The Importance of the Chemical Composition of Synthetic Nets Used in Repair of Parietal Deffects

TIBERIU STEFANITA TENEA COJAN[1#], LUCRETIU RADU[2]*, DRAGOS DAVITOIU[3#], IONELA MIHAELA VLADU[4#], VLAD DUMITRU BALEANU[5], DIANA CLENCIU[6], CRISTINA GABRIELA ENE[7], BOGDAN SOCEA[3]

[1] University of Medicine and Pharmacy of Craiova, Department of Surgery, CFR Hospital of Craiova, Stirbei-Voda Str., 200374, Craiova, Romania

[2] University of Medicine and Pharmacy of Craiova, Department of Hygiene, CFR Hospital of Craiova, Stirbei-Voda Str., 200374, Craiova, Romania

[3] University of Medicine and Pharmacy Carol Davila Bucharest, Clinical Emergency Hospital Sf. Pantelimon Bucharest, 340-343 Pantelimon Road, 021659, Bucharest, Romania

[4] University of Medicine and Pharmacy of Craiova, Department of Metabolism and Nutrition Diseases, Filantropia Clinical Hospital of Craiova, 1 Filantropiei Str., 200143, Craiova, Romania

[5] University of Medicine and Pharmacy of Craiova, Bucharest Universitary Emergency Hospital, Surgery Department 2 Petru Rares Str, 200349, Craiova, Romania

[6] Filantropia Clinical Hospital of Craiova, Department of Metabolism and Nutrition Diseases, 1 Filantropiei Str., 200143, Craiova, Romania

[7] University of Medicine and Pharmacy of Craiova, Pharmacology Department, County Hospital of Craiova, 2-4 Petru Rares Str., 200349, Craiova, Romania

Postoperative eventration is a pathology whose treatment is exclusively surgical, and is one of the most frequent interventions in general surgery along with other abdominal parietal defects. In large part, in the occurrence of postoperative eventrations, in addition to the local and general factors associated with the patients, the incision, the technique of wound closure, made during the previous intervention and the materials that are used have a special involvement.

Key words: polypropylene synthetic mesh, reccurences, monofilament wire.

Avoiding relapses is the main consideration in the surgical approach of eventrations. With the insertion of nets in the treatment of eventrations, the relapse rate dropped considerably.

The eventration remains a real problem in the current general surgery, as it is in fact a postoperative complication that sometimes ends up endangering the life of the patient.

Since the anatomy of the abdominal wall was described about 6000 years ago [1,2], abdominal interventions was considered one of the most laborious one, thus, important progres was made in this field. Multiple procedures that have emerged over time to repair parietal defects have created a series of discussions about postoperative complications of abdominal eventrations. Due to the many materials on the market required to cure eventrations, to develop minimally invasive techniques, and to improvements made in open surgery, surgeons still discuss what is the most appropriate technique for repairing postoperative abdominal defects, especially the best anatomical space for prosthetic and the type of mesh that should be used.

In 1901, Mayo describes a technique that overlaps the edges of the parietal defect and thus deduces the weakness. Studies at that time suggested that the 39-month relapse rate was 49% [3].

In 1910 the organic plasty started by overlapping of the peritoneum, fascia or scar tissue, and a technique with a skin graft (Loewe) was described [4].

The first polypropylene mesh is used by Usher in 1959 [5].

The Rives-Stoppa technique by mounting the synthetic retromuscular-preperitoneal mesh is now the standard technique for open surgery in the treatment of eventrations [6,7].

Numerous comparative studies between primary suture and prosthetic materials have been performed and it has been found that the recurrence of eventrations is much lower when prosthetic materials are used[8].

Laparoscopy has recently been reported in the treatment of abdominal parietal defects, and it has been described by LeBlanc in 1990 [9].

Many factors resulting in vicious scarring, both local and general, are involved in the etiopathogenesis of eventrations.[10,11]

Any factor that occurs during the healing process of a postoperative wound can contribute to the occurrence of sectoral flaws and defects in collagen production [12].

A.General Factors:

- Age
- Obesity
- Metabolic deficits
- General debility
- Post-operative bronchopulmonary complications
- Extended phisical exercises;
- Small but repetitive exercises;
- Smoking

B. Local factors

-Wound surgery suppuration

Is the most important cause of eventration, beeing met in 30-40% of patients with eventrations.

