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Original Research Article

A study on patterns of needle - stick injuries among gynaecologic and general surgeons in open surgery

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ABSTRACT

Background: An estimated 3,84,000 percutaneous injuries are reported by HCW in hospitals in the United States each year, placing them at risk of exposure to HIV, HBV, or HCV. Suture needles have been identified as the most frequent cause of injury. They are involved in as many as 44% of such injuries. This study is designed to note the NSI in major gynaecological procedures and surgical procedures using conventional method (CM) versus (VS) use of HK.

Methods: Study was conducted over a period of 12 months from January 2017 to December 2017. 60 patients were included in this study and were divided into 2 groups A and B with 30 patients in each group. Group A was major surgery performed by conventional method; Group B was major surgery performed by using harmonic knife. NSI in two groups were studied and analyzed.

Results: Most of the operated patients were between 41-50 years age group. 16.6% procedures were emergency and 83.3% were elective. NSI in conventional surgery was 63.3% in the surgeon and 33.3% with harmonic knife. There were 13.3% NSI in first assistant in conventional surgery and 23.3% in harmonic scalpel group. No such injuries were reported by second assistant in either group. Injuries were more in non-dominant hand in either groups in the surgeon and first assistant.

Conclusions: It is concluded that NSI are common in surgeons and first assistant. Such injuries are more in non-dominant hand and in procedures where there is little exposure like vaginal hysterectomy. Use of innovative technologies like harmonic scalpel may be useful.

Keywords: Dominant hand, Disease transmission, Harmonic scalpel, Non scalpel injury, Open surgery, Surgery assistants

INTRODUCTION

A needle stick injury (NSI) can be a devastating event and are common among health care workers (HCW). NSI can result in substantial health consequences and psychological stress for HCW and their loved ones.¹ NSI may introduce infective blood and body fluids (BBF) into

the body of HCW, by a hollow bore needle, suturing needle, lancets, scalpels, and contaminated broken glass.² Transmission of infection may depend upon amount of BBF involved, duration of exposure, depth of penetration, type of needle used, host factors and the amount of viruses in BBF.³ The risks of viral transmission have been estimated to be 12-27% for hepatitis B virus (HBV),

0.5-18% for hepatitis C virus (HCV) and 0.3-0.4% for HIV.^{4,5} Preventing NSI is the best approach against these diseases and it is an important part of exposure to any BBP prevention programme at the workplace. The rate of glove perforation has been investigated in various surgical specialties it is 10% for open lung surgery, 12-24% for caesarean section, 28% for major gynaecological surgery.^{6,7}

An estimated 3,84,000 percutaneous injuries are reported by HCW in hospitals in the United States each year, placing them at risk of exposure to HIV, HBV, or HCV.⁸

Suture needles have been identified as the most frequent cause of injury. They are involved in as many as 44% of such injuries. Scalpel blades are the second most frequent cause of injury, followed by syringes.⁹

The ultrasonically activated scalpel referred to by various names including harmonic knife (HK), harmonic scalpel (HS) and ultrasonic dissector or ultracision, was introduced into clinical use nearly a decade ago. The HK was originally devised as an instrument which could incise tissues while concomitantly achieving haemostasis.¹⁰ Conization of cervix using HK causes negligible bleeding.¹¹ Rapid motion of the HK (55,500 cycles /sec), disrupts hydrogen bonds in the tissues and denatures proteins to form a coagulum, which seals off blood vessels.¹² Since then it has proven to be an effective, efficient, and safe instrument for dissection and haemostasis in both open and laparoscopic surgical procedures.

The HK is useful for blunt dissections, since the tip is relatively cold due to minimal heat production and there is no danger of delivering current to the tissues, even accidentally. The splash of blood while grasping tissue can also be minimized.¹³

As most of NSIs occur during hand-to-hand passing of sharp instruments, suture needles, and other sharp devices, which may be avoided by using HK.⁹

NSI are mainly encountered during and after an intravenous line insertion, during various operative procedures, while recapping needles, inappropriate disposal, while transferring a body fluid between containers and syringes.¹³ Surgeons in training have the greatest risk of exposure to BBP due to increased propensity for injury while learning new technical skill sets.¹⁴

There is no vaccine to prevent HIV infection or no definitive cure to treat AIDS. Hence, prevention is the best method to contain HIV infection. Preventing NSI is the best approach during surgical procedures. NSI may occur inadvertently hence prevention of NSI is extremely important to prevent the exposure of HIV from patients to doctors. Those who become infected are at risk of being uncompensated and deprived of gainful employment.¹⁵

Unless specific infective incidents can be identified, neither employer nor insurance company is likely to be generous.

