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New surgical technique in complex incisional hernias: Component Separation Technique (CST) with prosthesis and new muscle insertions

Fernando Carbonell Tatay, Santiago Bonafé Diana, Providencia García Pastor, Concepción Gómez i Gavara, and Ricardo Baquero Valdelomar*

Unidad de Cirugía General, Sección de Cirugía de Pared Abdominal, Hospital Universitario La Fe, Valencia, Spain

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A B S T R A C T

Introduction: Our goal is to show the surgical community a new technique developed by our team for treating complex and catastrophic ventral hernias: Separation of Anatomical Component (SAC) amended by Carbonell–Bonafé.

Material and method: A total of 100 patients with complex incisional hernias have been treated. The size, content and reducibility of ventral hernia (preoperative CT scan), recurrences and pre-closure techniques, height and weight, trophic skin alterations and need for preoperative pneumoperitoneum were all documented. The operation was performed following a standardised protocol; intra-abdominal pressure (IAP) was measured before, during and after the intervention. Patients were evaluated in the clinic at 15 and 30 days, monthly for 3 months, at sixth months and annually for up to 5 years.

Results: A total of 100 consecutive patients were operated on between January 2003 and May 2008. In the immediate post-surgical period there were 12% seromas, 8% of partial-ischaemia on the edges of the wound and 1 death due to multi-organ failure. In the later period, 6% had transitional pain in bone anchorage points. They resumed their normal activities after an average of 2 months, with great improvement in their quality of life. There have been no recurrences to date.

Conclusions: The SAC technique, as modified by our Unit, is an excellent resource in managing large ventral hernias: successfully closing with low morbidity, as well as reconstructing the biomechanics of the abdominal wall.

Nuevo método de operar en la eventración compleja: separación anatómica de componentes con prótesis y nuevas inserciones musculares

Palabras clave:
Eventración catastrófica
Neumoperitoneo

R E S U M E N

Introducción: El objetivo de este trabajo es mostrar a la comunidad quirúrgica una nueva técnica para el tratamiento de eventraciones complejas y catastróficas desarrollada en este equipo: separación anatómica de componentes (SAC) modificada por Carbonell-Bonafé.

*Corresponding author.
E-mail address: fercarb@terra.es (F. Carbonell Tatay).
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Separación anatómica
de componentes
Malla de polipropileno

Material y método: Se trató a 100 pacientes con eventración compleja. Se documentó tamaño, contenido y reductibilidad de la eventración (tomografía computarizada preoperatoria), recidivas y técnicas de cierre previas, talla y peso, alteraciones tróficas de la piel y necesidad de neumoperitoneo preoperatorio. Se operó siguiendo un protocolo homogéneo, con medida de presión intraabdominal antes, durante y tras la intervención. Se evaluó al paciente en consulta a los 15 y 30 días, mensualmente durante 3 meses, al sexto mes y anualmente hasta 5 años.

Resultados: Entre enero de 2003 y mayo de 2008 se intervino a 100 pacientes consecutivos. En el postoperatorio inmediato se tuvo un 12% de seromas, un 8% de isquemia parcial de bordes de la herida y un fallecimiento debido a fallo multiorgánico; en el postoperatorio tardío se tuvo un 6% de algias transitorias en los puntos de anclaje óseo. Los pacientes reanudaron su actividad habitual en una media de 2 meses con gran mejoría en su calidad de vida. No se han encontrado recidivas hasta la fecha.

Conclusiones: La técnica SAC que esta Unidad ha modificado es un excelente recurso en el tratamiento de grandes eventraciones: garantiza el éxito del cierre con poca morbilidad y, además, reconstruye la biomecánica de la pared abdominal.

"*Never* would we discover new things if we were content with the things already discovered." Seneca (Cordoba, Spain). 4 B.C. – 65 A.D.)

