

## Comparison of surgical gloves perforation in open and laparoscopic cholecystectomy

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### Abstract

**Background:** Health care workers are at risk acquiring viral diseases such as HBS, HCV or HIV through exposure to contaminated blood and body fluids at work. Most often infection occurs when health care workers inadvertently puncture the skin of their hand with a sharp implement that has been used in the treatment of an infected patient, thus bringing the patient's blood into contact with their own. The objective of this study was to compare the frequency of unnoticed surgical gloves perforation of the operating surgeon and the first assistant in open and laparoscopic cholecystectomy.

**Material and methods:** This prospective randomized controlled trial was conducted at the Department of Surgery, Khyber Teaching Hospital, Peshawar over a period of two years from July 2015 to June 2017 on 374 patients, hospitalized for open and laparoscopic cholecystectomy after fulfilling the inclusion and exclusion criteria. Patients were randomized into two groups by lottery method. Group-A comprising of 187 patients were to undergo open cholecystectomy while group-B comprising of 187 patients were to undergo laparoscopic cholecystectomy. Gloves from the operating surgeon and the first assistant were collected after operation and tested immediately using water leak test which is an approved standardized method to detect holes after filling up the gloves with 1000 ml of water. Data were compiled and analyzed with SPSS19.

**Results:** In group A (open cholecystectomy), the perforation rate was 15% (28) of which 50% (14) were in dominant hand while in Group B (laparoscopic cholecystectomy) the perforation rate was 6% (11) of which 36.3% (4) were in dominant hand. Status of operating team was analyzed as in group A 50% (14) were operating surgeons while 50% (14) were first assistants. Where as in group B 81.8% (9) were operating surgeons while 18.1% (2) were first assistants.

**Conclusion:** In view of the critical importance of safety at work by having a safety barrier between surgeon and patients it is extremely important to use double gloves in open cholecystectomy.

**Keywords:** Gloves perforation, open cholecystectomy, laparoscopic cholecystectomy, HBS, HCV, HIV

### Introduction:

Health care workers are at risk acquiring viral diseases such as HBS, HCV or HIV through exposure to contaminated blood and body fluids at work. Most often infection occurs when health care workers inadvertently puncture the skin of their hand with a sharp implement that has been used in the treatment of an infected patient, thus bringing the patient's blood into contact with

their own. Such occurrences are commonly known as percutaneous exposure incidents.<sup>1</sup>

Both patients and the surgical team need to be protected from this risk. The risk can be reduced by implementing protective barriers such as wearing surgical gloves. However, glove perforations are very common and puncture rates as high as 8-40% is published in the literature

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which are often un-recognized by the surgeon or nurse.<sup>2</sup> There are conflicting results of unnoticed surgical gloves perforation in open and laparoscopic surgical procedures. Studies have shown that the frequency of surgical gloves perforation in open surgery ranges from 9.6% to 30.6% while in laparoscopic surgery it ranges from 3.3% to 25.0%.<sup>3,4</sup>

There is moderate quality evidence that double gloving compared to single gloving during surgery reduces perforations and blood stains on the skin indicating a decrease in percutaneous exposure incidents.<sup>1</sup> The addition of a second pair of surgical gloves significantly reduces perforation to innermost gloves which is the last barrier to pathogens between surgeon and the patient, thus reducing surgical site infections with significant impact on patient morbidity and health care costs.<sup>5,6</sup>

Bacterial migration through un-noticed micro-perforations in surgical gloves occurs under real practice surgical conditions. Un-detected perforation of surgical gloves occurs frequently. Bacterial migration from the patient through micro perforations on the hand of surgeons was confirmed limiting the protective barrier function of gloves if worn over longer periods.<sup>7</sup>

Because of the increase in the rate of micro perforations over time it is recommended that surgeons, first assistants and surgical nurses directly assisting in the operating field change gloves after 90 minutes of surgery.<sup>8</sup> Besides the duration of wearing and the role within the surgical team, the integrity of gloves depends upon the type of surgery performed.<sup>9</sup> Cholecystectomy is one of the commonest procedures in general surgical practices either in the form of conventional open cholecystectomy or minimal invasive laparoscopic cholecystectomy.

The rationale of our study is based upon a research question that although the rate of gloves perforation for different general, orthopedic, urological procedures ranges from 8-40% but there are very few comparative trials comparing the frequency of gloves perforation in open and

laparoscopic procedures. So we want to establish the real statistics of gloves perforation during open and laparoscopic cholecystectomy. This study may bring some suggestion for the safety of both the operating team and the patients in preventing blood-borne infection.

#### **Material and methods:**

This prospective randomized control trial was conducted in Department of Surgery, Khyber Teaching Hospital, Peshawar over a period of two years from July, 2015 to June, 2017.

Sample size was 187 in each group using proportion P1 = 9.6% and P2 = 3.3%. 4 Power of test = 80%, level of significance = 5%.

