



Primary Wound Closure Versus Delayed Primary Wound Closure in Complicated Appendicitis in Tikrit Teaching Hospital

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Abstract

Background: Two methods are used routinely for wound management following an appendectomy: delayed primary closure, which involves packing an open wound for 4-5 days followed by wound closure, and primary closure, which means closing the wound at the time of surgery. Primary closure has the potential benefit of rapid wound healing associated with the elimination of painful and time-consuming dressing, as well as a reduction in overall hospital costs.

Objective: To compare the incidence of wound infection after primary wound closure and delayed primary closure in patients with complicated appendicitis.

Patients and Methods: A total of 78 patients with complicated appendicitis (gangrenous, perforated, and abscess) admitted to surgical wards in Tikrit Teaching Hospital for a period of 12 months (January 2013 to January 2014). Males were 45 and females were 33, their ages ranged from 17-55 years were included in the study. The patients were adult males and non-pregnant adult females whom underwent appendectomy for complicated appendicitis.

Results: Age and gender were not significant factors affecting wound closure type ($p=0.772$ and $p=0.942$ respectively). The mean period of symptoms duration in patients with delayed primary closure was significantly ($p=0.037$) longer (5.9 ± 3.11 days), than that with primary closure (2.81 ± 2.07 days). Duration of surgery was significantly ($p=0.021$) longer (37.98 ± 6.7 minutes) for delayed primary closure, than for primary closure (22.71 ± 8.11 minutes). The mean duration of stay per hospital was significantly ($p=0.030$) shorter (6.84 ± 1.71 days) for delayed primary closure than for primary closure (8.7 ± 0.94 days).

Conclusion: A better overall results related to the strategy of delayed primary closure despite the relative longer time of surgery and greater efforts done by the surgeon. This will give benefits to both the patient and surgeon.

Key words: Appendicitis, primary closure, surgical site infection.

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Introduction

Appendectomy is still one of the most commonly performed emergency surgical procedures worldwide. Despite the use of antibiotics and peri-operative care, postoperative surgical site infection (SSI) remains the most common post-operative complication [1]. Primary Closure (PC) has been in use by many surgeons for both simple and complicated appendicitis [2-4]. Delayed Primary Closure (DPC) had been advocated for appendectomy wounds, especially in cases of complicated appendicitis [5, 6].

Although PC for complicated appendicitis in adults has been advocated recently to reduce morbidity and cost (mainly due to the daily change of dressing and hospital care) [7-9]. Yet it has to gain the status of a consensus because of previous perception of increased rate of SSI in cases of PC as compared to DPC in cases of complicated appendicitis [3].

Despite the routine use of prophylactic antibiotics that target both aerobic and anaerobic organisms, infection of the operative incision is the most common cause of morbidity after appendectomy. Therefore, it can result in increased pain and a lengthy hospital stay [10].

In patients with non-perforated appendicitis the incidence of wound infection is <10% [4-6]. Wound infection increases with perforated appendicitis to 15% to 20% and is highest with diffuse peritonitis (35%) [11]. Traditionally, in an effort to decrease the risk of operative site infection, gangrenous or perforated appendicitis has been managed with delayed primary closure [12-13]. Open wound management has previously been considered as the standard of care for most cases of perforated appendicitis [10]. These methods have been developed in response

to the high rates of wound infections, up to 58%, seen in these cases. However, most reports predate the era of current antimicrobial therapy, which has led to decreased rates of wound infection. Many studies in the 1980s and 1990s have reported low rates of infection using primary closure, suggesting that such management might be safely and successfully used [13].

This study aims to compare the incidence of wound infection after primary wound closure and delayed primary closure in patients with complicated appendicitis.

Patients and Methods

Complicated appendicitis was defined as perforated appendicitis, gangrenous appendicitis, or appendiceal abscess. All patients received perioperative intravenous antibiotics with anaerobic coverage and intravenous fluids. They underwent conventional appendectomy through a McBurney's muscle-splitting incision.

A total of 78 consecutive patients with complicated appendicitis (gangrenous, perforated, and abscess) were included for a period of 12 months from January 2013 to January 2014, admitted to surgical wards in Tikrit Teaching Hospital. Males were 45 and females were 33, their ages ranged from 17-55 years. The patients were adult males and non-pregnant adult females whom underwent appendectomy for complicated appendicitis. Patients with non-complicated appendicitis, normal appendix found at operation, pregnant female patients, and patients aged younger than 15 years or older than 60 years were excluded from the study.

