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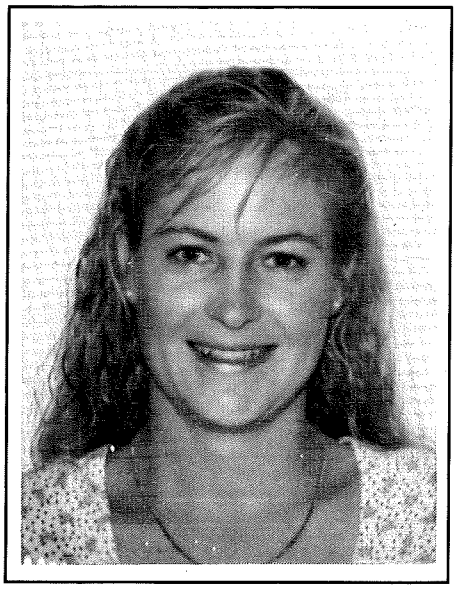
GLOVE PERFORATIONS IN PAEDIATRIC SURGERY: A STUDY OF INCIDENCE



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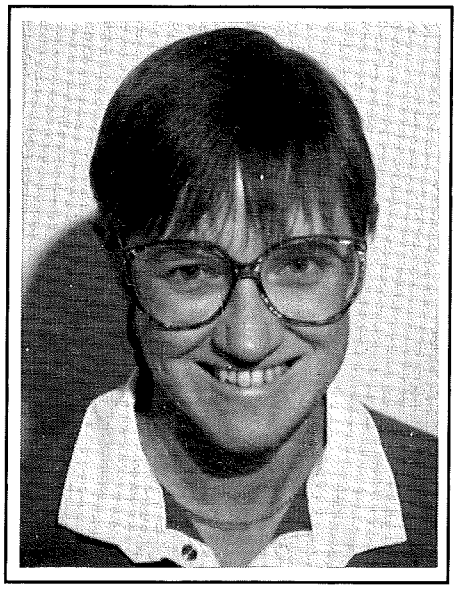

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INTRODUCTION

As the incidence of infection by the Hepatitis B and Human Immunodeficiency (HIV) viruses has become increasingly prevalent in the community, work practices have been reviewed in order to maximise protection for all health care workers. All blood and other body tissues and fluids are now regarded as being potentially infectious and, in an effort to protect individuals working in the health care industry from the hazards associated with these substances, Universal Blood and Body Substance Precautions have been introduced throughout the world.

Because of their increased contact with body fluids and/or tissues, operating room personnel depend upon reliable surgical gloves to minimise the possibility of contact with potentially contaminted body fluids, as "intact latex surgical gloves are known to be impermeable to HIV, but perforated gloves constitute no barrier".

In recent years several studies have been undertaken throughout the world to determine the incidence of perforation in used surgical gloves and, like the trials completed by Gani[1], studies by Fell et al[2] and Brough, Hunt and Barrie[3] have indicated that double gloving can reduce cutaneous hand exposure to blood, therefore increasing the degree of protection against the patient's tissue and body fluids and reducing the risk of contamination by pathogens.

The aim of the study described here was to determine the rate of glove perforations during surgery and compare the rate with similar studies. Furthermore, the survey sought to determine whether the incidence of perforation could be linked to specific kinds of surgery or speciality, occurred in one type of glove more than another, occurred without the wearers knowledge, indicated a need for double gloving in procedures found to have a high risk of glove perforation.

METHOD

Prior to the commencement of the study, theatre staff were notified of the intention to undertake a study of used gloves via notices placed in each theatre and on general notice boards in the theatre suite. These notices outlined the aims of the study and described how the gloves were to be collected. The results of a small pilot study (which had yielded a perforation rate of 20.5%) were also included — to justify the reason for undertaking the study.