-Large, multiple and long maintained drainages

-Incision type

Vertical incisions are a cause for 3-5 times more eventrations than transversal incisions, because they perpendicularly cut aponevrotic fibers, and the contraction of abdominal muscles, given their orientation, tends to deviate the wound edges.

-The material used for suture

* email: lucretiu.radu@gmail.com; Phone: 0040762615877 # The authors contributed equally to the manuscript and share first authorship

Over the years, in the abdominal parietal defect surgery, various suture materials, from biological to metallic, have been used. In 1920, Berkeley Moyniham spoke about the properties of the suture material, which are still valid: to be resistant so as to keep the edges of the wound close, resilient, resistant to infections, and not toxic to the body.[13] Currently, the most used suture material is polypropylene.

-High blood presure

-Factors related to technical procedures

The treatment of the postoperative eventrations is both medical and surgical, the medical being discussed only for the preoperative preparation of the patient for cardiovascular and respiratory rebalancing and associated tars. Surgical treatment can be performed both through open and laparoscopic surgery. Several tissue and plastic surgical procedures (synthetic mesh) have been tried but the evidence of time has shown that recurrences have been high in tissue processes.

Procedures using prosthetic materials

Numerous surgical techniques have been described that use implantation of prostheses in the treatment of postoperative eventrations. These vary depending on the net used and where it is installed. The materials we use in the clinic are non-resorbable monofilaments of propylene, synthetic low molecular weight polypropylene meshes (the mesh being bigger and the thinner wire). Several ways to mount synthetic mesh have been designed, but the most important and with the best results are:

a. The procedure for installing the intraperitoneal net

In our clinic it is preferable in about 85% of cases to fit the synthetic net as deep as possible with thick polypropylene wires passed into the *U* transfixant. In order not to come into contact with thin intestinal complaints, we resort to an artifice, namely suturing the great omentum with separate wires to the parietal peritoneum.

Regarding the nets, the microporous ones of ePTFE (polytetrafluoroethylene), Gore-Tex, Dual-Mesh, etc. can be used.

-The ePTFE type mesh is the only one that can be mounted in direct contact with intestines due to the fine surface of the microporous material. This type of material is not compatible to be embedded in the abdominal wall and so texture changes have been made for laparoscopy use(fig. 2).

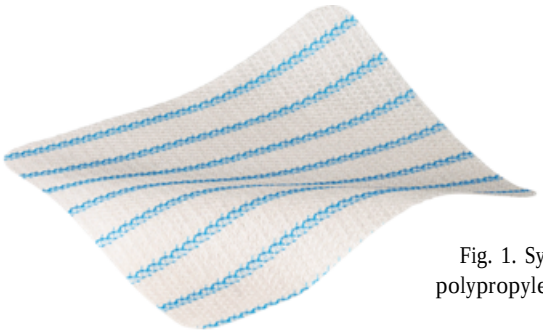

Fig. 1. Synthetic polypropylene mesh

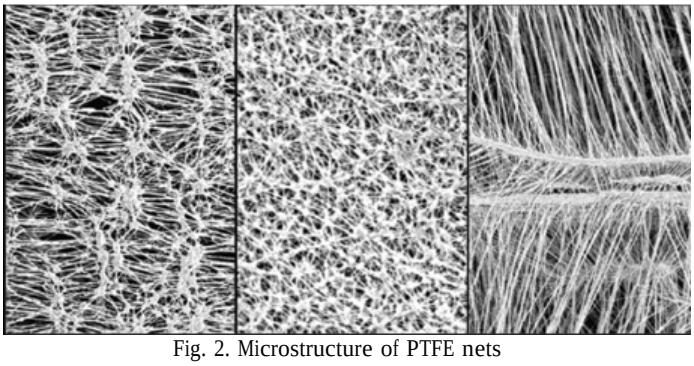

Fig. 2. Microstructure of PTFE nets

- Gore-Tex mesh is, in fact, expanded polytetrafluoroethylene. It consists of a microporous, smooth surface that is in contact with he content of the abdominal cavity and another corrugated, macroporous surface which is applied in contact with the abdominal wall, where it is incorporated by activated fibroblasts. It has an important feature, namely that it is impregnated with silver and chlorhexidine, which prevents infections induced by nets in the operatory field. It is the most widespread, and comparative studies demonstrated that dense and difficult to separate adhesions occur at the level of the smooth surface. It also produces retraction of the mesh with fibrous reactions around it. It has been suggested that Gore-Tex net should be attach past transparietally. Due to the absence of clinical studies confirming the occurrence of intestinal oclusions or fistulas [14], it is regarded as the primary target in the surgical treatment of intraperitoneal-assembled nets [15,16].