A closed system drain were placed in the pelvis through a separate incision in the abdominal wall. The muscles, and fascia were closed in layers. The patients were allocated to either one of the following two strategies for wound management: PC for patients with clean field following good



mopping, and DPC for those whom their operative field contains adequate amount of pus. For PC, wounds were closed with monofilament nylon interrupted sutures. For DPC, skin and subcutaneous tissue were left open and packed with diluted Betadine (0.5% povidone iodine)-soaked gauze that was changed daily to prevent excessive collection of exudate. If the wound appeared clean on postoperative day 5, it was repaired under local anesthesia in operating room. Otherwise, wet packing was continued, and then DPC was performed on a later date, when the wound became clean.

Infected wounds in both groups were opened

and packed, and bacterial culture of the pus was made. Possibly infected wounds were observed closely and opened if purulent discharge, increasing erythema, induration or warmth developed.

Statistical analysis

A questionnaire designed (Fig. 1) to collect data. These collected data were processed via SPSS v.19 computer program. Data from each parameter were expressed as mean ± standard deviation. Chi square at p value < 0.05 was the measure for statistical significance.

[][]	Case N ^o .
[][]	Age (years)
[]	Gender (0=female, 1=male)
[][]	Duration of Symptoms (days)
[][]	WBC count (x1000/dL)
[]	Complication (0=gangrenous, 1=perforated, 2=abscess)
[][][]	Duration of surgery (minutes)
[]	Type of wound closure (0=PC, 1=DPC)
[]	SSI (0=no, 1=yes)
[]	Type of SSI (Surgical Site Infection) (0=minor, 1=major)
[]	Wound swab result (0=no growth, 1= <i>Escherichia coli</i> , 2= <i>Bacteroides fragilis</i> , 3= <i>Streptococcal species</i> , 4= <i>Pseudomonas aeruginosa</i> , 5= <i>Clostridial species</i>) *
[]	Management of SSI (0=antibiotics, 1=wash by saline, 2=frequent change of dressing, 3=wound debridement)
[][]	Length of stay in hospital (days)

Figure (1): Form designed for data collection.

* The pathogens chosen according to local hospital guidelines

Results

From a total of 78 complicated appendectomized patients included in our study, 45 (57.69%) were males and 33 (42.31%) were females. Mean age was 34.1±17.41 years (range, 17-55 years). No patient was withdrawn from the study, and there was no perioperative mortality or major complication such as organ failure,

appendiceal stump leakage or intra-abdominal abscess.

The mean age of DPC was 36.8±18.12years, while that of PC was 31.3±11.07years. From a total of 51 patients DPC, there were 31 (60.78%) males and 20 (39.22%) females; while from a total of 27 PC, there were 14 (51.85%) males, and 13 (48.15%) females (Table 1).



The mean period of symptoms duration was 4.64 ± 2.01 days before surgery. The mean period of symptoms duration conveyed into DPC was 5.9 ± 3.11 days, while that conveyed into PC 2.81 ± 2.07 days.

Patients of DPC group were found with mean WBC count of $16.7 \pm 1.83 \times 1000/dL$

while those of PC group were found with mean WBC count of $14.88 \pm 1.84 \times 1000/dL$.

The study showed duration of surgery mean 31.24 ± 5.91 minutes; 37.98 ± 6.7 minutes for DPC, and 22.71 ± 8.11 minutes for PC. These results are shown in Table 1.

Table (1): Patient demographics.

Parameter	DPC (n=51)	PC (n=27)	Total (n=78)	P value
Age (years)*	36.8 ± 18.12	31.3 ± 11.07	34.1 ± 17.41	0.772
Gender**	Male (68.89%)	14 (31.11%)	45 (57.69%)	0.204
	Female (60.61%)	13 (39.39%)	33 (42.31%)	0.347
	Male/Female ratio	1.55	1.077	1.36
Duration of symptoms (Days)*	5.9 ± 3.11	2.81 ± 2.07	4.64 ± 2.01	0.037 ⁺
WBC (x1000/dL)*	16.7 ± 1.83	14.88 ± 1.84	16.27 ± 1.42	0.243
Duration of surgery (minutes)*	37.98 ± 6.7	22.71 ± 8.11	31.24 ± 5.91	0.021 ⁺

(*) Mean \pm Standard deviation,

(**) Number of cases (Percentage),

(DPC) Delayed primary closure, (PC) Primary closure, (+) Statistical significance

Ten (19.61%) patients were with positive bacterial culture after DPC and 19 (70.37%) after PC. Themicroorganisms

cultured from the wounds were summarized (Table 2).