Introduction

Complex hernias, including those which are large, relapsed, incarcerated with loss of domain and the catastrophic one, are a challenge for abdominal wall surgeons. This Unit's team defines large hernias with major defects of 12 cm as "catastrophic." A variety of techniques have been used to repair these hernias,[1,11] from simple closure with sutures to the use of myoplasty,[12] muscular flaps, or synthetic prostheses. At present there is no consensus among surgeons or sufficient scientific tests for electing the appropriate technique for each procedure. It is known, however, that repairs using replacement or reinforcement mesh will reduce reoccurrence, although some authors have disputed this.[13]

Among these catastrophic hernias, there is a special group consisting of patients with conditions such as obesity, liver disease, organ transplant, advanced diabetes, bronchitis, neoplasm, chronic cardiopathy, several hernia relapses, trophic skin disorder, and in many cases loss of domain of the hernial sac. This group presents a real dilemma for abdominal surgeons.

As is already known, tension in the healed wound and, therefore, in the suturing line, can cause relapse. Positioning a reinforcement mesh on the surface is not a solution to this problem, as the join can still fail beneath this. Surgeons instead must find a way to release this tension.[14] It was Wolfer[15] who, in 1892, first successfully carried out a relaxing incision on an aponeurosis, to try to prevent relapse and so that the tendon joined to the inguinal ligament could be more easily reached when repairing an inguinal hernia. Following this, many surgeons have used relaxing incisions in aponeuroses of the abdominal wall when repairing eventrations, with no long-term success. However, Ramírez[13] in 1990 wrote in the Plastic and Reconstructive Surgery of his method for closing defects in the abdominal cavity, the component separation technique (CST), which allows for an expansion of 4-6 cm for each of the hernial defect edges and thus much less tension in closure. Positive results from this procedure have been reported.

Having learned of this technique, this working team has introduced the method, after first practising it as described by the author, without the use of prostheses, adding new external oblique muscle flap insertions, as we will describe at a later point.

Material and methods

A longitudinal prospective study was carried out including all patients upon whom this modified CST was performed between January 2003 and December 2007.

Patient selection

1) Primary indication of infraumbilical or supraumbilical midline hernia with a cross-sectional diameter of more than 10 cm.
2) Tension in primary hernia suture line.
3) Recurring midline hernias.
4) Lateral hernia with large defect and tension in closure wound.
5) Hernia with loss of domain.
6) Midline hernia with concomitant parostomal hernia (with temporary or permanent stoma).

Preoperative preparation, global treatment strategy

All patients were weighed and measured (height, abdominal perimeter) both before (at the moment of inclusion on the waiting list) and after (in the sixth postoperative month)

surgery. Specialists advised the patients to undertake some respiratory physiotherapy in order to improve their ventilatory capacity, which can be affected during the postoperative period.

Due to the chronicity of the hernia and relapses with previous scarring or dermic flaps, many of these types of patients require skin treatment prior to intervention, since they may show ulcerations caused by ischaemia, infections caused by fungus in skin folds, etc. Any lesions are treated with emollient creams or topical fungicide. One day prior to intervention, the patient should shower and thoroughly wash the skin with povidone-iodine soap.

A large number of cases presented as overweight or obese; many of these patients had been rejected for bariatric surgery due to age or other considerations, and attended consultation presenting with obesity with a body mass index (BMI) of over 45. For this reason, collaboration with a dietician-endocrinologist, who can assist with weight loss and lowering of BMI, is important. This is normally attempted through outpatient care but, occasionally, preoperative admission is required for better monitoring.

In other cases a prior pneumoperitoneum is necessary, as described in 1946 by Argentinian surgeon Goñi Moreno,[4,5] with the aim of creating more space in the abdominal cavity for rehousing the contents of the sac without complication. These contents are nearly always intestinal, and resection should be avoided if possible. This procedure has been effective in patients for whom the reintegration of hernial contents seemed impossible. There were 6 cases of catastrophic hernia, with insufflation—on request—of up to 30 litres of air, and a maximum of one month's treatment: intraabdominal pressure (IAP) was measured and oximetries, blood gases, and periodic electrocardiographies were carried out. Although initially this was entirely an inpatient process, in recent cases the patient has been monitored via the ambulatory unit and readmitted 24-48 h prior to surgical intervention.

In preoperative examination, in addition to standard tests which included complete analysis with coagulation, electrocardiogram, functional respiratory tests and chest x-ray, the protocol for this unit includes an abdominopelvic computed tomography (using the Valsalva manoeuvre), with a particular interest in studying the abdominal wall, making this a dynamic range of tests. In this way, the diameters of the hernia, its contents, and the distensibility and elasticity of the abdominal musculature are all measured exactly, and a theoretical calculation of available space can be established.

