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LAPAROTOMY WOUND DISRUPTION AN AVOIDABLE TECHNICAL FAILURE

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SUMMARY

Laparotomy wound disruption, in spite of being a quite avoidable complication, the result of a technical mishap, as it is, still carries a significantly high morbidity and mortality. A group of 648 major laparotomies, with no dehiscences, is compared with another one of 1154, with 39 disruptions, the most significant differences residing on the technical type of closure.

When, during the immediate postoperative period, a rupture occurs, at all levels of a laparotomy wound, with exposure of the intraperitoneal organs, one is faced with a dehiscence (when these are exteriorized the term *evisceration* is used). The clinical evidence of this complication is, usually, announced by the appearance of a copious sero-sanguinous effusion on the wound dressing, frequently after a coughing or vomiting spell, which are, then, erroneously thought of being the origin of the problem.

With Norris[1] we think that the *elimination of postoperative dehiscence is entirely within the jurisdiction of the operating surgeon,* even on those patients thought to be highly susceptible.

When this problem occurs on a high risk patient, whose postoperative course was, otherwise, running smoothly, it represents, all too often the ultimate cause of de compensation. Since it appears, very frequently, among other severe complications, it is quite difficult to assess, precisely, the exact role of this event as a direct cause of mortality. The figures published in the litterature vary widely[2], ranging from 11% to 63%. Even when it is not a direct cause of death it represents, at least, a quite significant factor of economical loss (hospital expenses, waste of working hours, etc.), as well as highly increased morbidity.

Wolff[3], in 1950, published a classical paper, where he stated that the incidence of 2,6% would be an acceptable rate in most major medical centers. With advancing knowlwdge and improved technical ability we feel that this figure is much too high. Recently Sanders[4] reported the occurrence of 11 dehiscences among 4000 laparotomies (0,27%). We strongly believe that, with a correct technique, the incidence of this catastrophe should not be any higher.

CLINICAL MATERIAL, TECHNIQUES, RESULTS

Trying to prove this last statement we evaluated, retrospectively, the experience of a General Surgery Service (Cirurgia I — Hospital de Santa Maria) during the period December 1972 — July 1979. In this Service, with a total of 48 beds, there are three surgical teams, with 16 beds each. This is a major teaching Hospital Center from the University of Lisbon Medical School, without private beds. The admission and transference of patients, as well as the emergency duties are similar on every

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team. A total of 648 major laparotomies were carried out by the team led by the senior author (A.M.A.) constituing Group 2 of present series. Group 1 is made up by 1154 laparotomies performed by the other two teams. Lumbar Sympathectomies, Herniorraphies, McBurney's incisions or any other incision shorter than 15 cms are not included. There were no significant differences, regarding age and sex, between both groups (Table 1). Figures 1, 2 and 3 summarize the totals, the incidence of dehiscences and the difference in utilization of median, paramedian and anatomical incisions. Figs. 4 and 5 demonstrate our technique (Group 2): mass closure of the musculo-fascial plane, on one single layer of interrupted stitches, 10-15 mm apart from each other, inserted 15-20 mm from the fascial cut edge. Figs. 6 and 7 display the technique of Group 1: running stitches, layered closure, suturing the peritoneal layer separately. Retention sutures are utilized, as well, on those cases classically considered to be more susceptible (neoplasms, hipoalbuminemia, jaundice, obesity, etc.) by the surgeons of this group, while, on our team, we never used them. Table 2 summarizes the main technical features and differences between both groups. Table 3 shows the percentage of patients with malignancy or jaundice of the same groups.