Table (2): Bacteria cultured from wound.

Bacteria*	DPC (n=51)	PC (n=27)	Total (n=78)	P value
No growth	41 (80.39%)	8 (29.63%)	49 (62.8%)	0.045 ⁺
<i>Escherichia coli</i>	9 (90.0%)	17 (62.96%)	32 (41.03%)	0.039 ⁺
<i>Bacteroides fragilis</i>	1 (10.0%)	5 (18.52%)	6 (7.69%)	0.745
<i>Streptococcal species</i>	0 (0%)	3 (11.11%)	3 (3.85%)	0.633
<i>Pseudomonas aeruginosa</i>	0 (0%)	0 (0%)	0 (0%)	0.980
<i>Clostridial species</i>	0 (0%)	1 (3.73%)	1 (1.28%)	0.283

(*) Number of cases (Percentage)

(DPC) Delayed primary closure, (PC) Primary closure, (+) Statistical significance

appendicitis were perforated, 15 (71.43%) were closed with DPC and 6 (28.57%) were closed with PC. Five (10.26%) of complicated appendicitis were abscesses that all closed with DPC (Table 3).

Fifty-two (60.26%) out of 78 complicated appendicitis were gangrenous, of them 31 (59.62%) were closed with DPC and 21 (40.38%) were closed with PC. Twenty-one (29.48%) complicated



Table (3): Wound closure type according to intraoperative complication.

Complication	DPC (n=51)	PC (n=27)	Total (n=78)	P value
Gangrenous*	31 (59.62%)	21 (40.38%)	52 (60.26%)	0.218
Perforated*	15 (71.43%)	6 (28.57%)	21 (29.48%)	
Abscess*	5 (15.69%)	0 (0%)	5 (10.26%)	

(*) Number of cases (Percentage)

(DPC) Delayed primary closure, (PC) Primary closure

From a total of 78 cases of complicated appendicitis, there were 58 (74.36%) patients shown no infection, 20 (25.64%) shown an infection at the surgical site (90% minor and 10% major according to the definition) and 44 (86.27%) out of 51 DPC patients were non-infected, while 7

(13.73%) were infected (all were of minor type) and 14 (51.85%) out of 27 PC patients were non-infected, while 13 (48.15%) were infected (92.31% were of minor and 7.69% were of major type) (Table 4).

Table (4): Surgical site infection according to wound closure type.

Type of closure*	No infection	Infection		
		Minor	Major	Total
DPC (n=51)	44 (86.27%)	7 (100%)	0 (0%)	7 (13.73%)
PC (n=27)	14 (51.85%)	12 (92.31%)	1 (7.69%)	13 (48.15%)
Total (n=78)	58 (74.36%)	18 (90%)	2 (10%)	20 (25.64%)
P value	0.132	0.822	0.652	0.167

(*) Number of cases (Percentage)

(DPC) Delayed primary closure, (PC) Primary closure

washing by saline (73.08%), frequent change of dressing (82.05%), and wound debridement (3.84%) of total patients (Table 5).

All patients involved in the study were received antibiotics regardless to the type of wound management. Many measures were used in management of wound closure like

Table (5): Infection management according to the type of closure.

Management*	DPC (n=51)	PC (n=27)	Total (n=78)	P-value
Antibiotics	51 (100%)	27 (100%)	78 (100%)	3.988
Wash by saline	51 (100%)	6 (22.22%)	57 (73.08%)	0.012 ⁺
Frequent change of dressing	51 (100%)	13 (48.15%)	64 (82.05%)	0.030 ⁺
Wound debridement	0 (0%)	3 (11.11%)	3 (3.84%)	0.129

(*) Number of cases (Percentage)

(DPC) Delayed primary closure, (PC) Primary closure, (+) Statistical significance



Patients stay per hospital mean was 6.98 ± 1.05 days for all patients. The mean duration was 6.84 ± 1.71 days for DPC, while that of PC was 8.7 ± 0.94 days (Table 6).

Table (6): Length of stay in hospital according to the type of closure.

