Original Article

A comparative study between Staplers and Hand-Sewn Anastomosis in Gastrojejunostomy Surgery in Shaheed Suhrawardy Medical College Hospital.

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ABSTRACT:

Background: *Gastrointestinal anastomoses are common surgical procedure which is being done on different situations from many years back. In earlier days it was done by manual anastomotic technique using sutures. Day by day anastomotic techniques were developed and stapled devices are being used to make the anastomoses. In recent years most of the anastomoses in advanced countries have been done by staple devices and now it is also popular in our country. Very recently, advances in intestinal stapling devices have led to an increased frequency of stapled anastomoses for a variety of proposed beneficial reasons like better blood supply, reduced tissue manipulation, minimum tissue trauma and oedema, uniformity of sutures, wide lumen at the site of anastomosis than double layered suturing and the easy and rapidity of anastomosis. Considering the above advantages, stapled technique has now become good alternative method of anastomosis than hand-sewn technique in gastrointestinal surgery, specially in gastrojejunostomy operation.*

Aim:*This study was designed to find out the outcome between stapling and hand-sewn gastrojejunostomy.*

Methods:*This cross sectional, hospital based observational comparative study was carried out in the indoor of different surgical units of Shaheed Suhrawardy Medical College Hospital from September 2014 to March 2015, between two groups of patient who underwent gastrojejunostomy surgery. Total study populations were 100 which were divided into two groups. 50 anastomoses were done by stapled technique and other 50 patients anastomosis were done by hand-sewn technique. But in both groups there were two types of patients, in benign disease only gastrojejunostomy and malignant disease radical partial gastrectomy and gastrojejunostomy were done. The two groups were compared on various intra operative and postoperative outcomes.*

Results: *In this study it was found that anastomotic integrity was better in stapled technique rather than hand-sewn anastomoses. Other variables like anastomotic time 16.96 minutes vs. 21.45 minutes, total operating time 115.2 minutes vs. 135.5 minutes, return of bowel sound 4.52 days vs. 5.1 days, postoperative hospital stays 12.28 days vs. 13.58 days and postoperative complications 14% vs. 34% in cases of stapled and hand-sewn anastomoses respectively.*

Key Words:
Gasrtrojejunostomy, Anastomosis, Gastrectomy

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Introduction

When a tubular viscus or vessel is joined together after resection or bypass it is called anastomosis. Gastrointestinal resection and anastomosis is a surgical procedure in which a section of gastrointestinal tract is removed and remaining two cut ends of proximal and distal segment are united together to maintain the continuity by anastomosis with the help of either by stapled technique or by hand-sewn technique1.Although improved surgical technique, anesthetic care, diagnostic accuracy and antibiotic prophylaxis all have contributed to improve the result of gastrointestinal surgery, yet the confidence of surgeon hides in the recognition of prerequisites for anastomotic security. Many influencing factors that relate to a sound anastomotic healing are the systematic conditions of the individual patient together with local and technical factors, such as adequate blood supply, free of tension at the anastomotic site and absence of active disease or distal obstruction.The need for good edge to edge apposition with time saving attitude and adequate luminal patency are also essential. With this point of view, stapling technique has steered into a new era in the anastomosis of luminal structure1,2,3. Inthe last decade, advances in intestinal stapling devices have led to an increased frequency of stapled anastomosis for a variety of proposed beneficial reasons like- better blood supply, reduced tissue manipulation, minimum tissue trauma and oedema, uniformity of sutures, adequate or perhaps wide lumen at the site of anastomosis than double layered hand-sewn suturing and the easy and rapidity of anastomosis. The factors are believed to save anastomotic time and facilitate sound healing of the anastomosis without increased incidence of postoperative anastomotic leak, prolonged ileus and strictures4 .This anastomotic security ensured sound healing, reduced rate of post-operative complications, enhanced recovery, reduced hospital stay after operation and thereby decreased total cost of operation. Anastomosis in the bowel was not undertaken successfully until the nineteenth century. Before that, experience was limited to exteriors or closure of simple laceration. Lambert described his seromuscular suture technique for bowel anastomosis in 1926. Senn advocated two layer techniques for closure. Halsted favored a one layer extra mucosal closure. Connell used single layer of interrupted sutures incorporating all layers of bowel. Kocher`s method, a two layer anastomosis, first a continuous all three layers by suture using catgut and theninverting continuous or interrupted seromuscular by silk which became standard. Currently, the single layer extra mucosal anastomosis is popular, advocated by Matheson of Aberdeen, as it probably causes the least tissue necrosis or luminal narrowing. However, in all cases catgut and silk are being replaced by synthetic polymers. Stapling devices was widely used in intestinal anastomosis by Hungarian, Russian and American surgeons in the eighth decade of twentieth century. From that period most surgeon`s intention to find out the most ideal and safe method of anastomosis and essentially it is yet to be defined. Many surgeons showed many differing outcomes. Recently there is a rapid proliferation in the dimension of devices. Very few studies have yet been reported comparing complications following stapled anastomosis with those following hand-sutured procedures performed by the same group of surgeons5,6 . The introduction and widespread application of stapling devices helped revolutionize the technical aspects of surgery that have allowed minimally invasive procedures to be developed. Thus in recent years mechanical stapling devices have improved and become more versatile so that many surgeons now consider stapling technique as best alternate method of anastomosis of suture technique7,8 . Recent adaptation of the surgical staplers by some surgeons of our country has prompted to undertake this comparative study between stapled and hand-sewn technique of gastrointestinal anastomosis specially in gastrojejunostomy operation. Most of the patients in our country are unable to purchase staplers as it is costly in our economic perspective9,10. But, yet a good number of patients agree to undergo such a costly anastomotic technique in surgery for gastrointestinal diseases. In ShSMCH government supplied linear cutter staplers for the admitted patients. There are a lot of studies in the developed countries, but there is small number of published data on this regard in our country. So this is to build up and increase the awareness among the general surgeons and counseling the patient in favor of stapling techniques.