Thus, this study is designed to note the NSI in major gynaecological procedures and surgical procedures using conventional method (CM) versus (VS) use of HK. Aim and objective of the study was:

- To study the needle stick injury sustained during major gynaecological and surgical operative procedure.
- To compare the incidence of needle stick injury sustained during major gynaecological and surgical operative procedure using conventional method versus use of harmonic knife.

METHODS

The study was conducted in the Department of Obstetrics and Gynaecology in conjunction with the department of General Surgery at Himalayan Institute of Medical Sciences (HIMS), Swami Ram Nagar, Dehradun, over a period of twelve months. Subjects were recruited after taking informed consent.

Study design

This was observational study. Study was conducted over a period of 12 months from January 2017 to December 2017. 60 patients were included in this study and were divided into 2 groups A and B with 30 patients in each group.

Selection of subjects

Subjects were divided into two groups:

- Group A: Surgery performed by conventional method for major gynaecological and surgical procedures.
- Group B: Surgery performed by using harmonic knife for major gynaecological and surgical procedures.

Inclusion criteria

- All patients who had undergone major elective and emergency gynaecological operations
- All patients who had undergone major elective and emergency surgical operations.

Exclusion criteria

- Patients, doctors and nurses who were unwilling to be included in this study
- Confirmed cases of HIV/Hepatitis B/ Hepatitis C infection.

- All patients who had undergone laparoscopic operations
- All patients who had undergone obstetrical operations.

Study tools

- Structured study instruments (case reporting form) were used to record all cases to generate data.
- Johnson and Johnson company Cincinnati OH4542-2839 USA Harmonic knife.

Study protocol

- Detailed history, clinical examination, investigations (as applicable) and operative procedure were recorded in the performa.
- Surgeons and other members of surgical team were questioned at the end of the operative procedure for the incidence and site of needle stick injury.

Data management and statistical analysis

- Interpretation and analysis of result was carried out and differences in mean age, in two groups were tested by independent Student's t-test categorical.

Data were compared using Pearson Chi-square test or Fisher's exact test as appropriate. All analyses were conducted using SPSS version 17.

RESULTS

Age distribution of the subjects in the two groups is shown in Table 1. A total of 60 patients were included and were equally divided into 2 groups of 30 each. Highest number of subjects was in 41-50 years age group.

Table 1: Age distribution of source subjects (n = 60).

Age group (years)	No. of operations N = 60 No. (%)	Conventional Method N = 30 No. (%)	Harmonic Knife N = 30 No. (%)
≤ 20	2	2	0
21-30	6	3	3
31-40	11	5	6
41-50	22	10	12
51-60	10	5	5
> 60	9	5	4

Table 2: Distribution of procedures: conventional method vs harmonic knife (n = 60).

Procedure	No.	Emergency		Elective	
		No.	%	No.	%
Conventional method	30	5	16.6	25	83.33
Harmonic Knife	30	5	16.6	25	83.33

Table 3: NSI in the surgical team in conventional method and harmonic knife group.

NSI	Operations CM/HK * No.	Exposure to Surgeon No.	Exposure to first Assistant No.	Exposure to second assistant No. (%)
40	CM	30	19 (63.3%)	4 (13.3%)
	HK	30	10 (33.3%)	7 (23.3%)

* CM: Conventional method, * HK: Harmonic knife

Table 4: Areas of NSI in surgical team in conventional method and harmonic knife group.

Area (n = 40)	NSI CM/HK * No.	Exposures		
		Surgeon No.	First assistant No.	Second assistant No.
Dominant hand NSI 14 (%)	CM	8	7	1
	HK	6	3	3
Non-dominant hand NSI 26 (%)	CM	15	12	3
	HK	11	7	4

*CM: Conventional Method, * HK: Harmonic knife

In present study, elective procedures were more common than emergency procedures in both groups (HK and CM).