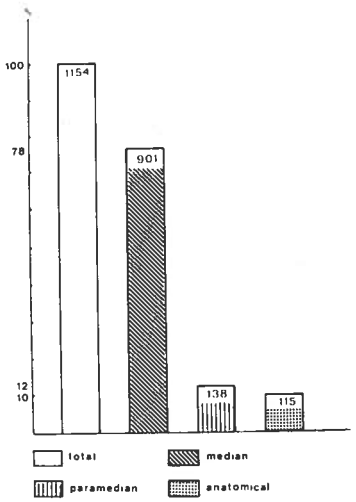

Fig. 1 — *Laparotomies of Group 1 (39 dehiscences)*

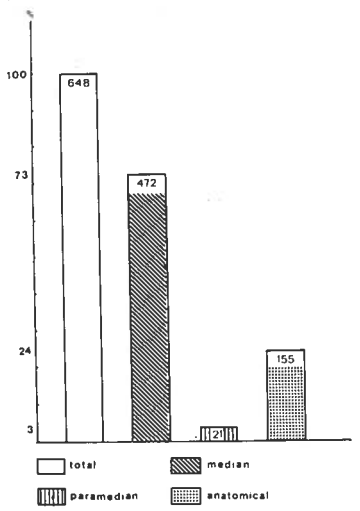

Fig. 2 — *Laparotomies of Group 2 (No dehiscences)*

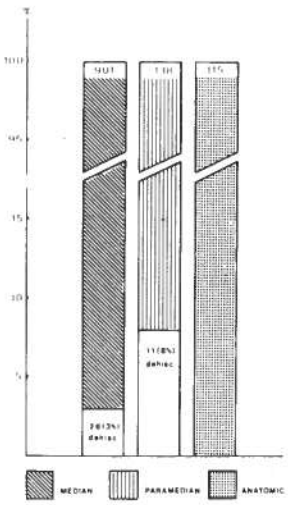

Fig. 3 — *Incidence of dehiscences on laparotomies of Group 1*

Table 1
Age and sex of patients on Groups 1 and 2

	Age	Males	Females
Group 1	8-85 (mean 45)	588 (51%)	566 (49%)
Group 2	7-87 (mean 52)	362 (56%)	286 (44%)

Table 2
Main Technical Differences between Groups 1 and 2

	Group 1	Group 2
Closure	Layered	Single Layer
Suture Technique	Runing Stitches	Interrupted Stitches
Catgut	Yes	Never
Retention Stitches	Yes	Never
Paramedian Incision	12%	3%
Anatomical Incision	10%	24%

Table 3
Percentage of patients with jaundice or malignancy on Groups 1 and 2

	Group 1	Group 2
Total Laparotomies	1154	648
With Jaundice	57 (4,9%)	45 (6,9%)
With Malignancy	380 (32,9%)	200 (30,9%)

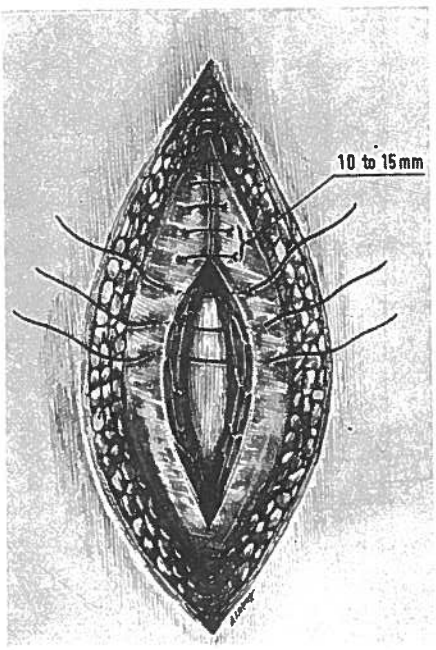

Fig. 4 — *Technical details of laparotomy closure utilized by surgeons on Group 2*