Recently, specialty literature has described biological nets, which are of organic origin, usually from animal tissue, and have the property that the tissue on which it is positioned is regenerated and does not appear to be a foreign body reaction

b.The technique of mounting the net in the prefascial retromuscular space

When we do not find enough epiplone to inzolate the small intestinal tracts from the synthetic mesh, we resort to the opening of the abdominal cavity fitting the intrathecal mesh.

c. Laparoscopic technique in the treatment of injuries

The laparoscopic approach is reserved for well-selected cases with small and medium musculoaponevrotic defects and it is mainly done in surgical centers trained in these miniinvasive procedures. We recognize that in our clinic we do not approach the laparoscopic events because of the very high costs and economic problems that we face.

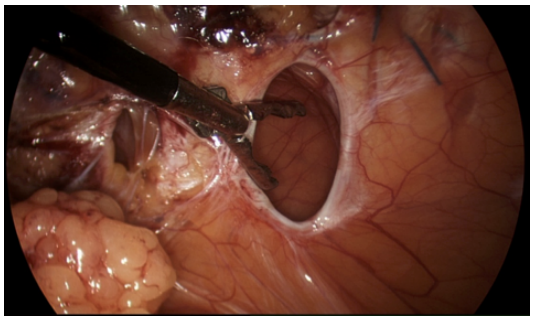

Fig. 3. Highlighting parietal defects. Laparoscopic aspect

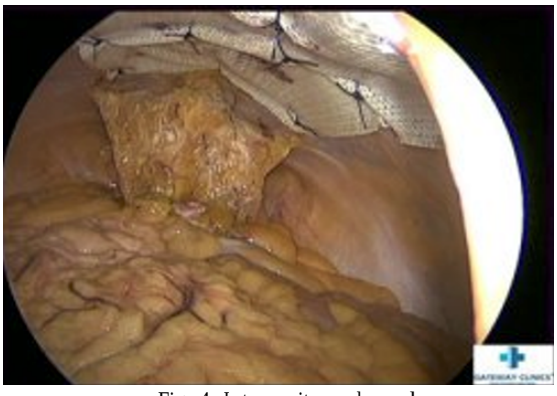

Fig. 4. Intraperitoneal mesh

Experimental part

The aim of the study

The presented study is a retrospective one and it's aim is to analise of postoperative eventrations in terms of etiopathogenesis, clinical aspects, abdominal wall location, types of treatment and their results for a group of 100 patients admitted to the Surgery Clinic of CF Hospital of Craiova, over a 4-year period between 2014-2017.

Material and method

The presented study was conducted between 2014-2017 in the Surgery Clinic of CF Hospital of Craiova on a number of 100 patients diagnosed with postoperrative eventration to whom surgical treatment through classical approach was performed.

Datas were colected from clinical observational sheets of the patients, surgery protocols and discharge sheets of the patients. For each patient included in the study the following datas were analized:

-Age
-Sex
-Residence area
-Dimensions of parietal defect
-Types of prostheses and materials used for fastening
-Surgery type
-Relapses

Results and discussions

Gender distribution in the studied group showed a higher rate in female patients than in male patients. Thus, out of 100 patients, 76 were women and 24 were men with a rate of 3:1 (M:F) (fig. 5).

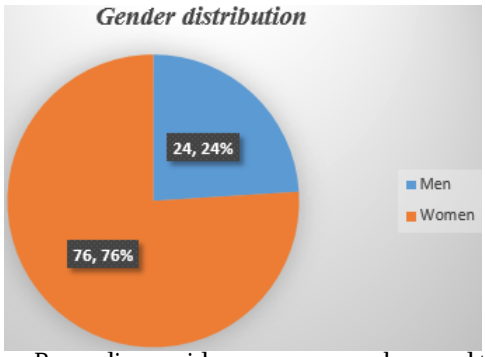

Fig. 5. Gender distribution among the studied group

Regarding residence area, we observed that there were no siggnifficant differences between rural and urban areas. Thus, 56 patients are form rural areas and 44 from urban areas (fig. 6) .