Table 2 shows distribution of procedures by conventional method and by harmonic knife. 83.3% patients in each group had elective surgery and 16.6% had emergency

surgery. Elective procedures were more common. Table 3 shows NSI in the surgical team in conventional method and harmonic knife group. Surgeon had NSI in 63.3% in conventional method and 33.3% in harmonic knife group. First assistant had NSI in 13.3% in conventional method, and 23.3% in harmonic knife group. There were no

injuries in second assistant. In CM group incidence of NSI among surgeons (63.3%) was more than HK group (33.3%).

As shown in Table 4, injuries were more in the non-dominant hand in both the groups in the surgeon as well as the first assistant. Table 5 and Table 6 show the site of injury in dominant hand and non-dominant hand. Higher

number of injuries was noted on index finger in either of the groups.

Predominant age group of source subjects undergoing major surgeries with conventional method and harmonic knife group was 41-50 years. Non dominant hand is more common site for NSI in both conventional and HK group than dominant hand.

Table 5: Sites of NSI in surgical team in conventional method and harmonic knife group (Palmar surface, dominant hand).

Sites	CM/HK*	NSI		
		Surgeon	First assistant	Second assistant
Thumb	CM	1	0	0
	HK	1	0	0
Index finger	CM	5	4	1
	HK	3	1	2
Middle finger	CM	1	1	0
	HK	1	1	0
Ring and little finger	CM	0	0	0
	HK	0	0	0
Palm	CM	1	1	0
	HK	1	0	1
Total	CM	8	7	1
	HK	6	3	3

* CM: Conventional Method, * HK: Harmonic knife

Table 6: Sites of NSI in surgical team in conventional method and harmonic knife groups (Palmar surface, non-dominant hand)

Sites	CM/HK	NSI		
		Surgeon	First assistant	Second assistant
Thumb	CM	1	1	0
	HK	1	0	1
Index finger	CM	7	5	2
	HK	5	3	2
Middle finger	CM	2	2	0
	HK	1	1	0
Ring and little finger	CM	0	0	0
	HK	0	0	0
Palm	CM	4	3	1
	HK	3	2	1
Total	CM	14	11	3
	HK	10	6	4

* CM: Conventional Method, * HK: Harmonic knife

DISCUSSION

In the present study 60 major surgical cases were studied who were divided into 2 groups with 30 patients in each group. Group A consisted of surgery performed by conventional method and Group B consisted of surgery performed by harmonic knife for major gynaecological procedures and general surgical procedures. In today's

scenario while operating surgeon and their assistants are exposed to infected or potentially infected blood and body fluids. In spite of all precautions, inadvertently NSI may occur. Since most of NSI occur while operating in depth or while taking suture to control bleeding; harmonic knife cuts and coagulates simultaneously which reduces the bleeding and need for taking surgical suture reduces.

In the present study that included 60 procedures with needle stick injury, 83.33 percent were elective procedures and 16.67 percent were emergency procedures. Abdominal procedures were 22 and vaginal procedures were 8 in each group. In abdominal procedures, NSI per procedure in surgeon was 0.59 in group A, whereas it was 0.32 in group B. On the other hand, in vaginal procedures, NSI per procedure in surgeon was 0.88 in group A, whereas it was 0.38 in group B. First assistant, mostly a surgery resident suffered NSI in 13.3% in conventional surgery and 23.3% with harmonic scalpel in our study. Walee JF in their study on sharp injuries among surgeons observed that surgeons are at risk for injury in the operating room daily.¹⁶ On average, surgeons report a rate of approximately 11 injuries over a 3-year time period. Unfortunately, medical students and surgery residents are the most vulnerable. Over half the residents reported that they had suffered a needle stick injury, with an average number of 7 injuries during residency. Over half of surgery residents reported that they had suffered a high-risk exposure from injuries, and trainees report feeling rushed, inexperienced and fatigued as contributing factors to their injuries.

NSI were significantly higher in vaginal surgeries than abdominal surgeries due to operative difficulties and limited exposure. Although the causes of needle stick injuries vary widely, multiple studies demonstrate that both fatigue and inexperience play critical roles. Waljee JF stated that 23% of injuries were attributed to long working hours and sleep deprivation. Injuries are more likely to occur during evening or night shifts when most of the emergency procedures are performed.¹⁶

Rizk C observed that the most common cause of NSI in the surgical setting most commonly occurs to the surgeon while the suture is being used.¹⁷ 90% injuries were deemed to be “self-inflicted,” the majority due to “awkward position,” or a “sense of being rushed.” However, notable injuries also occur during passage of needle driver and in between suture use. Various safety measures proposed are- utilize the safety blade scalpel blades, no touch technique when assembling and disassembling scalpel blades, avoid placing hands in direction of applied force. The study also suggests that NSI were significantly less with the use of harmonic scalpel as compared to conventional surgery, hence recommend its use judiciously.