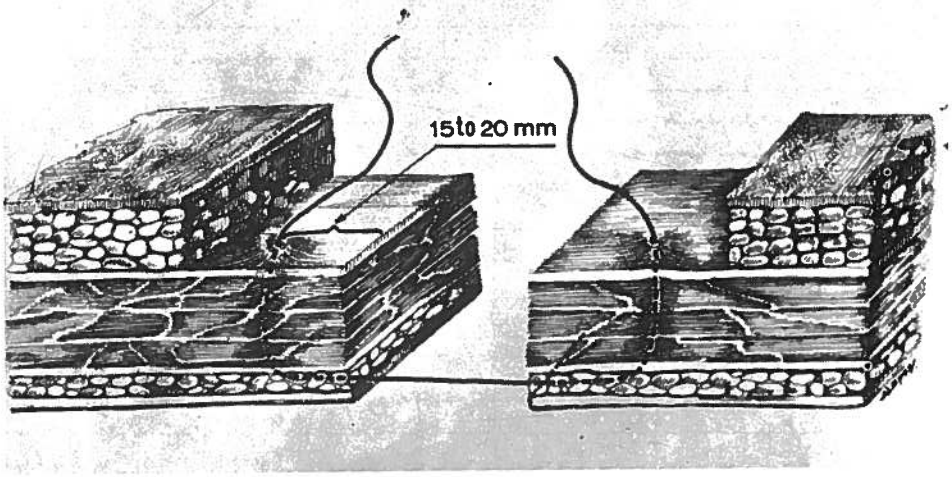

Fig. 5 — *Another view of Group 2 technique*

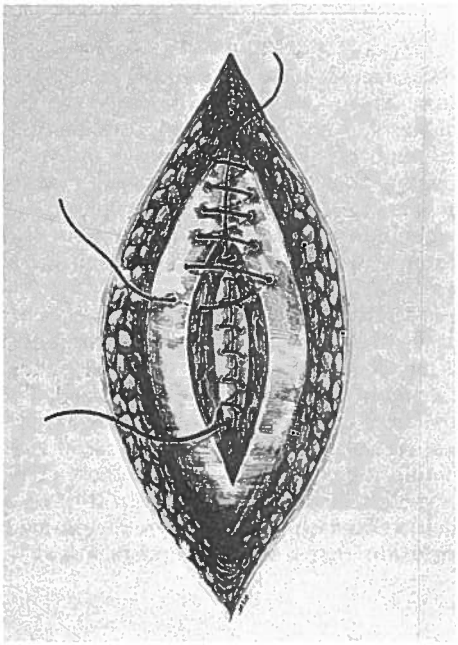

Fig. 6 — *Technical details of laparotomy closure utilized by surgeons on Group I*

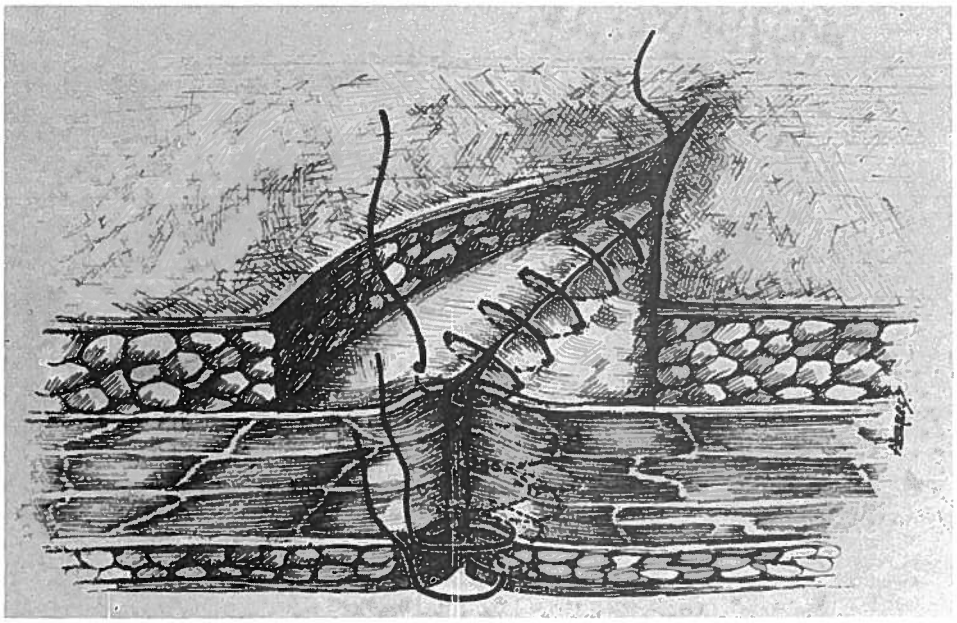

Fig. 7 — *Another view of Group I technique*

COMMENTS

Many controversial factors have been implicated, along the years, as major culprits of an evisceration. From our own experience we classify and think of these factors as shown on tables 4, 5 and 6: technical, contributing and questionably contributing factors. Several reports[2,5] back this concept up. Accordingly, we believe, it is among the technical factors that the primary cause of a dehiscence should be searched for, regardless of the presence or absence of any one of the others. Needless to say, the existence of one or more of these factors might favor the disruption of a less than perfectly closed laparotomy, which would have gone through, without major troubles, were they not present.

