
   - ◯ Pre-filled applicator
   - ◯ Prep-kit and poured solution
   - ◯ Other

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