A thromboembolic prophylaxis is administered on the night prior to intervention, which lasts for fifteen days following surgery. Likewise, patients carry the Arterio-Venous Impulse (AVI) system[16] (prophylaxis for pulmonary embolism) from the day prior to surgery, during the intervention and during the immediate postoperative period.

The collaboration of the anaesthetist is fundamental for the efficient measuring of IAP[17]—generally using a urethral catheter, before (at the moment of catheterisation), during (when the abdominal wall is closed) and at the end of the intervention—and ensuring that this is maintained below 12 mm Hg.

Description of the technique

Level 1. Large defects (10-15 cm), where disinsertion and release of the large oblique muscles on both sides is sufficient for achieving a tension-free defect closure.

Level 2. Defects generally larger than 15 cm, where not enough progress has been made with the first expansion of oblique muscle on both sides, and expansion of the rear face of both rectus muscles becomes necessary.

Repair begins by resecting the affected skin segments. This continues until two skin and subcutaneous cell flaps reaching to the outer axillary line have been achieved; leaving the dissected aponeurosis healthy on both sides. During this step it is important to know the skin and subcutaneous cell tissue vascularisation, and endeavour not to bind the trunk vessels, in order to avoid producing posterior ischaemias of the skin. It is a good idea to alternate cutting and coagulation with the electrosurgery unit used by the surgeon immediately above the aponeurosis, whilst assisting surgeons pull the skin perpendicular to the central wound, grasping it with Allis forceps or their hands and applying compresses to the edges: this manoeuvre is simple and facilitates dissection (Figure 1).

If there are previous prostheses in the case of a relapsed hernia, it is necessary to remove these and leave the aponeurosis clear.

Once the healthy aponeurosis is located, dissection of the sac up to its neck is started. It is important not to open the sac, as this allows for better dissection of the structures and total clearance of the rectus and external oblique muscles. It is important to leave good subcutaneous cell tissue in the skin flaps, as this allows adequate cushioning and vascularisation of the skin.

With the surgical area clear and an adequate haemostasis established, often with small ligatures or transfixive stitches, the opening of the entire hernial sac can proceed: all loop or peritoneal adhesions are freed, leaving the cavity free so that

Figure 1 – Dissection of the aponeurosis subcutaneous cell tissue. The assisting surgeons pull the skin perpendicularly to the central wound and hold it with Allis forceps or their hands, then apply compresses to the edges.

it has no strength through fixation with which to impede closure. Check that the edges close without tension: if this is the case, only at this point can the sac be resected, from the wall opening to the edges.

With the abdomen open and freed and the greater omentum in place, the left hand grasps the opposite edge of the wound, encompassing the whole muscular wall. The subcutaneous cell and skin flap is elevated by an assistant: with the right hand the wall is pulled away, and the external oblique muscle insertion line can be felt with the left hand (it is felt very easily by carrying out this attraction manoeuvre in the centre). The electrosurgery unit can be taken hold of at this point and, after releasing the pressure, the section line is marked with the right hand: if this site is adequate there will be no muscular fibres. The index finger can then be introduced through this small incision into an avascular space and bluntly dissect with the tip, both upward towards the ribs and downward towards the pubis. Sectioning with the electrosurgery unit on the back of the finger is simple and should be done very close to the insertion into the external face of the rectus muscle.

Doing this, the linea semilunaris is dissected at the point where the external oblique muscle is inserted into the rectus aponeurosis, an incision is made into it and the muscle is disinserted. In this way, a muscle flap can be achieved from the ribs to the inguinal region and pubis. This manoeuvre, as described by Ramírez, can achieve an expansion of some centimetres from the rectus muscles to the midline which, added to the contralaterals, that is, carrying out the manoeuvre in two steps, means that the abdominal opening can be closed without tension in the majority of cases (Figure 2).