The Nature of the Gloves Tested

All the gloves tested in this study were made by the Ansell Medical Company. These gloves, purported to be individually electronically tested before use, were noted to have an Acceptable Quality Level (AQL) of $<0.065\%$[4], (with the exception of the eight Dermaprene gloves which had an AQL of 1.5%). It was therefore considered that the gloves were unlikely to be perforated prior to surgery.

Collection of Gloves

At the end of each case (performed during normal working hours for one week) all gloves were collected, double bagged and sent to the sluice in the Theatre Sterilising Unit to await testing.

Gloves excluded from the study were gloves from 'dirty' cases — to minimise the risk of cross infection

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At Princess Margaret Hospital for Children, a study was undertaken to determine the incidence of perforation in used surgical gloves. A total of 393 gloves from 85 surgical procedures were tested using a method which replicated that of other similar studies. Findings revealed an overall glove perforation rate of 15.27% and demonstrated significant relationships between the incidence of perforation and both the duration of the surgery and the presence of powder in the glove. The researchers therefore recommend that consideration be given by operating room staff to wearing unpowdered gloves when undertaking those procedures identified as being likely to result in perforation.

and gloves collected from orthopaedic cases where a plaster of Paris had been applied. This was because it was considered that the spicules of dried plaster which adhered to these gloves could possibly be responsible for the perforations — rather than the surgical procedure itself.

Data Collection Form

Accompanying each bag of gloves was a form (Figure 1) on which the scout nurse had entered basic information regarding the date, order on the list, theatre number, nature of the operation (RIH, tonsillectomy, appendicectomy etc) and the duration of the surgery.

To facilitate the identification of the gloves, the form also provided for staff to record the size of and presence of powder in the gloves worn by each member of the surgical team —as well as the designation of the wearer (eg doctor, doctors assistant, scrub nurse).

If a glove was changed during the procedure — due to perforation or contamination, this information was recorded by circling the offending glove on the diagrams incorporated into the data collection forms and by drawing an arrow to indicate the replacement glove. Where two staff members wore the same size and type of glove (eg size 7 powdered) one pair of gloves and the corresponding diagram was marked with a cross to distinguish each pair.

In addition, staff were also asked "Was anyone aware of any perforations?" This question was included to eliminate the possibility of perforations incurred after the completion of a case (whilst tidying up the instruments for example) being attributed to the procedure itself.

Testing the Gloves

A 500 ml bottle was filled with water and a few drops of blue ink added. The gloves were turned right side out and the water was then tipped into each glove. The cuff was secured by twisting it — rather than by an artery forcep which had the potential to perforate the glove.

The glove was tested by applying pressure to each finger in turn and then to the body of the glove, while squeezing the fingers and thumb. Perforations were visible as a blue tinted stream of water leaking from the glove.

The site of any hole/s detected was recorded on the glove outlines incorporated into the data collection form. Gloves were tested throughout the day — time permitting and at the end of each testing session, the control gloves were tested using the same method used to test the used gloves.

With the exception of size 5½ which was too small and sizes 8 and 8½ which were too big and interfered with the testing procedure, both powdered and non-powdered gloves of all sizes were used as controls. The control gloves were