Materials and Method

This is a cross sectional study done at Shaheed Suhrawardy Medical College and Hospitalover a period of one year (September 2013 to March 2014) amongst the admitted patient in Department of Surgery. A total of 100 subjects (n=160) were chosen for purposive sampling. Relevant important physical findings and investigations were performed in all cases and recorded. Specific investi-

gations like endoscopy of upper GIT with biopsy, ultrasonogram of whole abdomen. Patients were then selected for surgery. Presence of peritoneal metastasis was diagnosed by direct visualization through open surgery. At operation gastric cancers were staged for local nodal and metastatic spread. A D1 (with left gastric) lymph node dissection was carried out in all patients undertaking curative resection. Hepatic and peritoneal metastases were diagnosed by intra operative observation.

Results

The present study was aimed to find out the comparison between the stapled and handsewn anastomosis in gastrojejunostomy surgery that were recorded in different surgical units of Shaheed Suhrawardy Medical college hospital,Dhaka in the period of September" 2014 to March" 2015. The findings of the study are presented below.

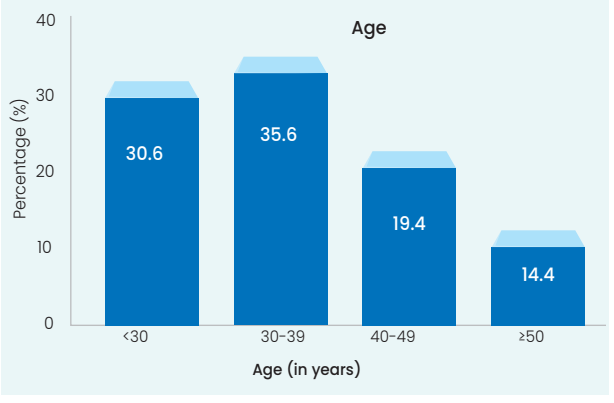

Figure 1: Age distribution of study population (n=100)

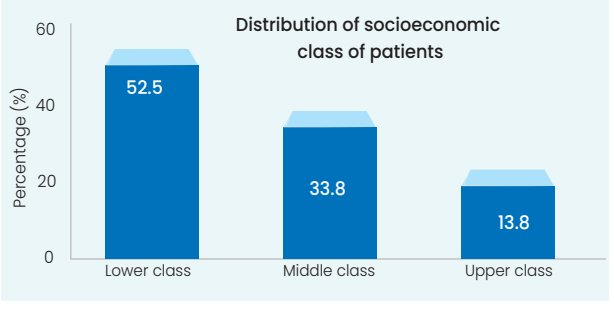

Figure 2. Economic class distribution of study population (n=100)

Figure shows age distribution of the study populations, mean±SD age group of staple technique and hand-sewn technique were 49.04(±12.04) yrs and 53.30(±13.06) yrs respectively. In 100 study populations, mean±SD age groups were 51.17(±12.68) yrs.

