

Three-port colectomy: reduced port laparoscopy for general surgeons.

A single center experience



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Three-port colectomy: reduced port laparoscopy for general surgeons. A single center experience

AIM: To evaluate three-port colectomy as an alternative reduced-port laparoscopy technique in colonic surgery.

MATERIAL OF STUDY: Retrospective study carried out through the analysis of 32 consecutive patients that underwent alternatively to a three ports left colectomy or a conventional laparoscopic colectomy for colonic diseases in order to evaluate the benefits of the reduced-port technique. A multivariate analysis among duration of surgery, hospital stay and conversion rate was performed using the OLS regression and the binary logistic regression.

RESULTS: We found a reduced operative time in the three-port colectomy in comparison to the four-port technique ($p=0.07$). The hospital stay was not found related to the number of port. Conversion rate was higher in the three-port colectomy group and in patients admitted in emergency ($p=0.009$).

DISCUSSION: We did not find difference between three-port and traditional lap in relation to hospital stay. The reduced port technique allows to reduce operative times even adds more conversions.

CONCLUSIONS: Three-port colectomy seems an affordable reduced port laparoscopy technique. General surgeons can use it without the need of specific tools minimizing the port-related complications.

KEY WORDS: Colon Colectomy, Laparoscopy, Three ports

Introduction

Laparoscopy is becoming the treatment of choice for most of the benign and malignant colo-rectal diseases. Compared with open surgery, laparoscopy offers well

known advantages of early resumption of preoperative performance status, lower risk of infections, lower hospitalization time, and so on.

The minimally invasive approach is safe and effective and it showed results comparable to the open technique also for colon cancer; it was also approved by the scientific community thanks to several multicenter randomized trials¹⁻⁸.

Oncological disease can be treated without differences in comparison with the conventional open treatments in terms of overall survival and with improvement in recovery³.

The technique was developed in the earliest 90' and since then many procedural variants had been proposed like laparoscopic facilitated, laparoscopic assisted, minimal access surgery⁹; these proposals are the expression of the great enthusiasm that followed the progression of this surgery.

The conventional laparoscopic technique of left colectomy involves the use of four trocars: a periumbilical 10 mm. camera port, a 12 mm. operative port in the right

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iliac fossa, and two 5 mm. ports respectively located in the right hypochondrium and in the left iliac fossa. In spite of the lower rate of incisional hernia (if compared with open surgery), laparoscopy shows up to 2% complication related to the port access, especially to the 10 or 12 mm. ones (96%)¹⁰.

The aim to reduce the number of abdominal access, to minimize the related complications and to offer better cosmetrical outcomes brings to the development of the single-port surgery also in colo-rectal interventions.

The single-port technique appears less traumatic than conventional laparoscopic technique but increases significantly the difficulty and the operation time; moreover, this technique needs single-use devices that increase significantly the operation costs. Another important element in the evaluation of single port procedure is the umbilical scar to consent colonic extraction which is mostly up to 5 cm and as incisional hernia or non-cosmetic results are possible in this area, some Authors associate the single access with a Pfannenstiel incision¹¹.

The three-port laparoscopic colorectal resection was described by Heidi Nelson and is known around the world due to its utilization in the COST trial¹².

Seow-Choen investigated on the three-port colectomy as an affordable alternative to reduce the number of access performing the same surgical act¹³.

The author in 2010 proposed a three-port technique to perform a left colectomy using an umbilical port for the camera, a 10/12 mm operative port inserted medial to the right anterior superior iliac spine and a third port of 5 mm between the umbilical port and the 10/12 mm port. The specimens in his report were extracted by an enlarged umbilical incision.

Amin proposed his three-port technique using two mid-clavicular ports and an umbilical one in 2014¹⁴.

In the Department of General and Urgent Surgery of the Policlinico "P. Giaccone" of Palermo, a three port modified colectomy is performed even for right and left colectomy.

We propose this retrospective study to analyze the safety and the feasibility of three-port left colectomy in comparison to the conventional technique.

Material and Methods

A retrospective study was carried out through the analysis of 32 consecutive patients that underwent a modified three ports left colectomy for colonic diseases in order to evaluate the benefits of the technique in comparison to the classical laparoscopic left colectomy.

A multivariate analysis among the duration of surgery, the hospital stay and the conversion rate was performed using the STATA software for the OLS regression and the SPSS software for the binary logistic regression to evaluate the impact of the reduction of trocar's number in our series.