	DPC (n=51)	PC (n=27)	Total (n=78)	P- value
Length of stay in hospital (days)*	6.84 ± 1.71	8.7 ± 0.94	6.98 ± 1.05	0.030 ⁺

(*) Mean±Standard deviation

(DPC) Delayed primary closure, (PC) Primary closure, (+) Statistical significance

Discussion

One of the most common surgical causes of abdominal pain leading to surgical intervention is acute appendicitis. Although morbidity and mortality have decreased to a great extent due to advances in the perioperative care, yet keeping in view the incidence of appendicitis, this low rate of surgical site infection still accounts for significant morbidity and consumes a major part of health budgets [14].

Age group of appendicitis was not a significantly affecting wound closure type ($p=0.772$) although mean age was slightly greater in DPC than in PC. This may be due to the more complication associated with advance of age that accompany immunity deterioration. This picture agree with Khan (2012) *et al.*, [15]. Chiang (2012) *et al.*, [16]. Henry and Moss (2005)[17]. And Ashraf (2009) *et al.*, [18].

Male to female ratio was slightly more in DPC than in PC. This may be due to the delayed presentation in male (increase pain tolerance) and seeking for medical advice. This difference was not significant statistically ($p=0.942$), and agreed with Khan (2012) *et al.*, [15]. Chiang (2012) *et al.*, [16]. Henry and Moss (2005) [17]. And Ashraf (2009) *et al.*, [18].

Duration of symptoms until decision of surgery was also more in DPC than in PC. This is because the more the delay the greater chance for the appendix to develop

complication and diagnosis become more difficult. Wound closure type statistically affected by duration of symptoms significantly ($p=0.037$). This may be due to the fact that the more delayed the symptoms the more chance to have complicated appendicitis with the latter preference to close the wound in the DPC; and disagree with Khan (2012) *et al* [15]. Chiang (2012) *et al.*, [16]. And Ashraf (2009) *et al.*, [18].

Our study shown WBC count mean was also slightly more in DPC than in PC. This is the result of the longer duration and the higher inflammatory response in cases belong to DPC group. This difference in WBC count mean between DPC and PC was statistically not significant ($p=0.243$) and agree with Khan (2012) *et al.*, [15], Chiang (2012) *et al.*, [16], Henry and Moss (2005) [17]. And Ashraf (2009) *et al.*, [18].

Surgical operations done of appendectomy closed with DPC were longer in mean duration than those with PC (37.98 ± 6.7 and 22.71 ± 8.11 minutes respectively). This additional time consumed by operation closed with DPC is due to drainage of the excessive amount of debris and pus from perforated appendix or appendicular abscess and thorough mopping of peritoneal cavity to clean up the field. This difference in duration was statistically significant ($p=0.021$) but not agree with Khan (2012) *et al.*, [15]. Chiang (2012) *et al.*, [16]. And Ashraf (2009) *et al.*, [18].



Our study presented that surgical wounds closed with DPC were much less contaminated than with PC, because wounds closed with DPC method were frequently washed with antiseptics thus reducing the number of microorganisms. The study shown a significant statistical difference among type of closure affecting clarity of bacterial growth ($p=0.045$) and agree with Chiang (2012) *et al.*, whom presented a $p=0.038$ [16].

The closure type presented no statistical significant difference for complication of appendicitis ($p=0.218$) and agree with Mehrabi (2010) *et al.*, whom shown $p=0.407$ [19].

Considering infection of the wound, this study shown a reduced frequency of wound infection closed with DPC than with PC. Though no significant statistical differences of wound closure type on all classes of infection and this was agree with Khan *et al.*, (2012) whom shown $p=0.699$ [15]. And disagree with Chiang *et al* (2012) whom presented a $p<0.001$ [16].

Patients with appendectomy whom their surgical wound closed with DPC stay in hospital for shorter periods compared with those with PC. This was due to the high risk of postoperative infection for wounds closed with PC which need re-exploration of the wound. The difference was statistically significant ($p=0.030$) and agree with Chiang *et al* (2012) whom presented a $p=0.038$, [16]. And Khan *et al* (2012) whom shown $p<0.05$ [15].

In conclusions, our study indicated a better overall results related to the strategy of delayed primary closure despite the relative longer time of surgery and greater efforts done by the surgeon. This will give rise to many benefits to both the patient (e.g. less infection and growth of bacteria so that he/she feels better and gain health sooner than patient with appendectomy wound

closed with primary closure, as well as staying in hospital postoperatively for a relatively shorter period) and surgeon (e.g. less complication faced and better reputation).

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