Figure also shows sex distribution of the study subjects, in 100 study subjects, 66 were male and 34 were female. Out of 66 male patients 27(40.9%) were staple group and 39(59.1%) were in hand-sewn group. Out of 34female patients 23(67.65%) were staple group and 11(32.35%) were in hand-sewn group.

Table I. Risk factors responsible for anastomotic leakage (n=100)

Risk factors	SSI present (n=33)		SSI absent (n=127)		Total (n=160)		P value
	N	%	N	%	N	%	
HTN	22	66.7	25	19.7	47	29.4	<.001
DM	21	63.6	18	14.2	39	24.4	<.001
Obesity	7	21.2	17	13.4	24	15	.262
Older age (>60 years)	15	45.5	16	12.6	31	19.4	<.001
Nutritional status below average	8	24.2	14	11.0	22	13.8	.049
Anaemia	17	51.5	29	22.8	46	28.7	.001
Jaundice	11	33.3	23	18.1	34	21.3	.057
Smoking	8	24.2	16	12.6	24	15	.09

P value determined by Chi-square test

In 100 study subjects, 50 were staple group and 50 were in hand-sewn group. Out of 50 staple group of 38(76%) were Ca-stomach and 12(24%) were pyloric stenosis patients, and 50 hand-sewn group 41(82%) were Ca-stomach and 09(18%) were pyloric stenosis patients.

Table II. Duration of surgery and its relation with anastomotic leakage (n=100)

Risk factors	SSI present (n=33)		SSI absent (n=127)		Total (n=160)		P value
	N	%	N	%	N	%	
One hour	8	24.2	54	42.5	62	38.8	0.04
More than one hour	25	75.8	73	57.5	98	61.3	

P value determined by Chi-square test

In radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop, staple technique was done in 10(10%) cases and hand-sewn technique in 11(11%) cases ,in radical partial gastrectomy and gastrojejunostomy, staple technique was done in 17(17%) cases and hand-sewn technique in 22(22%) cases, in Billroth-II staple technique

was done in 11(11%) cases and hand-sewn technique in 8(8%) cases and gastrojejunostomy only in benign disease staple technique was done in 12(12%) cases and hand-sewn technique in 09(9%) cases.

Table III: Comparison of time required for anastomosis between stapled and hand-sewn groups.

	Study group	Study group	P-value
Time required for anastomosis (in miniutes)	Staple technique (Mean time±SD)	Hand-sewn technique (Mean time±SD)	
Radical partial gastrectomy with gastrojejunostomy with Rous-en-Y-Loop	22.50±2.16	29.20±1.09	0.001
Radical partial gastrectomy and gastrojejunostomy.	18.44±4.39	21.85±2.31	0.001
Partial gastrectomy and gastrojejunostomy(BillrothII)	16.42±1.27	21.50 ±1.25	0.001
Gastrojejunostomy only in benign disease	10.5±1.25	13.25±1.27	0.001

Unpaired „t" test was done to see the group difference .P was significant at 0.05

Mean time (minutes) in stapled groups in radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop 22.50±2.16, in radical partial gastrectomy and gastrojejunostomy 18.44±4.39, in partial gastrectomy and gastrojejunostomy(Billroth-II) 16.42±1.27 in gastrojejunostomy only 10.5±1.25. And in hand-sewn technique radical partial Gastrectomyand gastrojejunostomy with Roux-en-Y loop 29.20±1.09, in radical partial gastrectomy and gastrojejunostomy 21.85±2.31, Partial gastrectomy and gastrojejunostomy(Billroth-II) 21.50 ±1.25 in gastrojejunostomy only 13.25±1.27

Table IV: Comparison of time required for total operating time between stapled and hand-sewn groups.