The technique used was a three-port colectomy with a 12 mm. umbilical port and two 5 mm. ports introduced in right iliac fossa and in right hypochondrium. A 10 mm. camera was introduced in the umbilical trocar and the operator used a bowel grasper and an ultrasound device in his left and right hand, respectively.

THE TECHNIQUE

The surgical approach to the left colon was the same than in classical technique.

For neoplastic disease it started with the isolation and ligation of the inferior mesenteric vessels, the colon-epiploic dissection and a middle-lateral colonic mobilization. Then the mobilization of the splenic flexure was performed till the junction between distal and middle traverse colon. The mobilization of sigma was executed firstly on the right side following the incisional line of mesenteric vessels and then on the left side along the Monk's line. Resection was performed with a linear stapler introduced in the umbilical trocar, while a 5 mm camera was introduced through the trocar in the iliac fossa¹⁵. Colon was extracted through a Pfannenstiel incision. The colon-rectal anastomosis was performed under vision, coming back to the primary assessment with the 10 mm. umbilical camera and the two 5 mm. trocars finalized to the left and the right hand of the surgeon. In benign disease the vascular ligation was usually performed more distally from the origin and it was done with a previous mobilization of the sigmoid tract and the descending colon. Splenic flexure was not always mobilized even recommendable.

STATISTICAL ANALYSIS

It was firstly performed a univariate analysis using frequencies and percentages of patients' data. The demographical data about sex and ages, the elective or emergency admission modality and the diagnoses accounting for colonic cancer, rectal cancer, diverticular disease, slow transit constipation were resumed by the clinical diaries. The patient's ASA score, the administration of antibiotic prophylaxis and the elective or emergent surgical procedures modality were collected by the computerized surgical register. The type of colectomy performed, the number of trocars, the operative time and the conversion rate were analyzed. Morbidity and mortality rate were resumed through data on post-operative hospital stay. Then, a multivariate analysis among the duration of surgery, the hospital stay and the conversion rate was performed to evaluate the impact of the reduction of trocars' number in our series. Data were analyzed using the STATA software for the OLS regression and the SPSS software for the binary logistic regression; it was verified the relation between variables with the "correlate" com-

mand, while the absence of multi-collinearity between variable was tested with VIF to perform the regression. The first OLS regression studied the correlation of operative time with admission modality, sex, age, antibiotic prophylaxis, ASA score, hospital stay, the different diagnoses (left colon cancer, rectal cancer, diverticular disease, slow transit constipation), the different surgical intervention (sigmoidectomy, left hemicolectomy, anterior resection), the conversion rate and the number of trocars utilized. Then, it was done a Fisher's F test to evaluate which regression was preferable between the OLS and a STEPWISE regression (a normal linear regression) to highlight the relevant factors related to operative time in our series.

The second OLS regression studied the post-operative hospital stay in a similar model correlating it to operative time, admission modality, sex, age, antibiotic prophylaxis, ASA score, emergent or elective intervention, diagnoses, intervention type, conversion rate and number of trocars.

Even for this second OLS regression it was proposed a STEPWISE regression, to identify the relevant factors related to the post-operative hospital stay in our series. The third OLS regression and STEPWISE regression analyzed the factors related to conversion correlating it with operative time, hospital stay, admission modality, sex, age, antibiotic prophylaxis, ASA score, emergent or elective intervention, diagnoses, intervention type and number of trocars.

Results

32 laparoscopic left colon-rectal resections took place at General and Urgent Surgery O.U. of the University hospital "P. Giaccone" of Palermo in 2014.

The average age of treated patients was 61.4 years old with a standard deviation of 15.3 years. Among patients, 15 (46.9%) were males and 17 females. 14 patients (48.8%) had an admission in emergency while 18 came from a pre-hospitalization.

Diagnoses were left colon cancer, rectal cancer, diverticular disease and slow transit constipation. The admittance diagnoses are summarized in Table I.

The ASA score of patients are summarized in Table II. Antibiotic prophylaxis was administered in 18 patients (56.3%) with a regimen of cefazolin 2 gr. and metronidazole 500 mg. one hour prior to the surgical intervention.

Only in four patients the intervention was performed in emergency while in the others medical therapy was administered prior to surgery to assess the clinical conditions.

The different resections performed according to the diagnoses were left hemicolectomy, sigmoidectomy and anterior resection; three-port technique was used in 13 patients (40.6%), data are showed in Table III.

