Outcomes of Laparoscopic vs. Open Appendectomy in Patients with Acute Appendicitis & Generalized Peritonitis

Authors: Saad Shebrain, M.D., Rebecca Rice, D.O., Gitonga Munene, M.D., John Collins, M.D., Robert Sawyer, M.D.

Western Michigan University Homer Stryker M.D. School of Medicine

Background: Peritonitis is a surgical emergency that is traditionally approached through a laparotomy. However, the laparoscopic approach has gained popularity over the last two decades as minimally invasive surgery evolves. This study aims to evaluate the 30-day outcomes of laparoscopic and open appendectomy in patients presenting with acute appendicitis and generalized peritonitis (AAGP).

Methods: Using the ACS-NSQIP database (2017), patients who presented with AAGP were identified and divided into two groups: laparoscopic (LA) and open appendectomy (OA). The outcomes examined included 30-day mortality, morbidity, overall morbidity, readmission rates, operative time, and total length of hospital stay (LOS). Pearson's chi-squared and Fisher's exact tests were used to test group differences of categorical variables. Continuous variables were tested with the Student t-test, with statistical significance set at a value of p<0.05.

Comorbid Conditions:

Characteristics	Group A Lap. Appendectomy (n=3739)	Group B Open Appendectomy (n = 557)	Total (n = 4296)	p-value
Medical Comorbidities, n (%)				
Diabetes	306 (8.2)	66 (11.8)	372 (8.6)	0.001
Smoking	700 (18.7)	110 (19.7)	810 (18.9)	0.563
Dyspnea, moderate/at rest	57 (1.5)	13 (2.4)	70 (1.6)	<0.367
Functional Status				
▪ Partially dependent	23 (0.6)	9 (1.6)	32 (0.7)	0.054
▪ Totally dependent	2 (0.1)	1 (0.2)	3 (0.1)	
Ventilator Dependent	2 (0.1)	2 (0.4)	4 (0.1)	0.027
COPD- History of severe	69 (1.8)	14 (2.5)	83 (1.9)	0.285
Ascites	5 (0.1)	6 (1.1)	11 (0.3)	<0.001
CHF in 30 days before surgery	12 (0.3)	3 (0.5)	15 (0.3)	0.417
HTN requiring medical Rx	930 (24.9)	170 (30.5)	110 (25.6)	0.004
Acute Renal Failure (Post-op)	9 (0.2)	5 (0.9)	14 (0.3)	0.011
Dialysis, Currently on dialysis	7 (0.2)	5 (0.9)	12 (0.3)	0.003
Disseminated Cancer	8 (0.2)	5 (0.9)	13 (0.3)	0.006
Open wound/wound infection	6 (0.2)	3 (0.5)	9 (0.2)	<0.069
Steroid Use for Chronic Conditions	49 (1.3)	13 (2.3)	62 (1.4)	0.059
Weight loss (>10% in last 6Months)	7 (0.2)	2 (0.4)	9 (0.2)	<0.408
Bleeding Disorders	107 (2.9)	28 (5.0)	135 (3.1)	0.006
Transfusion => 1 Unit PRBC 72h preop	3 (0.1)	1 (0.2)	4 (0.1)	0.473
Systemic Sepsis:				
▪ SIRS	474 (12.7)	62 (11.1)	536 (12.5)	<0.001
▪ Sepsis	1463 (39.1)	270 (48.5)	1733 (40.3)	
▪ Septic Shock	21 (0.6)	13 (2.3)	34 (0.8)	

Results: Of a total of 41,368 patients with appendicitis, 4,296 (10.4%) had appendicitis and generalized peritonitis (AAGP). We divided the AAGP patients into two groups. Group A, laparoscopic appendectomy (LA), included 3,739 patients (89%) and Group B, open appendectomy (OA), included 557 (13%) patients. Overall, both groups had similar demographic characteristics. However, patients in Group B were older and had higher BMI compared to Group A with a mean (SD) of 51.15 (±17.7) years vs. 47.6 (±17.55) years, p <0.001, and mean (SD) of 30 (±8.2) vs. 29 (±6.64), p=003, respectively. Group B had more comorbidities, including HTN (30.5% vs. 24.9%, p =0.004), bleeding disorders (5% vs. 2.9%, p=0.006), and kidney disease or on dialysis (1.8% vs 0.4%, p=001). Additionally, Group B presented more frequently with sepsis (50.8% vs. 39.7%, p<0.001). Group B had higher 30-day mortality (0.9 % vs 0.1%, p<0.001), higher serious morbidity (37.5% vs. 23.3%, p < 0.001), and overall morbidity (43.6% vs. 24.7%, p<0.001), respectively. Group B had increased mean (SD) hospital LOS, 6 (±4.6) vs. 3.3 (±3.7) days, p<0.001, and increased mean (SD) total operative time, 81(±38) vs. 59 (±28) minutes, p<0.001]. There were no differences between Group B and Group A in 30-day readmission rate (8.6% vs. 7.2%, p=0.221).