	Study group	Study group	P-value
Time required for anastomosis (in miniutes)	Staple technique (Mean time±SD)	Hand-sewn technique (Mean time±SD)	
Radical partial gastrectomy with gastrojejunostomy with Rous-en-Y-Loop	130.5±2.5	150.5±3.5	0.001
Radical partial gastrectomy and gastrojejunostomy.	121.9±1.75	141.35±2.7	0.001
Partial gastrectomy and gastrojejunostomy(BillrothII)	117.9±1.50	139.35±2.5	0.001
Gastrojejunostomy only in benign disease	90.5±1.5	110.9±2.5	0.001

Unpaired „t" test was done to see the group difference . P was significant at 0.05

Table shows comparison of time required for total operation between stapled and hand-sewn group. Mean time (minutes) in stapled groups in radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop 130.5±2.5, in radical partial gastrectomy and gastrojejunostomy 121.9±1.75, in partial gastrectomy and gastrojejunostomy(Billroth-II) 117.9±1.50, in gastrojejunostomy only 90.5±1.5. And in hand-sewn technique radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop150.5±3.5, in radical partial gastrectomy and gastrojejunostomy 141.35±2.7, in partial gastrectomy and Gastrojejunostomy (Billroth-II) 139.35±2.5 ,and in gastrojejunostomy only 110.9±2.5.

Table V: Comparison of post operative return of gastrointestinal functions between stapled and hand-sewn groups.

	Study group	Study group	P-value
Time required for anastomosis(in days)	Staple technique (Mean time±SD)	Hand-sewn technique (Mean time±SD)	
Radical partial gastrectomy with gastrojejunostomy with Rous-en-Y-Loop	5.3±1.7	6.2±1.8	0.001
Radical partial gastrectomy and gastrojejunostomy.	4.50 ±1.5	5.0 ±1.5	0.001
Partial gastrectomy and gastrojejunostomy(BillrothII)	4.50 ±1.5	5.0 ±1.5	0.001
Gastrojejunostomy only in benign disease	3.8±1.2	4.2±0.3	0.001

Unpaired „t" test was done to see the group difference .P was significant at 0.05

Table VI: Comparison of post operative hospital stays between stapled and hand-sewn groups

	Study group	Study group	P-value
Time required for anastomosis(in days)	Staple technique (Mean time±SD)	Hand-sewn technique (Mean time±SD)	
Radical partial gastrectomy with gastrojejunostomy with Rous-en-Y-Loop	13.50±3.4	15.80±3.6	0.001
Radical partial gastrectomy and gastrojejunostomy.	12.88±2.5	13.78±2.4	0.001
Partial gastrectomy and gastrojejunostomy(BillrothII)	12.80±2.4	13.25±2.1	0.001
Gastrojejunostomy only in benign disease	10.14 ±1.3	11.50±1.5	0.001

Unpaired „t" test was done to see the group difference .P was significant at 0.05

Discussion

From the beginning gastrointestinal anastomosis was done by only hand-sewn technique using suture. But very recently, stapled devices were developed and used to make the anastomosis. Most of the anastomosis in advanced countries is being done by stapled technique and it become popular in our country. There is long journey of modification in suture materials and suture technique in gastrointestinal surgery. Anastomosis in the bowel not undertaken successfully until the nineteenth century. In hand-sewn technique -some surgeons used seromuscular hand-sewn technique for bowel closure and some surgeons choose two layer technique. And others like single layer extra mucosal closure with continuous suture technique. At present single layer extra mucosal closure with interrupted suture technique is popular, advocated by Matheson of Aberdeen as it probably causes least tissue necrosis and luminal narrowing. In eight decade of twentieth century there was wide use of stapling devices in intestinal anastomosis among Hungarian, Russian and American surgeon. The advances in intestinal devices have lead to an increase frequency of stapled anastomosis. For a variety of proposed beneficial reasons like better blood supply, reduced tissue manipulation, minimum tissue trauma and edema, uniformity of sutures, adequate or perhaps wide lumen at the site of anastomosis than hand-sewn suturing and the easy and rapidity of anastomosis. In addition, it increases the access to difficult anatomical site like posterior aspect of stomach.,19