Table I - Diagnoses.

Diagnosis	N. of patients	%
Left colon cancer	9	28.1
Rectal cancer	4	12.5
Diverticular disease	17	53.1
Slow transit constipation	2	6.3
Total	32	100

Table II - Patient's ASA score.

ASA	N. of patients	%
1	1	3.1
2	5	15.6
3	22	68.8
4	4	12.5
Total	32	100

Table III - Type of colectomy and number of trocars.

Type of colectomy	N.	%	3 ports	4 ports
Left hemicolectomy	16	50	8	9
Sigmoidectomy	12	37.5	5	5
Anterior resection	4	12.5	0	4
Total	32	100		

The overall mean operative time was 187 min (range 104-352 min; sd 48); it was 194 min in the four-port colectomy group, while it was 177 min in the three-port colectomy one.

Overall conversion rate was 12.5%. The mean hospital stay was 8.97 days (sd 6.3).

The ASA score and the number of trocar resulted significant variables modifying operative times. Highest ASA scores were related to longer operative times; for each point of ASA, 30 minutes more. Three-port colectomy was associated to shorter operative times (194 vs 177min). The STEPWISE regression for the operative time correlate variables is showed in Table IV.

In regards to hospital stay related variables, the age of patients was found as the only significant variable; for each year, 0.12 more days of hospitalization. The number of ports utilized weren't found related to the hospital stay length. The multivariate analysis is reported in Table V.

Conversion rate related variables were investigated with the linear regression; this analysis highlighted the three-port technique and the emergency admissions of patients as significant variables modifying the conversion rate.

TABLE IV - The multivariate analysis for the operative times.

. regress LNtempop ASA trocars3					
Source	SS	df	MS	Number of obs = 32	
Model	.436276049	2	.218138025	F(2, 29) =	4.29
Residual	1.4729197	29	.050790335	Prob > F =	0.0232
				R-squared =	0.2285
				Adj R-squared =	0.1753
				Root MSE =	.22537
Total	1.90919575	31	.06158696		

LNtempop	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
ASA	.1569034	.0636765	2.46	0.020	.0266704 .2871364
trocars3	-.1534962	.0817387	-1.88	0.070	-.3206706 .0136781
_cons	4.808138	.1882158	25.55	0.000	4.423193 5.193082

TABLE V - The multivariate analysis for hospital stay.

. regress degenzapostop ETA, vce(robust)					
Linear regression					
				Number of obs =	32
				F(1, 30) =	3.66
				Prob > F =	0.0653
				R-squared =	0.0858
				Root MSE =	6.1296

degenzapos-p	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]
ETA	.1205938	.0630335	1.91	0.065	-.0081378 .2493253
_cons	1.56354	3.062839	0.51	0.613	-4.691612 7.818692

TABLE VI - The multivariate analysis for the conversion rate.

Linear regression					
				Number of obs =	32
				F(2, 29) =	5.51
				Prob > F =	0.0093
				R-squared =	0.2769
				Root MSE =	.34866

conversione	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]
trocars3	.3883495	.139304	2.79	0.009	.1034408 .6732583
ricovero	.2578209	.1260503	2.05	0.050	.0000191 .5156227
_cons	-.0830636	.0639638	-1.30	0.204	-.2138843 .0477571

The multivariate analysis with the STEPWISE regression regarding the conversion rate is reported in Table VI. Our post-operative mortality rate was 3.1%, one patient with rectal cancer with a complicated postoperative course characterized by anastomotic dehiscence and peritonitis.

Discussion

Laparoscopy is widely used in the management of colorectal diseases, both for benign diseases likewise malignant ones¹⁶. "Milestone" of laparoscopic colon surgery is the so-called COLOR study, whose aim was to evaluate the safety of

laparoscopic surgery and the long-term survival in comparison to traditional surgery for colon cancer. 3-year disease-free survival and overall survival after laparoscopic and open resection of solitary colorectal cancer were the principal end-points. Secondary outcomes were morbidity and mortality in the short term, the number of positive resection margins, local recurrence, and blood loss during surgery. The median follow-up was 53 months. Positive resection margins, number of lymph nodes removed, and morbidity and mortality were similar in both groups of patients. As a result, this randomized controlled trial showed that laparoscopic colectomy reaches the same standards than open surgery in colon cancer treatment, with the advantages of a less invasive treatment³.