Wound healing is a rather complex process which, schematically, can be thought of taking place by phases (Table 7). During the inflammatory period and most of the fibroblastic phase the tensile strength of the wound depends entirely on the technical quality of the closure, namely the suture material utilized. The great majority of dehiscences occur during the first 12-14 days[5]. Dehiscences are, sometimes, diagnosed only a few days after its real occurrence at the musculo-fascial level, the skin sutures remaining the only layer hiding the complication. It is, then, rather confortable to blame a counhing or vomiting spell, which disrupts the skin stitches quite easily, as the culprit. Only four of the 39 dehiscences on Group 1 were diagnosed beyond the 2nd week. It's easy to draw the conclusion that a technical mistake was, primarily, at their origin.

Table 4
Technical Factors

1 — Type of Closure (single layer vs. layered, Insertion of stitches, Retention stitches)
2 — Type of Incision (anatomical vs. Vertical)
3 — Anestesia, disintubation
4 — Suture material
5 — Excessive material
6 — Hemostasis, hematoma, serona
7 — Contamination, infection
8 — Drains
9 — Gastrostomy, enterostomy, colostomy

Table 5
Contributing Factors

1 — Age
2 — Sex
3 — Abdominal Distension (Gastric, Intestinal)
4 — Respiratory Complications, Cough (Atelectasis, Pneumonia)
5 — Peritoneal Irritation (Vomits, Hiccups)
6 — Ascitis
7 — Obesity

Table 6
Questionably Contributing Factors

1 — Hypovolemia
2 — Anemia
3 — Malignancy, «Starvation»
4 — Hypoproteinemia
5 — Metabolic Disorders (Diabetes, Renal Insufficiency, Liver Failure, etc.)
6 — Jaundice
7 — Hypercorticism. Corticoid Therapy
8 — Hypovitaminosis «C»

Table 7
Wound Healing Phases

1 — Inflammatory Phase («lag» phase)	0 — 5th day
2 — Fibroblastic Phase	6th — 21st day
3 — Maturation Phase	2 years

Until 1971, when we started our Chief Residency, we used to close the laparotomy wound as we had seen being done by many surgeons: layered closure with running stitches. Being vigorously admonished, on the weekly Morbidity and Mortality Conference, because of having the misfortune of two young men disrupting their wounds, despite what, apparently, had been done correctly, we went back to previous publications, concerning this subject. Surprisingly we found the layered closure bluntly blamed by many authors[6-12] as the source of dehiscences. Ever since then we've been using the technique shown on Figs. 4 and 5, on any type of laparotomy.

The argument that the peritoneal layer must be separately stitched up, to avoid adhesion formation, does not have any scientific background. In fact, there is experimental evidence proving exactly the opposite[13, 14]. Catgut is particularly harmful on this respect. A running stitch, too, is, indeed, a rather imperfect way of approximating tissue layers since it decreases, remarkably, the blood supply to an, already, disturbed area.

The tissue areas around the fascial incision undergo profound biochemical changes. This fact has been proven, experimentally, by Adamsons[15] who showed the clear evidence of these alterations on the strips immediately adjacent to the incision, 7,5 mm on each side of it. It is, so, quite understandable the reason why the stitches should be inserted the way we do (Group 2): 15-20 mm away from the fascial edge. The same reasoning applies to avoid the placement, at this level, of any crushing clamp, all too frequently utilized, attempting to approximate and strain tissues that should, on the contrary, come into apposition smoothly, rather than harshly strangled. By doing so we avoid sutures cutting through unhealthy tissues, which is the underlying cause of most, if not all, abdominal wound dehiscences.

Many surgeons utilize the so called *retention* sutures (mass, through-and--through, closure of, not only the fascial layers but the subcutaneous tissue and skin, as well) on patients handicapped by some of the factors pointed out on tables 5 and 6. But, after all, do they really serve the purpose they are meant for? With Taylor[16] *we believe that the usual retention suture is mechanically unsound; that from its very nature and design it can do little toward holding fascial layers together and that, at best, it relieves skin tension only.* Goligher, on a prospective study, concludes that this stitch does not seem, indeed, to offer any advantage, whatsoever. They appear to us, as a matther of fact, to be potentially harmfull, increasing significantly the chances of wound infection, because, if they are to serve the purpose they are meant for, they will have to remain in position for, at least, 3 weeks, the minimum period of time necessary for adequate fibroplasia and collagen deposition, with enough gain in tensile strength. On retrospective studies, Mayo[17] and Del Junco[2] noticed that 25% of the dehiscences took place on laparotomies where retention sutures were used. On Group 1 of present series 9(24%) of the dehiscences had retention stitches, whereas on Group 2, where these sutures were never utilized, we had no such complication. These facts suggest, at least, the uselessness of this technical manoeuver.