This study of 100 patients (stapled 50 and hand-sewn technique 50) showed multivariate analysis of both numerical and categorical data to identify better anastomotic technique. Sample size of 100 was justified and approved by authority on this study of new device. Age distributions of study populations mean age of stapled group were 49.04 years and hand-sewn group were 53.30 years. It is not statically significant. Elderly patients are prone to have comorbid conditions like diabetes mellitus, atherosclerotic changes, hypoproteinaemia and malnutrition. These factors are closely related to anastomotic healing.

ex distributions of the study populations showed 66 were male and 34 were female. Out of 66 male patients 27(40.9%) were stapled group and 39(51.1%) were hand-sewn group. Out of 34 female patients 23(67.65%) were stapled group and 11(32.35%) were hand-sewn group. Diagnosis and investigations: All patients were diagnosed by careful evaluation of history, clinical examination and investigations. Pertinent investigations were upper gastrointestinal endoscopy and biopsy, and some cases contrast X-ray of stomach. For staging purpose X-ray chest P/A view, Ultrasonography of whole abdomen, CT scan of abdomen was done. Assessment for the general fitness of the patient complete blood counts, blood sugar, blood urea, serum creatinine, liver function test (serum bilirubin, ALT, alkaline phosphates, serum albumin), urine R/M/E, ECG in all leads, serum electrolytes. For screening purpose HBSAg, Anti HCV, Anti HIV I&II were done.

Diagnosis of study subject from carcinoma of stomach(distal), gastric outlet obstruction due to any benign condition underwent gastrojejunostomy operation by any procedure like- radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop, radical partial gastrectomy and gastrojejunostomy, partial gastrectomy and gastrojejunostomy(Billroth-II) and gastrojejunostomy only were included in this study. In stapled and hand-sewn group patients of carcinoma stomach were 79 and GOO due to benign cause 21 in number. Anastomosis varies according to diagnosis and age of patients then types of operation. In this study series out of 100 patients carcinoma stomach were 79 patients and 21 patients were GOO due to benign cause. By stapled technique distal radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop was done in 10(20%) cases, radical partial gastrectomy and gastrojejunostomy in 17(34%) cases, partial gastrectomy and gastrojejunostomy(Billroth-II) 11(22%) cases and gastrojejunostomy only in12(24%) cases. And by hand-sewn technique radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop was done in 11(22%) cases, radical partial gastrectomy and gastrojejunostomy in 22(44%) cases, partial gastrectomy and gastrojejunostomy(Billroth-II) in 08(16%) and gastrojejunostomy only in 09(18%) casesMean time (minutes) in stapled groups in radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop 22.50±2.16, in radical partial gastrectomy and gastrojejunostomy 18.44±4.39, in partial gastrectomy and gastrojejunostomy(Billroth-II) 16.42±1.27 in gastrojejunostomy only 10.5±1.25 and in hand-sewn technique radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop 29.20±1.09, in radical partial gastrectomy and gastrojejunostomy 21.85±2.31, Partial

gastrectomy and gastrojejunostomy(Billroth-II) 21.50 ±1.25 in gastrojejunostomy only 13.25±1.27 . Stapled technique needs less time for anastomosis because rapid and easy application (materials for anastomosis are prepared commercially as organized fashion which needs single fire only) but hand-sewn technique needs more time because multiple bites require for completion of anastomosis. Unpaired „t" test was done to see the group difference . P-value was significant