The COST trial demonstrated similar disease-free survivals in patients undergoing laparoscopic and open colectomy^{1,2}.

The laparoscopic-assisted surgery for cancer of the colon is as effective as open surgery in the short term and is likely to produce similar long-term outcomes. However, impaired short-term outcomes after laparoscopic-assisted anterior resection for cancer of the rectum have not justified its routine use, yet¹⁷.

According to Di, in a meta-analysis on outcomes that compared laparoscopic versus open surgery for colon cancer with 5 years follow-up, the total recurrence rate, the total mortality rate, the tumor free survival and the overall survival rate are not significantly different. Moreover, he recommends its use, as short time outcomes are better in laparoscopy¹⁸.

Likewise, Theophilus meta-analysis found no statistical difference in long-term overall survival and in 5 year overall survival for individual stages¹⁹.

Consequently being confirmed the feasibility of laparoscopy in colon surgery, a progressive impulse for the reduction of access number brings to the introduction of several reduced port techniques.

Lasts single-incision technique (SILS) that produces better cosmetic results and improves patient satisfaction, having less postoperative pain and faster recovery; however, it increases the difficulty, the operation time and the complication rate²⁰.

Unexpectedly, the rate of incisional hernia following laparoscopic colorectal resection developed in the port-sites or in the specimen removal site was seen not inferior in comparison to laparotomy incisional hernia; indeed laparoscopy produces smaller hernias amenable to repair by laparoscopic approach²¹.

Moreover, the location of ports has to be focused as midline ports and umbilical ports are the most common site for the development of hernia and the number of ports used should be also considered²²⁻²⁴.

The umbilical scar used in single port technique, both as operative port and as site of colonic extraction is mostly up to 5 cm, so in this area incisional hernia or non-cosmetic results are possible. Pfannestiel inci-

sion produces less incisional hernia so some Authors associate the single access with a Pfannenstiel incision for the extraction^{11,25}.

The role of three-port technique feasibility in colorectal disease was investigated as an alternative to single port in order to reduce abdominal access and related complications, reducing costs, dedicated skills and operative time.

Seow-Choen shows that the recovery after surgery is better after three-port laparoscopy than after four or more ports; tumor clearance and hospital stay being similar²⁶.

Tawfik, in a prospective trial on colorectal cancer, states that three-port laparoscopy colorectal surgery is safe, effective and has cosmetic advantages in comparison to conventional technique. He reports mean operative times of 110 min; in his series the conversion rate due to local advanced neoplasia and for bleeding was 12.5%; the average of retrieved lymph nodes was 14. He proves that while the single-port colorectal surgery requires high volume surgeons, reduced-port surgery is feasible by average-volume laparoscopic colorectal surgeons with the same instrumentation than classical laparoscopy¹⁴.

In our study we found reduced operative times for three-port colectomy in comparison to the four-port technique; these operations were almost always executed by a single operator with a dedicated staff.

The unchanged postoperative care for patients conducts to similar length of hospital stay, both in three than in four-port colectomies.

Conversion rate was higher in the three-port group and in patients admitted in emergency. This finding could be related to difficult cases where a first attempt of laparoscopic procedure was done but an early conversion was needed, among other causes.

We reported a failure in a patient over 70, ASA 4, with a post-operative diffuse peritonitis with a sepsis severity score of 7 in which according to literature mortality rate was 42%²⁷.

One of the limitations of this study is due to the small sample size, being a single center study. Patients were collected in a single series without a randomization for the participants in 3 ports and 4 ports group. A follow-up analysis could be useful in evaluate the presence of comparable results for oncological patients. Further studies will be needed to validate the technique.

Conclusions

In conclusion, the three-port colectomy seems an affordable option in the reduced-port laparoscopic surgery. It is comparable to conventional technique and an alternative to single port technique, both in benign and in malignant colorectal diseases.

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Riassunto

Le resezioni coliche laparoscopiche sia per patologie benigne che maligne sono state investigate da importanti RCT che ne hanno dimostrato la sovrapponibilità alla tecnica open convenzionale.

La laparoscopia con un numero ridotto di trocar ha da quel momento trovato ampio sviluppo nell'ottica di massimizzare i benefici della mini-invasività.

Proponiamo un'analisi dei nostri risultati nell'utilizzo della tecnica three-port nella emicolectomia sinistra attraverso un confronto con la classica resezione laparoscopica con quattro/cinque accessi.