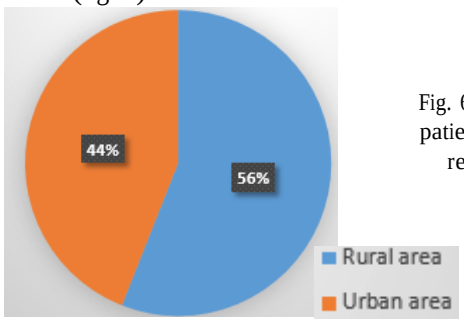

Fig. 6. Distribution of patients according to residence area

The conducted analise showed a larger number of patients for the 50-59 years old age category (34%), while the smallest number of patients were registered for the extreme categories, namely 20-29 y.o. and 80-89 y.o age groups (1% respectively 2%) (fig. 7).

Three types of postoperative eventrations were identified depending on the size of the parietal defect (fig. 8):

-Small eventrations - less than 4 cm in diameter; were present in 16% of patients;

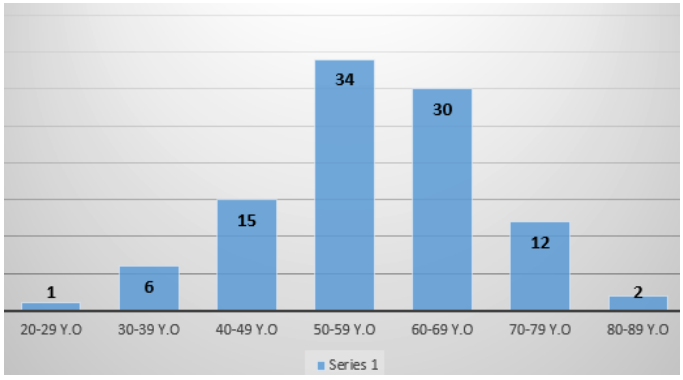

Fig. 7. Age group distribution of patients

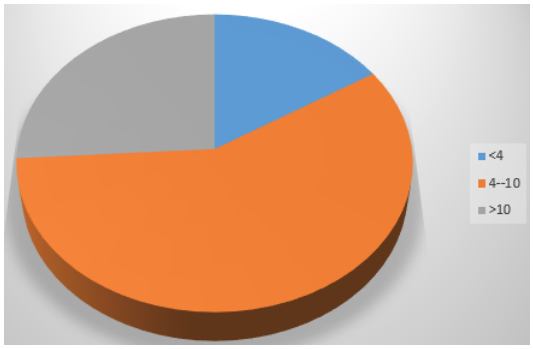

Fig. 8. Eventration classification in the studied group depending on their size according to EHS

-Medium evenrations - with a diameter of 4 to 10 cm; were present in 58% of patients;

-Large events - with a diameter of more than 10 cm; were present in 26% of patients.

In the studied group, 9 patients presented recurrent postoperative eventrations resulting from the association of etiopathogenic factors with an inappropriate surgical technique in the closure of the previous wound, most of which had a history of a tissue process.

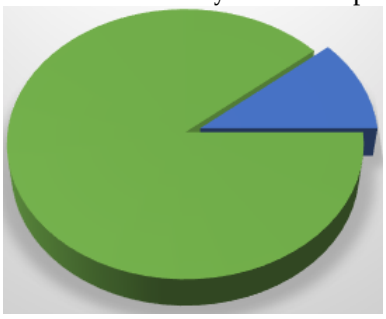

Fig. 9. Gender distribution of patients with recurrent eventrations

In recurrent eventrations, the incidence is higher in women, 8 cases (88.88%), than for men, with 1 case (11.11%) (fig. 9). It is highlighted once again that postoperative eventrations are more common in women due to decreased abdominal muscle tone, multiple pregnancies and increased intervention, especially in the genital area.

For surgical treatment, in 5 cases (5%) tissular procedure were used, and in 95% cases (95%) prostetic procedures. (fig. 10).

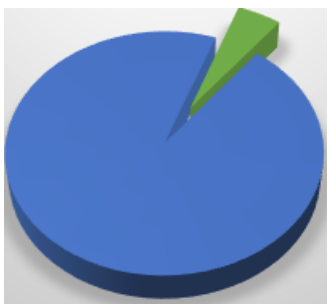

Fig. 10. Practiced procedures for the treatment of eventrations

Out of the 95 prostetic procedures, 64 (67.36%) were represented by strenghtening plasty and 31(32.63%) by substitution plasty (fig. 11).