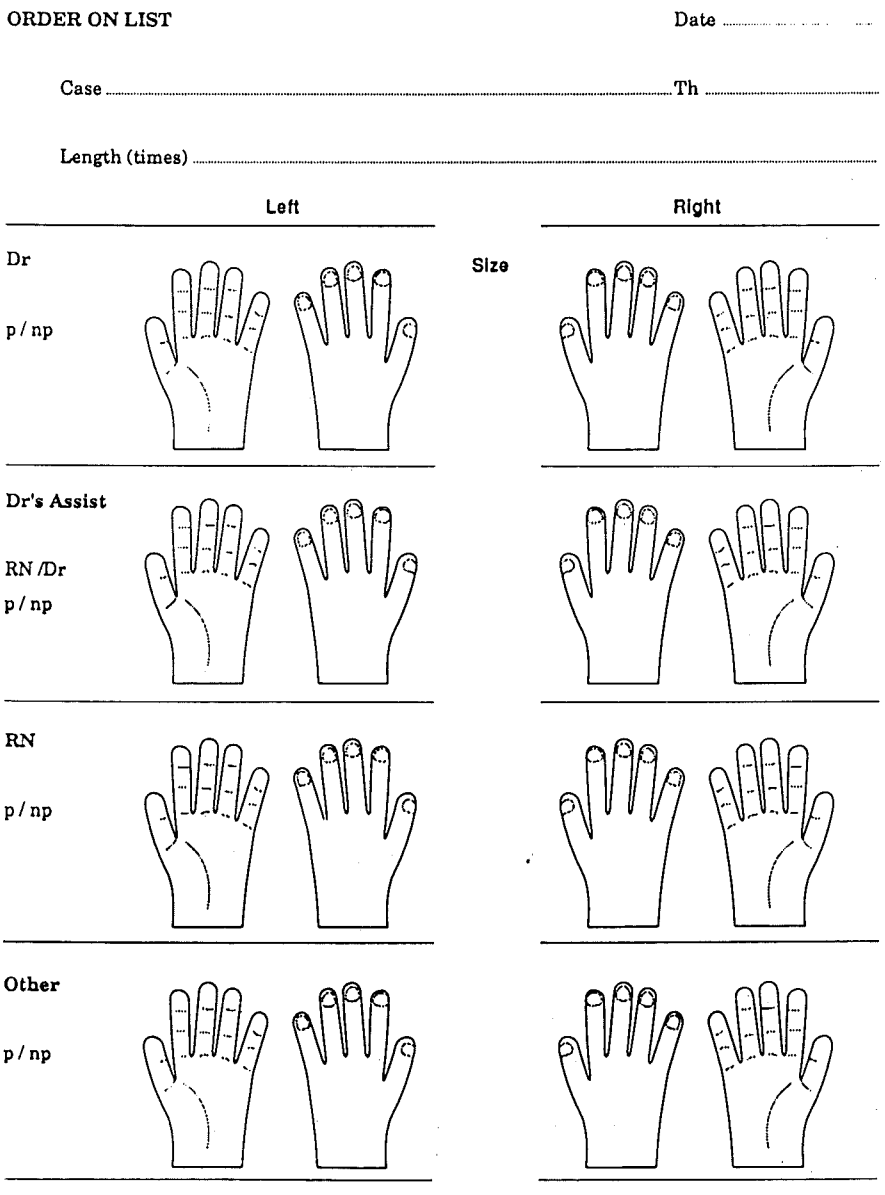

Figure 1.

selected at random from the three scrub rooms and were worn for between 1-2½ hours at a time — while testing the used gloves. Of these controls, the right hand of a size 7½ powdered variety was the only glove found to be perforated on subsequent testing. Although it is believed that the two holes found in the right thumb of this glove were caused by the jagged right thumb nail of the researcher, this explanation is pure conjecture.

RESULTS

In total, 393 gloves were collected from 85 cases. Of these 60 gloves showed at least one perforation to give an overall perforation rate of 15.27% which is almost twice the 8.8% detected by Fell et al[2]. Although in some gloves, more than one hole was detected, this fact has not been reported separately as only intact latex surgical gloves are known to be impermeable to HIV — the number of perforations being incidental once the barrier is breached.

Using the Statistical Analysis System (SAS), chi squares were calculated for the incidence of perforation against those variables identified in the literature as possibly contributing to glove failure. The critical value of 'p' was established at 0.05. In Table 1, the incidence of perforation is depicted by staff designation and although the registered nurses assisting the doctor would seem to perforate their gloves more frequently, this was not confirmed by statistical analysis.

In Table 2, obvious differences can be observed between the surgical specialties when the rates of perforation are compared. Although these differences have been statistically confirmed, counts of less than five in three of the categories detract from the validity of the chi square result.