Mean time (minutes) in stapled groups in radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop 130.5±2.5, in radical partial gastrectomy and gastrojejunostomy 121.9±1.75, in partial gastrectomy and gastrojejunostomy(Billroth-II) 117.9±1.50, in gastrojejunostomy only 90.5±1.5 and in hand-sewn technique radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop150.5±3.5, in radical partial gastrectomy and gastrojejunostomy 141.35±2.7, in partial gastrectomy and gastrojejunostomy(Billroth-II) 139.35±2.5 ,and in gastrojejunostomy only 110.9±2.5. Stapled technique needs less time because rapid and easy application (materials for anastomosis are prepared commercially as organized fashion which needs single fire only) but hand-sewn technique needs more time because multiple bites require for completion of anastomosis. Unpaired„t" test was done to see group difference .P-value was significant. Post operative return of gastrointestinal functions (in days) in radical partial gastrectomy and gastrojejunostomy with Roux-en-Y loop in stapled technique it was 5.3±1.7 and hand-sewn technique 6.2±1.8, in radical partial gastrectomy and gastrojejunostomy in stapled technique it was 4.50 ±1.5and hand-sewn technique 5.0 ±1.5, in partial gastrectomy and gastrojejunostomy(Billroth-II) in stapled technique it was 4.50 ±1.5 and hand-sewn technique 5.0±1.5 and gastrojejunostomy only it was 3.8±1.2 and 4.2±0.3 respectively. In stapled technique the time of post operative return of gastrointestinal functions is less because tissue handling is less, smooth and less edema in suture site.But unpaired „t" test was done to see group difference .P-value>0.05, which was not significant. Out of 100 patients 76 had no complications, 24 had complications, among them 07 complications in stapled group and 17 complications in hand-sewn group. In staple technique anastomotic hemorrhage occurred in 01patient, paralytic ileus in 04 patients, surgical site infection in 01patient and anastomotic leakage in 01patient. In hand-sewn group anastomotic hemorrhage occurred in 04patients, paralytic ileus in 09 patients, surgical site infection in 02 patients and anastomotic leakage in 02patients. In staple technique post operative complications is less because less manipulations, more anastomotic integrity, less spillage of gastric and intestinal contents etc. Chi-squire test was done, X 2 =5.48, p-value 0.05 which was significant.

Limitations

The study had several limitations that include As study period was limited so number of cases were small. This was not the overall picture of Bangladesh. This study was conducted only among patients attending Shaheed Suhrawardy Medical College Hospital. All patients in this study group were not able to carry on all investigations needed such as CT scan of abdomen. Purposive sampling was done, for realistic evidence random sampling should be done. Patient"s management as well as operations was done by different senior surgeons of different surgical unit of Shaheed Suhrawardy Medical College Hospital. So it would be better if all operations were done by same surgeon. Follow up period was short, so longer follow up period would have made the study more valid and rational.

Recommendation

This study was conducted in a tertiary level referral hospital, and maximum stapled device were available here whice could be the reason for such high percentage of cases. There can be a campaign for use of stapler"s in gastrointestinal surgery. When surgeons are confident with skill and expertise, stapling device can be used safely in patients who can afford the equipment cost. To accentuate its use in wider spectrum, the manufacturers should consider its cost. For true evaluation a national level randomized control trial is required overcoming all biases and limitations.

Conclusion

After statistical analysis and significance testing of outcome variables of stapled and hand-sewn anastomosis, it was found that anastomotic time, total operating time and postoperative complications (14% vs. 34%) were much less in stapled than hand-sewn group. This difference was statistically significant. Considering more important variables of anastomosis related postoperative complications paying respect to analysis, it is difficult to make final comment on this small series study of many limitations. But it can be concluded by initial experience

that stapled anastomosis, though not overall but at least to some extent, is better than hand-sewn anastomosis in gastrojejunostomy surgery and in the implementation and user perspective, it also shows its superiority over hand-sewn technique. Howover, to strengthen the comment, more standardized, randomized and large scale prospective study is required overcoming the limitations of this study.