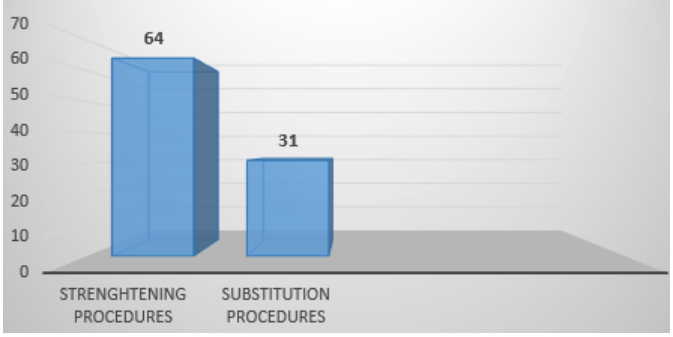

Fig. 11. Prosthetic procedures performed in the studied group

Regarding on the area in which the mesh was assembled among the patients to whom prostetic procedures were performed, 78 cases were intraperitoneal (82.10%) and 17 preperitoneal (17.89%) (fig. 12).

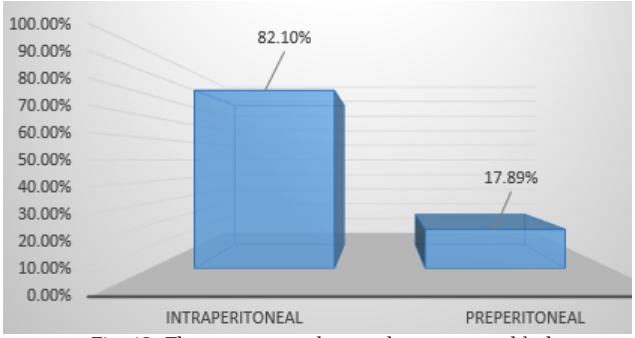

Fig. 12. The area were the mesh was assembled.

In our clinic we have reached for many years a consensus about how to mount synthetic nets and the chemical composition of these prostheses and sutures. There are some principles that need to be respected for good post-operative results, namely:

-The synthetic layer must be of low molecular weight polypropylene;

-The sutures are also polypropylene monofilaments;

-Synthetic prosthesis should be made as deep as possible (if possible in the peritoneal cavity);

-The suture of the net must be made with non resorbable wires using the *U* transparietal technique;

-The procedure must be performed in an aseptic environment.

We also had some special cases of postoperative eventrations – that we managed to solve them *in two stage*- and that we consider important to mention.

The fisrt case is one of a 65 years old woman, addmitted for a major pseudo-tumoral mass of 30/20cm in dimensions, located left paramedian, to the left flank - giant median eventration. Surgical treatment was performed and during the procedure we observed an intense process of perivisceritis, with slightly dilated, congested intestines, with a thickened wall (battle wall), which creates multiple obstacles in the intestinal loops.

We noticed that this pseudotumoral formation in the left flank is occupied entirely by these intestinal loops, which are difficult to insert into the peritoneal cavity. It is then decided to close the abdominal wall supported on polythene bracelets, following the installation of a synthetic net in a second stage. Approximately 8 months later, the patient returns for the treatment of the eventration with an intraperitoneally mounted synthetic mesh, which takes place in normal parameters.

The second case is a 61 years old female patient, who came in our Clinic about 3 weeks after the installation of a synthetic net in another university center, presenting with cellulite and fistulae holes in the middle of the postoperative scar, from which pus was evacuated. Surgical intervention was practiced and the synthetic material (infected mesh) is completely removed, closing the wall with polynithes bracelets, leaving the defect in place.

One year later, an intraperitoneal synthetic mesh was assembled, but during the procedure, an iatrogenic bladder lesion is performed by the operator, which is resolved by suturing it and mounting a urine probe that has been held for 3 weeks . Post-operative evolution was favorable.

It is important to note that these large eventrations, can be resolved *in two stages*, with a favorable later evolution taking into account the patients' tares. When there were intraoperative surprises (intestinal tumors, infected thread granulomas, etc.), the priority was to solve these lesions, with the principle of abandoning the assembly of the synthetic mesh at the same operator time.

It is forbidden to supraaponeurotic mount the synthetic surface net , or the use of multifilament nets and threads.

Conclusions

Our results came in accordance with speciality literature. Thus, in the studied lot, the higher incidence is in female patients with a ratio of 3:1 (W:M). Age distribution that we found in our group showed a larger number of patients with ages between 50-59 years old. As for the localisation of the eventrations, we found that median postoperative eventrations were the most frequent in the studied group.