Demographics:

Characteristics	Group A Lap. Appendectomy (n=3739)	Group B Open Appendectomy (n = 557)	Total (n = 4296)	p-value
Gender, Male, n (%)	2040 (54.6)	329 (59.1)	2369 (55.1)	<0.046
BMI, mean (SD)	29 (6.64)	30.0 (8.2)	29.16 (6.90)	0.003
Age, mean (SD)	47.60 (17.55)	51.14 (17.7)	48.04 (17.60)	<0.001
Race				
▪ White	2558 (68.4))	359 (64.5)	2917 (67.9)	0.156
▪ Black or African American	243 (6.5)	53 (9.5)	296 (6.9)	
▪ Asian	193 (5.2)	28 (5.0)	221 (5.1)	
▪ Unknown/Not Reported	702 (18.8)	110 (19.7)	812 (18.9)	
Transfer				
▪ Admitted from Home	3406 (91.1)	504 (90.5)	3910 (91.0)	<0.638
▪ From Acute Care Hospital In-patient	58 (1.6)	7 (1.3)	65 (1.5)	
▪ From Outside ED	232 (6.2)	40 (7.2)	272 (6.3)	
Discharge Destination				
▪ Home	3648 (97.6)	504 (90.5)	4152 (96.6)	<0.001
▪ Facility which was Home	20 (0.5)	5 (0.9)	25 (0.6)	
▪ Skilled care, Not Home	33 (0.9)	25 (4.5)	58 (1.4)	
Emergency Surgery, n (%)	2298 (61.5)	364 (65.4)	2662 (62.0)	<0.078
Anesthesia Class				
▪ 1-2	2801 (75)	345 (62)	3146 (73.3)	<0.001
▪ 3-4	933 (25)	211 (37.9)	1144 (26.7)	

Clinical Outcomes (Post-Operative Morbidities & Mortalities)

Outcome	Group A Lap. Appendectomy (n=3739)	Group B Open Appendectomy (n = 557)	Total (n = 4296)	p-value
Morbidity Outcomes, n, (%)				
Superficial Surgical Site Infection	38 (1.0)	32 (5.7)	70 (1.6)	<0.001
Deep Incisional SSI	6 (0.2)	6 (1.1)	12 (0.3)	<0.001
Organ Space SSI	311 (8.3)	70 (12.6)	381 (8.9)	0.001
Wound disruption	2 (0.1)	4 (0.7)	6 (0.1)	<0.001
Pneumonia	35 (0.9)	16 (2.9)	51 (1.2)	<0.001
Unplanned Intubation	15 (0.4)	7 (1.3)	22 (0.5)	0.008
Pulmonary Embolism	7 (0.2)	4 (0.7)	11 (0.3)	0.021
Ventilation >48 hours	9 (0.2)	9 (1.6)	18 (0.4)	<0.001
Progressive Renal Insufficiency	4 (0.1)	2 (0.4)	6 (0.1)	<0.137
Acute Renal failure	3 (0.1)	3 (0.5)	6 (0.1)	0.007
UTI	12 (0.3)	8(1.4)	20 (0.5)	<0.001
CVA/Stroke w/ Neuro deficit	0 (0.0)	3 (0.5)	3 (0.1)	<0.001
Cardiac Arrest requiring CPR	5 (0.1)	2 (0.4)	7 (0.2)	0.219
Myocardial Infarction (MI)	11 (0.3)	5 (0.9)	16 (0.4)	0.029
Bleeding/Transfusion	16 (0.4)	9 (1.6)	25 (0.6)	0.001
DVT/Thrombophlebitis	7 (0.2)	5 (0.9)	12 (0.3)	0.003
Sepsis	665 (17.8)	150 (26.9)	815 (19.0)	<0.001
Septic Shock	29 (0.8)	19 (3.4)	48 (1.1)	<0.001
C. Difficile	26 (0.7)	4 (0.7)	30 (0.7)	0.952
Outcomes, others				
Return to OR, n (%)	78 (2.1)	18 (3.2)	96 (2.2)	0.088
Readmit w/in 30 days, n (%)	268 (7.2)	48 (8.6)	316 (7.4)	0.221
Operative Time, mean (SD)	59 (28)	81 (38)	62 (31)	<0.001
Total Length of Hospital Stay, median (IQR)	2 (1, 4)	5.0 (3, 8)	2 (1, 4)	<0.001
Serious morbidity, n (%)	873 (23.3)	209 (37.5)	1082 (25.2)	<0.001
Overall Morbidity, n (%)	924 (24.7)	243 (43.6)	1167 (27.2)	<0.001
Mortality, n (%)	3 (0.1)	5 (0.9)	8 (0.2)	<0.001

Conclusion: Patients presented with AAGP who underwent laparoscopic or open appendectomy shared mostly similar demographic characteristics. However, those who underwent an open approach tended to be older, overweight/obese, and have higher comorbidities. Additionally, they had worse 30-day outcomes, including higher mortality, serious morbidity, overall morbidity, increased LOS, and operative time. The laparoscopic approach should be considered in all patients presenting with AAGP.