Conflicts of Interest

Not reported

References

1. P. B. Nichkaode, Mayank Kulshrestha, M. A. Akther, Gopal Gurjar, Rahul Zamad. Comparative Study of Stapler Anastomosis over hand-sewn anastomosis in elective Gastrointestinal surgeries. Journal of Evolution of Medical and Dental Sciences/Volume 2/Issue 19/ May 13,2013. P 3408-3415.
2. V Murthy , M V Pai , R Bhat , P Thejeswi , Comparative Study of Hand Sutures versus Staplers in elective Gastric surgeries In A South Indian Population. The Internet Journal of Surgery. 2013; 30(2) CDC. Surgical Site Infection (SSI) Event[cited 2014 Jan];
3. Mohamed Issa Ahmed. Prevalence of nosocomial wound infection among postoperative patients and antibiotics patterns at Teaching Hospital in Sudan. North Am J Med Sci ; Jan 2012, Vol 4, Issue 1; 29-34.
4. Anusha S, Vijaya LD, Pallavi K, Manna PK, Mohanta GP, Manavalan R. An Epidemiological Study of Surgical Wound Infections in a Surgical unit of Tertiary care Teaching Hospital. Indian Journal of Pharmacy Practice, Volume 3 , Issue 4; Oct-Dec 2010; 8-13.
5. Perren CJ, Robert S, Hunt TK, Mundy LM. Inflammation infection & Antibiotics. Way LW, Doherty GM, editors. Current Surgical Diagnosis & Treatment. 13th ed. New York: McGraw Hill; 2011. P. 121.
6. Perl TM and Roy MC. Post-operative wound infections: risk factor and role of Staph. Aureus nasal carriage. J Chemother 1995; 7: 29-35.
7. Hansis M. Pathophysiology of infection – a theoretical approach. Injyry 1996; 27:5-8.
8. Andenaes K, Amland PF, Lingaas E, Abyholm F, Samdal F, Giercksky KE. A. Prospective, randomized surveillance study of postoperative wound infections after plastic surgery: a study of incidence and surveillance methods. PlastReconstrSurg 1995; 96: 948-56.
9. AmanS.Bacteriological Analysis of wound infection in Mayo Hospital Lahore. JPMA 1982; 66-68.
10. Ford CR, Peterson DE, and Mitchell CR. An appraisal of the role of surgical masks. Am j Surg 1967; 133: 787-790.
11. Nichols RL. Prevntion of infection in high risk gastrointestinal surgery. Am j Med 1991; 91:152-157.
12. Culver DH, Horan TC, Gaynes RP et al. Surgical wound infection rates by wound class, operative procedure, and patient risk index. Am J Med 1991; 91: 152-157
13. Sickder HK, Lertwathanawilat W, Sethabouppha H, Viseskul N. Prevalence of surgical site infection in a tertiary-level hospital in Bangladesh. 2017;4(3):63–8.
14. Nur-e-elahi M, Jahan I, Siddiqui O, Ahmed SU, Joarder AI, Faruque S, et al. Wound infection in surgery department in bsmmu: A study of 100 cases. JBSA. 2011;24(2):65–9.
15. Mawalla B, Mshana SE, Chalya PL, Imirzalioglu C, Mahalu W. Predictors of surgical site infections among patients undergoing major surgery at Bugando Medical Centre in Northwestern Tanzania. BMC Surg 2011;11(1):21.
16. Kumar A, Rai A. Prevalence of surgical site infection in general surgery in a tertiary care centre in India. Int Surg J. 2017;4(9):3101–6.
17. Rural population (% of total population) | The World Bank [Internet]. 2017 [cited 2017 Nov 28].
18. Legesse Laloto T, Hiko Gemeda D, Abdella SH. Incidence and predictors of surgical site infection in Ethiopia: Prospective cohort. BMC Infect Dis. 2017;17(1):1–9.
19. Siddique M, Akhter J, Verma R, Premjeet Madhukar K, Rajiv Vaishampayan A, Unadkat PC, et al. Incidence of surgical site infection in postoperative patients at a tertiary care centre in India. J Wound Care. 2016;25(4):210-212,214-217.
20. Lubega A, Joel B, Justina Lucy N. Incidence and Etiology of Surgical Site Infections among Emergency Postoperative Patients in Mbarara Regional Referral Hospital, South Western Uganda. Surg Res Pract. 2017;2017.
21. Cruse PJE. Classification of operations and audit of infection. In: Taylor EW, editor. Infection in Surgical Practice. Oxford: Oxford University Press, 1992; 1-7.
22. Owens CD, Stoessel K. Surgical site infections: epidemiology, microbiology and prevention. J Hosp Infect. 2008 Nov;70:3–10.
23. Ki V, Rotstein C. Bacterial skin and soft tissue infections in adults: A review of their epidemiology, pathogenesis, diagnosis, treatment and site of care. Can J Infect Dis Med Microbiol. 2008;19(2):173–84.
24. Leaper DJ (2008) Basic surgical skills and anastomoses. In: Williams NS, Bulstrode CJ, O″Connell PR, (ed), Bailey and love″s short practice of surgery, 25th ed., Edward Arnold Ltd: Great Britain, p 239, 242–245
25. Brooks DC, Zinner MJ (2000) Surgery of the small and large bowel. In: Zinner MJ, Ellis H, editors, Maingot″s abdominal operations, 10th ed., Appleton and Lange, Connecticut (USA), p 1321–1330