Prosthetic procedures are preferred in the cure of postoperative eventrations due to a much lower rate of recidivism than in anatomical procedures, the latter being used only in the presence of an infectious wound process or if the intervention required septic times.

As for the mesh mounting, we found that mounting the net as deeply as possible, intra- or preperitoneal, using non-resorbable monofilament sutures, gave the best satisfaction. Always when intraoperative septic moments occure (infected coat granulomas accidentally discovered, tumors that required their exesis and associated septic tenses), surrendering the synthesis with synthetic mesh has been discarded and it was preferred an anatomical procedure.

Refferences

1.QUENU, E., (1896) Traitement operatoire de l'eventration. Med Acad Chir. 22:179-180.

2.BREASTED, J.,H. (1980) - The Edwin Smith Surgical Papyrus University of Chicago Press, Chicago.

3.MAYO W.,J. (1899) - IV. Remarks on the radical cure of hernia. Ann Surg. 29 (1): 51-61.

4.EISELE, M., STARKLOFF, G. (1951) - The use of skin grafts in hernia repair Ann Surg 5: 897-902.

5.USHER, F.,C., FRIES, J.,G., OCHSNER, J.,L., TUTTLE, L.,L. (1959)- Marlex mesh, a new plastic mesh for replacing tissue defects. II Clinical studies Arch Surg. 78:138-45.

6.RIVES, J., PIRES, J.C., FLAMENT, J.B., CONVERS, G. (1977) - Le traitement desgrandes eventrations. Minerve Chir. 32: 749-56.

7.STOPPA, R., HENRY, X., CANARELLI, J.,P., LAGUECHE, S., VERHAEGE, P., ABET, D., ET AL (1979) - Les indications de metodes operatoires selectionnees dans le traitement des eventrations post-operatoires de la paroi abdominal antero-laterale. Propositions fondees sur une serie de 326 observations. Chirur. 105:276-86.

8.VAN DER LEI, B., BLEICHRODT, R.P., SIMMERMACHER, R.,K.,J., VAN SCHILFGAARDE, R. (1989)-Expanded polytetrafluoroethylene patch for the repair of large abdominal wall defects Br J Surg. 76:803-5.
9.LEBLANC, K.A., BOOTH, W.,V. (1993)-Laparoscopic repair of incisional abdominal hernias using expanded polytetrafluoroethylene: preliminary findings. Surg Laparosc Endosc 3:39-41.
10.ANISIA, E.,I., CIUNTU, R., CANTEMIR, A., ANTON, N., DANIELESCU, C., NEGRU, R., BOGDANICI, C.,M., VASILUTA, C., GEORGESCU, S.,O., SIRBU, P.,D., CIUNTU, B.,M. The Importance of Fluconazole in Treatment of Endogenous Endophthalmitis in Patients Prior Treated Using Negative Pressure Therapy for Wound Closure Contaminated with Methicillin-resistant Staphylococcus aureus, Rev. Chim. (Bucharest), **68**, no.7, 2017, p 1598-1601.
11.EARAR, K., GRADINARU, S., PARIZA, G., MICULESCU F., ANTONIAC, A., COJOCARU, V.D., MOHAN, A., PINTILI, G., GRIGORESCU, D.O. Effect of the sterilization procedures of different surgical meches for abdominal surgery; Rev. Chim. (Bucharest), **68,** no.8, 2017,p 1868-1873.
12.WAGH, P.V., LEVERICH, A.P., SUN, C.N. ET AL (1974) - Direct inguinal herniation in men: a disease of collagen. J Surg Res 17(6): 425-433.
13.PINHEIRO, SAVIOLI, A., TORRES, S. (1963)- Nailon mesh in recurrent hernias and abdominal eventration, Rev. Paul Med.
14.EID, G.M., PRINCE, J.M., MATTAR, G.M., HAMAD, G (2003)- Medium-term follow up confirms the safety and durability of laparoscopic ventral hernia repair with PTFE Surgery 134:599-604.
15.HENIFORD, B.T., PARK, A., RAMSHAW, B.J., VOELLER, G. (2003)- Laparoscopic repair of ventral hernias. Ann Surg 238:391-400.
16.EREMIA, I.A., CIOBANU, M., TENEA, T., COMANESCU, M.V., CRAITOIU, S. Invasive papillary carcinoma of the mammary gland: histopathologic and immunohistochemical aspects, Rom J Morphol Embryol, 2012 ,53(3Suppl):811-815.

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