The apparent difference between the rates of perforation in powdered and in non-powdered gloves (as depicted in Table 3) has been statistically confirmed as has the obvious increase in the number of perforations in longer procedures (Table 4). Of the staff who perforated their gloves, 85% were reportedly unaware of the damage (p = 0.0000). As in Gani's study of single gloves[1], the index finger was the site most commonly perforated (44 cases) and this was found to be highly significant (p = 0.000) when compared to the numbers of perforations sustained in the webs of the fingers (4 cases) or palm of the hand (12 cases).

Table 1. Incidence of perforation by designation of staff member.

Staff designation	Not Perforated	Perforated	Rate %
Doctor	142	30	17.4
Doctors assistant (Dr)	49	8	14.0
Doctors assistant (RN)	10	4	28.6
Scrub nurse	132	18	12.0
Total	333	60	15.27

p = 0.27

Table 2. Incidence of perforation by surgical specialty.

Surgical specialty	Cases	Not Perforated	Perforated	Rate %
Cardio thoracic	3	10	12	54.54
Neuro	6	21	11	34.37
Dental	5	15	5	25.00
Bone marrow harvest	1	12	4	25.00
Plastic	9	26	5	16.13
General	22	112	16	12.50
Ophthalmic	8	30	2	6.25
ENT	27	97	5	4.90
Orthopaedic	4	10	0	0.00
Total	85	333	60	15.27

p = 0.000

Table 3. Incidence of perforation by presence of powder.

	Not Perforated	Perforated	Rate %
Powdered	131	35	21.08
Not Powdered	196	25	11.31
Dermaprene	6	0	0.0
Total	333	60	15.27

p = 0.017

Table 4. Incidence of perforation by duration of surgery.

Duration	Not Perforated	Perforated	Rate %
< 30 mins	110	4	3.51
30-60 mins	133	19	12.50
61-120 mins	63	16	20.25
> 120 mins	27	21	43.75
Total	333	60	15.27

p = 0.000

DISCUSSION

This study has demonstrated an overall rate of glove perforation of 15.27%. As in Fell's study[2], statistically significant differences have been demonstrated in the rates of perforation and the duration of the surgery and also between powdered and the thicker non-powdered gloves.

Cardiothoracic surgery has been identified as producing the highest incidence of glove perforations but this finding is not surprising, considering that staff have been observed to handle up to 80 atraumatic sutures during these procedures. This risk has been noted to be further compounded by the fact that this type of surgery often exceeds two hours.

The fact that only 15% of staff were aware of perforating their glove/s during surgery has given rise for some concern about personal and patient safety, especially as 'the holes may be a portal for HIV infection, particularly in the presence of minor skin abrasions on the hands of theatre staff'[1].

While no significant differences could be demonstrated between the number of perforations detected in the gloves worn on the preferred hand when compared to the non-preferred hand, it is interesting to note that all gloves collected were from right handed staff. The manoeuvre of repositioning atraumatic needles onto needle holders may have contributed to the number of holes detected in left handed gloves however, as the needle holder is commonly held in the right hand while the needle is picked up in the fingertips of the left hand.

IMPLICATIONS FOR PRACTICE

This study has identified those factors which increase the risk of glove perforation and subsequent cross infection during surgery. On the basis of the findings of this trial, it seems appropriate to ask staff to change gloves during lengthy procedures. According to Gani[1] however, 'although this procedure might reduce the risk of hand/skin contamination, repeated regloving is often associated with minor breaches of aseptic technique . . . rather than changing gloves therefore, it is recommended that theatre staff wear unpowdered gloves when undertaking procedures which have been identified as having a high risk of perforation. Furthermore in long, difficult or infectious cases it is hoped that staff will consider double gloving, as an additional means of protection for both staff and patient alike.

ACKNOWLEDGEMENTS

The authors would like to thank the theatre staff at Princess Margaret Hospital for Children for their co-operation in collecting the gloves for this study and Ralph Baker for his assistance with the artwork for the data collection form.

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