Come è noto i laparoceli si sviluppano maggiormente su incisioni mediane mentre non vi è differenza tra lo sviluppo di questi dopo tecnica open o laparoscopica.

Nell'ottica della chirurgia a numero ridotto di accessi, la tecnica single-port sembra dare vantaggi di minor traumatismo ma ciò a costo di aumentate difficoltà di esecuzione, aumento dei tempi operatori e dell'utilizzo di strumenti per lo più dedicati, con incisioni ombelicali che possono superare i 5 cm.

Le resezioni coliche three port consentono di ridurre il numero di accessi e dunque delle complicanze a questi correlate con l'utilizzo di strumentazione standard e la possibilità di esecuzione su larga scala da parte di ogni chirurgo.

L'analisi che abbiamo eseguito ha dimostrato nella nostra serie una riduzione dei tempi operatori nella tecnica three port e ciò può essere dovuto all'inserimento dei trocar addizionali ed al loro controllo ma soprattutto alla possibilità/necessità del chirurgo esperto di essere meno influenzato da fattori quali una equipe non dedicata.

Non sono stati evidenziati vantaggi nella riduzione della degenza operatoria.

Il tasso di conversione è stato maggiore nella tecnica a ridotto numero di accessi, questo è possibile sia un bias legato alle conversioni precoci prima del posizionamento di restanti trocar in casi particolarmente complessi.

In conclusione, la tecnica three port appare comparabile alla tradizionale laparoscopica, fornendo i vantaggi della riduzione del numero di accessi e delle complicanze a questi correlate.

References

1. Weeks JC, Nelson H, Gelber S, Sargent D, Schroeder G & Clinical Outcomes of Surgical Therapy (COST) Study Group: *Short-term quality-of-life outcomes following laparoscopic-assisted colec-*