Inclusion criteria included the surgical gloves worn only by the surgeon and the first assistant for open and laparoscopic cholecystectomy, all the patients for cholecystectomy in our study irrespective of gender and etiology of the disease, operating surgeons of consultant level and good quality latex surgical gloves irrespective of the number of perforations at the end of procedure were included. We excluded known patients of hepatitis-B virus, hepatitis-C virus and HIV because the surgical team usually wears double gloves during surgery on such patients, complicated cholecystectomies and procedures which exceeded more than ninety minutes.

All the health care workers who fulfill the above mentioned criteria and have given informed consent were included in this study. Permission from ethical committee of the hospital was taken. Patients were randomized into two groups by lottery method. Group-A comprising of 187 patients were to undergo open cholecystectomy while group-B comprising of 187 patients were to undergo laparoscopic cholecystectomy. Gloves from the operating surgeon and the first assistant were collected after operation and tested immediately using water leak test which is an approved standardized method to detect holes after filling up the gloves with 1000 ml of water. All the data was collected on structured proforma and the analysis was done on SPSS 19.0 version. Mean and standard devia-

Table 1a: Age distribution of operating surgeon

Age	Group A	Group B
35-45	137	131
46-55	45	49
56-65	5	7
Total	187	187
Mean and SD	44.06 years SD±5.89	45.17 years SD±5.49

Table 1b: Age distribution of first assistant

Age	Group A	Group B
35-45	29	34
46-55	148	148
56-65	10	5
Total	187	187
Mean and SD	30 years SD±1.60	29.88 years SD±1.45

Table 2a: Gender of operating surgeon

Gender	Group A	Group B
Male	172(92%)	167(89.3%)
Female	15(8%)	20(10.7%)
Total	187 (100%)	187 (100%)

Table 2a: Gender of operating surgeon

Gender	Group A	Group B
Male	162(86.6%)	166(88%)
Female	25(13.4%)	21(11.2%)
Total	187 (100%)	187 (100%)

Table 3: Surgical glove perforation

Perforation	Group A	Group B	P- Value
Yes	28(15%)	11(6%)	
No	159(85%)	176(94%)	0.004
Total	187( 100%)	187( 100%)	

Table 4: Dominancy of perforation

Dominancy	Group A	Group B
Dominant hand	14(50%)	4(36.3%)
Non dominant hand	14(50%)	7(63.6%)
Total	28(100%)	11(100%)

Table 5: Status of operating team with glove perforation

Operating Team	Group A	Group B
Primary Surgeon	14(50%)	9(81.8%)
First Assistant	14(50%)	2(18.1%)
Total	28(100%)	11(100%)

age. Frequency and percentage were computed for categorical variables like gender, surgical gloves perforation, perforation in dominant or non-dominant hand and status of operating team. Surgical gloves perforation was stratified using age and gender to see effect modification. Chi-square test was used to compare the surgical gloves perforation between both the groups. P value ≤0.05 was considered as significant. All the results were presented in the form of tables and graphs.

**Results:**

A total of 374 patients were included in this study, which were divided into two groups and each group has 187 patients. The age distribution among two groups is shown in table no.1a and 1b. The gender distribution among two groups is shown in table no.2a and 2b.

Perforation rate, Dominancy and Status of operating team were analyzed among both groups (as shown in table no.3 ,4, 5) respectively.

**Discussion:**

Health care workers are at risk acquiring viral diseases such as HBS, HCV or HIV through exposure to contaminated blood and body fluids at work. Most often infection occurs when health care workers inadvertently puncture the skin of their hand with a sharp implement that has been used in the treatment of an infected patient, thus bringing the patient’s blood into contact with their own. Such occurrences are commonly known as percutaneous exposure incidents.<sup>1</sup>

Our study shows that in group-A mean age of operating surgeon was 44.06 years with SD±5.89 whereas mean age of first assistant was 30 years with SD±1.60. While in group-B mean age of operating surgeon was 45.17 years with SD±5.49 whereas mean age of first assistant was 29.88 years with SD±1.45. In group-A 172(92%) operating surgeons were male and 15(8%) operating surgeons were female, whereas 162(86.6%) first assistants were male and 25(13.4%) first assistants were female. While in group-B 167(89.3%) operating surgeons were male and 20(10.7%) operating surgeons

tion were computed for numerical variable like

were female whereas 166(88%) first assistants were male and 21(11.2%) first assistants were female. In group-A the perforation rate was 15%(28) of which 14(50%) were in dominant hand while in group-B the perforation rate was 6%(11) of which 4(36.3%) were in dominant hand. Status of operating team was analyzed as in group-A 14(50%) were operating surgeons while 14(50%) were first assistants. Where as in group-B 9(81.8%) were operating surgeons while 2(18.1%) were first assistants.

Our result confirms that the frequency of surgical glove perforation is more in open cholecystectomy than in laparoscopic cholecystectomy. Furthermore, it is the operating surgeon who is more prone to surgical glove perforation during open cholecystectomy.

Our study is a randomized controlled trial and is the first one conducted in the present setup. It is cost effective and is eminent in the safety of both the operating team and the patients in preventing blood – borne infections.

The sample size is not very large. In a tertiary care hospital unfortunately the quality of gloves could not be maintained in the study.