Dennis[18] imagined a modified, fixed figure-of-eight, type of retention suture, which obviates the mechanical inconveniences pointed out by Taylor[16], and indeed, keeps the fascial layers, efficiently, close together. From these two authors work it is obvious that what makes the usual retention stitch mechanically unsound is the interposition of the fatty layer. It became apparent to us that a rather simple, non sophisticated type of stitch (Figs. 4 and 5) would do just as well, as long as it is closed down

loose, rather than tight, and not too near from each other. Recently Sanders[1] has proven, experimentally and clinically, the higher quality of this technique. Present series results, confirming the clinical, comparative, study of Dudley[6] clearly demonstrate the superiority of this type of closure over the layered one.

Avoiding a dehiscence starts when the surgeon selects the incision. It is well known the higher incidence of dehiscences with the paramedian access, especiallywhen it is done transrectally, as well as it is the lower incidence with the anatomical incision. Sloan[19] demonstrated, on clinical cases, that the strength necessary to approximate the edges of vertical fascial wounds was thirty times greater than on transverse incisions. He also found out that, on vertical laparotomies, the longer the incision the stronger the muscular pull would be, more so beyond 15 cms, whereas the length of transverse wounds had no significant impact on that parameter. On large, retrospective, studies by Singleton[20] and Del Junco[7] the superiority of anatomical incisions over vertical ones was clearly illustrated. Similar conclusions can be drawn from analyzing the results of present series (Figs. 1, 2, and 3).

Eleven (28%) of the 39 dehiscences of Group 1 occurred on paramedian laparotomies, which constitute only 12% (138) of the total on that particular group. Noteworthy is the fact that none of their anatomical incisions (115) dehisced (Fig. 3).

Much more important than the anesthetic drug utilized is the anesthetist. A good muscular relaxation, quiet and collapsed intestinal loops are essential requirements for a technically correct apposition of the fascial cut edges. The bronchial *Toilette*, with its inevitable coughing spells, should be done gently and immediately before the surgeon starts the closure.

A fundamental technical asset is the suture material utilized. The generally accepted characteristics of an ideal suture material include superior tensile strength, good knot security, excellent handling, minimal tissue reaction, absence of allergenic properties, resistance to infection and eventual absorption when tissue repair has reached satisfactory levels[21]. Catgut, which is, paradoxically, the most commonly used absorbable material, lacks most of the before mentioned characteristics. Indeed, its reabsorption takes place by phagocytosis, originating a quite significant inflammatory reaction[21-23] and all too often disappears from the tissues much to early, before the 8th day, as has been proven, clinically and experimentally[24]. Therefore, nonabsorbable sutures are, now, widely used, namely stainless steel wire and synthetic material, like Dacron. Since the late sixties a new synthetic material, the polyglycolic acid (PGA), has been tested, experimentally and clinically, as well.[21-23] From these studies it became apparent that this suture undergoes reabsorption by hydrolysis, causing minimal or no tissue inflammation, at all.[21] It disappears from the tissues within a period of 75 days,[23] well beyond the minimum required for satisfactory healing. It keeps a significantly higher level of tensile strength during the first 15 days[23] as compared to catgut and its breaking strength compares favorably to silk, being similar to Dacron.[21] From our clinical experience it seems to hold most of the before mentioned properties of an ideal suture. On Group 2 we closed the first 394 laparotomies with Dacron sutures and the last 254 with PGA. Sinus formation, which, not infrequently, caused significant discomfort on patients whose laparotomies were closed with Dacron did not occur on any one of the others.

Needless to say, hematoma and/or seroma formation is, most of the times, the result of a poor surgical technique, enhancing the emergence of a wound infection with the consequent delay of a satisfactory level of repair. A contaminated wound, after a technically poor anastomosis has increased chances of infection and, consequently, of dehiscence.[7]

On the very rare situations where the use of a drain is indicated, it should never be exteriorized through the laparotomy wound itself. The same reasoning applies to the construction of a gastrostomy, ileostomy or colostomy.