- tomy vs open colectomy for colon cancer: A randomized trial. *JAMA*, 2002; 287(3):321-28.
2. Clinical Outcomes of Surgical Therapy Study Group: *A comparison of laparoscopically assisted and open colectomy for colon cancer*. *N Engl J Med*, 2004; 350(20):2050.
3. Colon Cancer Laparoscopic or Open Resection Study Group: *Laparoscopic surgery versus open surgery for colon cancer: Short-term outcomes of a randomised trial*. *Lancet Onco*, 2005; 6(7):477-84.
4. Guillaou PJ, Quirke P, Thorpe H, Walker J, Jayne D G, Smith A M, et al.: *Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC CLASICC trial): multicenter randomized controlled trial*. *Lancet*, 2005; 365:9472.
5. Kuhry E, Schwenk W, Gaupset R, Romild U, Bonjer J: *Long-term outcome of laparoscopic surgery for colorectal cancer: A Cochrane systematic review of randomized controlled trials*. *Cancer Treat Rev*, 2008; 34(6):498-504.
6. Guerrieri M, Organetti L, Baldarelli M, Romiti C, Campagnacci R: *Laparoscopic colectomy is a reliable option for colon cancer treatment*. *Ann Ital Chir*, 2012; 83(3):239-44.
7. Del Rio P, Dell'Abate P, Gomes B, Fumagalli M, Papadia C, Coruzzi A, & Sianesi M: *Analysis of risk factors for complications in 262 cases of laparoscopic colectomy*. *Ann Ital Chir*, 2010; 81(1): 21-30.
8. Bianchi PP, Ceriani C, Montorsi M: *Laparoscopic surgery of colon cancer. State of art and literature review*. *Ann Ital Chir*, 2006; 77(4):289.
9. Bergamaschi RCM, Larach W, Pigazzi A, Marecik S, Valsdottir EB, Amrani S: *Laparoscopic Colon and Rectal Surgery*. In: *Corman ML. Colon and Rectal Surgery*. 6th ed. Philadelphia: Lippincott Williams and Wilkins; 2013; 546-607.
10. Helgstrand F, Rosenberg J, Bisgaard T: *Trocar site hernia after laparoscopic surgery: A qualitative systematic review*. *Hernia*, 2011; 15(2):113-21.
11. Ragupathi M, Ramos-Valadez DI, Yaakovian MD, Haas EM: *Single-incision laparoscopic colectomy: a novel approach through a Pfannenstiel incision*. *Tech Coloprocto*, 2011; 15(1):61-65.
12. Fleshman J, Sargent DJ, Green E, Anvari M, Stryker SJ, Beart RW Jr, et al.: *Laparoscopic colectomy for cancer is not inferior to open surgery based on 5-year data from the COST Study Group trial*. *Ann Surg*, 2007; 246(4):655-62.
13. Seow-En I, Tan KY, Daud MM, Seow-Choen F: *Traditional laparoscopic colorectal resections can be performed effectively using a three-port technique*. *Tech Coloprocto*, 2011; 15(1):91-93.
14. Tawfik A, Elsaba TM, Amira G: *Three ports laparoscopic resection for colorectal cancer: a step on refining of reduced port surgery*. *Int Sch Res Notices*, 2014; doi: 10.1155/2014/781549, 2014.
15. Giaccaglia V, Antonelli MS, Addario Chieco P, Cocorullo G, Cavallini M, Gulotta G: *Technical characteristics can make the difference in a surgical linear stapler. Or not?* *J Surg Res*, 2015; 197(1):101-06.
16. Agresta F, Ansaloni L, Baiocchi GL, Bergamini C, Campanile FC, Carlucci M, et al.: *Laparoscopic approach to acute abdomen from the Consensus Development Conference of the Società Italiana di Chirurgia Endoscopica e nuove tecnologie (SICE), Associazione Chirurghi Ospedalieri Italiani (ACOI), Società Italiana di Chirurgia (SIC), Società Italiana di Chirurgia d'Urgenza e del Trauma (SICUT), Società Italiana di Chirurgia nell'Ospedalità Privata (SICOP), and the European Association for Endoscopic Surgery (EAES)*. *Surg Endosc*, 2012; 2134-64.
17. Buunen M, Bonjer HJ, Hop WC, Haglund E, Kurlberg G, Rosenberg, J, et al.: *COLOR II. A randomized clinical trial comparing laparoscopic and open surgery for rectal cancer*. *Dan Med J*, 2009; 56(2):89-91.
18. Di B, Li Y, Wei K, Xiao X, Shi J, Zhang Y, et al.: *Laparoscopic versus open surgery for colon cancer: a meta-analysis of 5-year follow-up outcomes*. *Surg Oncol*, 2013; 22(3): e39-e43.
19. Theophilus M, Platell C, Spilsbury K: *Long term survival following laparoscopic and open colectomy for colon cancer: A meta analysis of randomized controlled trials*. *Colorectal Dis*, 2014; 16(3):75-81.
20. Poon JT, Cheung CW, Fan JK, Lo OS, Law WL: *Single-incision versus conventional laparoscopic colectomy for colonic neoplasm: A randomized, controlled trial*. *Surg Endosc*, 2012; 26(10):2729-734.
21. Skipworth JRA, Khan Y, Motson RW, Arulampalam TH, Engledow AH: *Incisional hernia rates following laparoscopic colorectal resection*. *Int J Surg*, 2010; 8(6):470-73.
22. Owens M, Barry M, Janjua AZ & Winter DC: *A systematic review of laparoscopic port site hernias in gastrointestinal surgery*. *The surgeon*, 2011; 9(4):218-24.
23. Salamone G, Licari L, Agrusa A, Romano G, Cocorullo G, Gulotta G: *Deep seroma after incisional hernia repair. Case reports and review of the literature*. *Ann Ital Chir*, 2015; 86(ePub).
24. Salamone G, Licari L, Atzeni J, Tutino R, Gulotta G: *Histologic considerations about a rare case of recurrent incisional hernia on McBurney incision*. *Ann Ital Chir*, 2014; 85(ePub).
25. Bergamaschi R, Tuech JJ, Cervi C, Arnaud JP: *Re-establish pneumoperitoneum in laparoscopic-assisted sigmoid resection? Randomized trial*. *Dis Colon Rectum*, 2000; 43(6):771-74.
26. Agrusa A, Romano G, Cucinella G, Cocorullo G, Bonventre S, Salamone G, et al.: *Laparoscopic, three-port and SILS cholecystectomy: a retrospective study*. *G Chir*, 2013; 34(9-10):249-53.
27. Sartelli M, Abu-Zidan FM, Catena F, Griffiths EA, Di Saverio S, Coimbra R, et al.: *Global validation of the WSES Sepsis Severity Score for patients with complicated intra-abdominal infections: A prospective multicentre study (WISS Study)*. *World J Emerg Surg*, 2015; 10:61.