According to a study the overall perforation rate was 8% which were more frequently observed after laparoscopic than open cholecystectomy. The gloves worn by the operator were more likely to be perforated than those worn by the assistant in both types of operation.<sup>2</sup> Altogether, 374 cases were studied of the total 39 gloves were perforated of which 28 were in open and 11 in laparoscopic cholecystectomy. The gloves of operating surgeon & first assistant found perforated were 23 and 16 in number respectively. In our study the perforation rates were seen more in gloves worn in dominant hand. In a developing country like ours it is the primary surgeon in open cholecystectomy advised to wear double gloves based on our study results.

Similar results were observed in other studies as the frequency of surgical gloves perforation in open surgery ranges from 9.6% to 30.6% while

in laparoscopic surgery it ranges from 3.3% to 25.0%.<sup>3,4</sup>

In another study the overall glove perforation frequency in all gloves was 8.7 percent. When the occurrence of glove perforation was calculated per operation, the frequency of barrier breach was 22.5% in conventional operations and 10.5% in video-assisted operations. In previous reports, perforations have occurred in 17–30% in surgical gloves during gastro-intestinal surgery.<sup>10-12</sup>

Thus our figures are comparable to those previously published<sup>10,13</sup> The reason for the differences in the perforation frequency between different studies and surgical centers can only be speculated, but it must be a sum of differences in the type of procedures performed, and differences in the surgical technique. The fact that a study on glove perforations is being conducted may cause a bias in the perforation frequency, but the impact of the surgeon's awareness of an ongoing study is difficult to determine.

A clear difference of perforation frequency between conventional and laparoscopic procedures was seen, which is in accord with a recent Danish study.<sup>12</sup> The lower frequency is probably due to a lesser amount of manual handling needed during video-assisted surgery. The majority of glove perforations occur during wound closure in conventional operations<sup>14</sup> and the closure of small incisional wounds in laparoscopy is less prone to cause glove breakage. Therefore, laparoscopic surgery is advantageous not only for the faster recovery of the patient but also considering the safety of the surgical staff. A double breakage of gloves was seen in only 1 of 31 perforations during 101 conventional operations, whereas 35 breakages of single gloves were recorded during 132 operations potentially resulting in blood contamination. Thus the type of the glove had no effect on the probability of perforation, but the usage of a double barrier decreased the incidence of blood contamination of the surgeon's hands by a factor of 27 (35/132 versus 1/101). Therefore, although perforations occur at a similar frequency in single gloves as in

the outer glove of the Biogel indicator system, double breakage of the two gloves is quite rare resulting in a significant improvement of work safety. Similar figures have also been reported by Naver and Gottrup.<sup>12</sup>

In addition of providing safety by the double barrier, gloves with a perforation indicator system enable a prompt detection of a barrier breach when it occurs: In conventional operations, 90% of glove perforations with the indicator system were noted preoperatively, whereas with standard single gloves only 59% were detected. The same tendency was seen in video-assisted procedures. A previous study with a single standard operation showed similar advantage for the use of double indicator gloves, especially with patients with a transmissible disease<sup>15,16</sup>

The majority of perforations in this study as well as in other reports<sup>11,17</sup> occur in the non-dominant hand and in the index finger and thumb in particular. These sites are most prone to be punctured, if the needle is handled directly. Knowledge of the mechanisms and reasons of needle puncture is essential for all surgeons and techniques to avoid punctures should be specially emphasized during surgical training in order to lessen the risks of a surgeon to be exposed to blood-borne pathogens.

The preferences of individual surgeons vary and some claim double gloving uncomfortable.<sup>18</sup> However, the data presented clearly demonstrates the improvement of surgeons' safety by use of double surgical indicator gloving by improving detection of breaches in the doctor-patient barrier and diminishing the risk of blood contamination.

Our study is implicated both on surgeons and patients and thus both the operating team and patients will benefit from it with respect to offer a solution to the increased risk for cross contamination from microscopic perforations. It shall be implicated on surgeons from all the disciplines such as general surgeons, urologists, cardiothoracic surgeons, and many more. In our study there was no correlation studied between glove

defects and operation time, surgeon experience & glove brand. The reasons for female surgeons being more prone to surgical glove perforations during open cholecystectomy need to be sought & hence further research is required in this regard.

#### **Conclusion:**

In view of the critical importance of safety at work by having a safety barrier between surgeon and patient, it is extremely important to use double gloves in open cholecystectomy.

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#### **Role and contribution of authors:**

Dr Mubashira Ahmad, collected the data and references and wrote the initial write up.

Dr Munir Ahmad, helped in collecting the references and helped in introduction and discussion writing.

Dr Ziauddin Afridi, helped in collecting the references and also helped in introduction, discussion writing.

Dr Sikandar Hayat, helped in collecting the data and references.

Dr Riaz Ahmad, helped in collecting the references and helped in discussion writing.

Dr Rafiullah, critically reviewed the article and making final changes.

Dr Ijaz Ahmad, critically review the article and helped in final changes in discussion and result writing.

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