It is well known the higher incidence of wound disruptions among elderly male patients.[2,5] The stronger muscular pull plus the delayed healing period, typical of the aging period, offer a good explanation. The results of Group 1 somehow confirm this assumption. Indeed, only two of the patients sustaining this complication were under 45 years of age, and only 6 of the 39 dehiscences (15,3%) occurred among the 566 (49%) female patients of that group. From our own experience on Group 2 (Table 1), though, we strongly believe that these two parameters, as well as all the others mentioned on Table 5 have to be considered, at best, as contributing. Even more controversial are the *questionably contributing* factors (Table 6), about which much has been written, regarding their ethiological role, without, ever, a consensus being obtained. Alexander's work[5] is rather illustrative concerning this matter.

Laparotomies carried out on patients with obstructive jaundice and/or malignancy are said to be more prone to dehiscences. Bayer and Ellis[25] demonstrated, experimentally, the adverse effect of jaundice on the healing process. However, the experimental findings of Greaney[26] *Suggest that the biochemical changes in the wounds of jaundiced animals did not interfere with wound repair and cast doubt on the thesis that jaundice has an adverse effect on wound healing*. The controversy seems rather evident. The percentage of patients with jaundice or malignancy on Groups 1 and 2 (Table 3) is not significantly different. However, while on Group 2 no dehiscences occurred, this catastrophe complicated the postoperative period of 39 patients of Group 1.

From all the facts discussed it seems rather difficult, indeed, to explain an evisceration on a basis other than technical failures.

Reiterating this last statement it is worthwhile mentioning that over 90% of all laparotomies of Group 2 were closed by interns during their period of training, which seems to confirm the superiority of the closure technique we advocate.

CONCLUSIONS

Laparotomy wound disruption carries a significantly high morbidity and mortality rates. However, it is a quite avoidable complication, once an adequate technique is utilized. The authors look back into the experience of a General Surgery Service, from December 1972 to July 1979, where a total of 1802 laparotomies were analyzed, none of them less than 15 cms long. The authors are responsible for 648, without any dehiscence. On the remaining 1154, performed by two other surgical teams, 39 (3,4%) dehiscences occurred, the only significant difference being the type of closure. The technical implications are discussed.

1 — The factors that can, possibly, be at the origin of a dehiscence are classified as: A) Technical, B) Contributing and C) Questionably Contributing.

2 — The elimination of postoperative disruption depends entirely on the surgeon.

3 — During the first two weeks the tensile strength of the wound depends, totally, on the technical quality of the closure.

4 — The technical errors most frequently responsible are: A) Layered closure, B) Running stitches, C) Utilizaton of catgut, D) Insertion of sutures in structurally altered tissues.

5 — Whenever possible and advisable an anatomical incision (transverse or oblique) should be used. When a vertical incision is needed the median access is preferable. Paramedian laparotomies should be avoided.

6 — The so called *retention* sutures are useless and can, in fact, enhance a wound infection.

7 — The factors classified as *Countributing* and *Questionably Contributing* can, indeed, be at the origin of a dehiscence, when faced with a less than perfect closure.

8 — When a dehiscence occurs beyond the 14 th day, one can speculate about the role played by the *Questionably Contributing* factors.

RESUMO

A ruptura, ocorrendo no período post-operatório imediato, duma laparotomia é uma complicação vulgarmente designada por evisceração, quando órgãos intra-peritomeais se exteriorizam ou por simples deiscência, quando, apesar da separação, total ou parcial, dos elementos suturados, as vísceras permanecem ocultas. Apesar de ser, fundamentalmente, consequência de erros técnicos, e portanto, eminentemente evitável, continua a constituir um importante factor de morbilidade e mortalidade post-operatória.

Num estudo retrospectivo de 1802 laparotomias *major* os autores comparam um grupo de 648, por eles efectuadas, sem ocorrência desta complicação, com outro de 1154, levadas a efeito, no mesmo Serviço, por outras equipas de cirurgiões, e em que ocorreram 39 eviscerações.

A única diferença significativa entre estes 2 grupos de doentes residiu na técnica de encerramento dos planos de laparotomia.

Os Autores discutem os diferentes factores, habitualmente invocados como eventuais responsáveis deste problema, e sugerem conclusões.

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