Difficult surgeries that included malignancies had higher rate of NSI in the study. Longer duration of surgery, awkward positions and difficult suturing are possible causative factors. Manjunath AP in a study of 29 laprotomies for gynaecological cancers observed glove perforations observed that perforation rate was 13% per glove.¹⁸

The perforation was 3 times higher when the duration of surgery was more than 5 hours. The perforation was 63%

for primary surgeons, 54.5% for first assistant, 4.7% for 2nd assistant and 40.5% for scrub nurses. Clinical fellows were at highest risk of injury (94%). Two third perforations were on index finger or thumb. The glove on non-dominant hand had perforation in 54% of cases. In 50% cases participants were not aware of perforations. There were lesser inner glove perforations in double glove compared to single gloves ($p = 0.0004$)

Yang L in a review on reducing needle stick injuries in healthcare professional observed using new devices to reduce needle stick injuries in healthcare occupations was mainly defined by comparing the number of glove perforations or numbers of needle stick injuries from the study populations with those of control populations.¹⁹ It was concluded that the current evidence suggests that both safeguard interventions and educational training programs are effective in reducing the risk of having needle stick injuries. However, there are insufficient studies using a combination of both safeguards and educational interventions in both randomized controlled trials and in studies utilizing other designs are needed.

Makaray MA in their study on needle stick injuries among 741 surgeons in training observed that 83% had needle stick injury during training.²⁰ The total number of such injuries during training was 3.8. 67% reported that the injury was self-inflicted, 81% reported injury by a solid needle, 72% reported that injury occurred in the operating room and 52% reported that it occurred during suturing. A feeling of being “rushed” was identified by 57%. Ninety percent identifies a single cause for the injury. It was suggested that system-based strategies such as the use of “sharpless” methods for handoff and passing of instruments and needles, a safe zone in the operative field, and innovative surgical techniques such as ‘sharpless surgery’ (using nonsharp alternatives whenever possible) and the use of blunt tip needles are associated with a reduced risk of injury.

Ganczak et al in a comparative study of sharp injuries reported by doctors versus nurses from surgical wards in the context of the prevalence of HBV, HCV and HIV infections. It was observed that 82 and doctors and 44.4% nurses ($p \leq 0.001$) had sustained at least one sharp injury 12.3% doctors versus 2.2% nurses ($p \leq 0.003$) sustained more than 10 injuries. The multivariate regression model revealed that being doctor was associated with greater odds (OR 4.2) of being injured with sharps. Sixty nine percent of nurses sustained a hollow bore needle injury vs 8.9% doctors $p < 0.001$. Anti HBC were found in 16.4% of doctors and 11.2% of nurses, $p \geq 0.28$ anti HCV in 1.1% of doctors versus 1.4% of nurses, $p > 0.79$ no anti-HIV positive cases were found.

Elseviers MM et al in a review of sharp injuries amongst healthcare workers reported that incidence of sharps injuries ranges from 1.4 to 9.5 per HCW, resulting in a weighted mean of 3.7/100HCW per year.²² Sharp injuries were associated with infective disease transmissions from

patients to HCWs resulting in 0.43 HBV infections, .05-1.3 HCV infections and 0.04 - 0.32 HIV infections per 100 sharps injuries per year. The related societal costs had a mean of 272 pound, amounting to a mean of 1,966 pound if the source patient was HIV positive with HBV and HCV co-infections. They concluded that sharp injuries remain a frequent threat amongst HCW. The follow-up and treatment of sharps injuries and deriving consequences represent a significant cost factor.

Limitations of this study were use of harmonic knife have lower incidence of NSI in group B (P value 0.028) which was statistically significant, larger studies with adequate power are needed. Being a delicate and costly instrument adequate number of patients could not be enrolled. Further surgeons need expertise to use it effectively.

CONCLUSION

It is concluded that NSI are common in surgeons and first assistant. Such injuries are more in non-dominant hand and in procedures where there is little exposure like vaginal hysterectomy. Suture needle is the commonest source of such injury. Use of double glove may be protective to some extent. Use of innovative technologies like harmonic scalpel may be useful. However larger studies are needed.

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