At that point, with provisional stitches or Kocher forceps, cavity closure is simulated and the anaesthetist measures IAP, under conditions of forcible anaesthetic inspiration and under basic conditions. If this is adequate, closure takes place using 1 or 2 reabsorbable Dexon loop running sutures. The closure should be carried out with no tension in the suture line, given that, as it is well known due to the studies of Lichtenstein,[18] among others, that these conditions are of great importance relative to relapse at this point caused by ischaemic failure, due to tension that should be supported.

In cases where tension or elevated IAP remain, the posterior aponeurosis of both rectus muscles are dissected in order to loosen them before proceeding to level two. If, despite this, abdominal hyperpressure remains, before sectioning the sac, it should be folded in over itself as if carrying out a Mayo procedure, ie, crossing it over using 2 suture lines to avoid edge separation and achieve a normal IAP. Subsequently, on positioning a mesh over the peritoneum lodged under the rectus muscles, and another one on top positioned below the two external oblique muscle flaps, an effective repair without tension or postoperative abdominal hyperpressure is achieved.

If dealing with a level 1 hernia, once the cavity is closed with the 2 external oblique muscle flaps dissected, the space is measured and a mesh positioned, almost always 30×30 cm (Figures 3 and 4). This gives an elliptical or romboidal form with extremes in the xifoid process and pubis, and is fixed with helical staples or transfixive stitches at an internal angle to these flaps and at the coastal margins and pubis, with a stitch, not too tight, in the anterior face of the abdominal wall. The prosthesis (always polypropylene) remains lodged under the muscular flaps, at their lateral extremes and centres, supported on the aponeurotic closure. It is convenient not to leave the prosthesis too tightened, as the studies of Amid[19] tell us that it retracts some 20% after scar formation and can produce problems.

All that remains is to reinsert the external and internal oblique and transverse muscles into the mesh (the externals have vascularisation and, therefore, do not become necrotic) with a running suture or single stitches: this new insertion is more outward and more lateral than its original position. In this way, the physiology of the abdominal wall is maintained. The repair is complete (Figure 4).

Figure 2 – Separation of the external oblique muscle of the rectus aponeurosis, through which the muscular flap is achieved below the site where the prosthesis is attached.

Figure 3 – Once the external oblique muscle flaps have been dissected, the space is measured and a mesh is positioned.

Figure 4 – Reinsertion of the external oblique muscles, onto the mesh, and the internal oblique and transverse muscles with a running suture or individual stitches.

Figure 5 – The prosthesis is soaked with biological glue and the subcutaneous cell tissue is placed onto the prosthesis, then a little pressure is applied to facilitate compaction of both and to achieve an improved haemostasis.

The final step is to position 2 suction drains (one in each iliac fossa), close the subcutaneous cell tissue with stitches that also hold the prosthesis so as not to leave any open space and, if preferred, nebulise the bloody area or spray with fibrin.[20] This achieves an improved haemostasis with the biological glue that attaches the prosthesis to the aponeurosis and subcutaneous cells (Figure 5), and prevents seromas, haematomas and other consequential infectious complications. This team prefers to close the skin using individual single-wire stitches rather than staples, as these do not hold much tissue (Figure 6). An example of the postoperative result can be seen in Figure 7.

Experience and results

A schematic summary is shown in Table:

One elderly female patient, suffering from previous chronic pulmonary disease, died as the result of a catastrophic hernia with trophic disorders of the skin and loss of domain. The patient suffered multi-organ failure in the recovery unit on the fifth day following surgery. This was the sixth patient in the group; following this case, preoperative pneumoperitoneum was implemented in the unit for all catastrophic cases or cases with prior deterioration of cardiorespiratory function.[4,5,6,8]

Figure 6 – The skin is closed using individual single-wire stitches.

To date no relapses have been observed in the patients operated on, although it is best to wait 5 years after surgery to be sure of success.

It is of the utmost importance that patients maintain a healthy weight and regularly undertake aerobic exercise. The use of a soft and adjustable abdominal girdle is advised during the first three months following surgery, which can be gradually loosened until complete removal.

Discussion

Catastrophic hernia is a challenge for abdominal wall surgeons. Their distinct presentation and location, together with the disinterest of the surgical community in abdominal "bodywork," means that at present there is insufficient evidence to show treatment results; due to their complexity

and size, laparoscopic techniques are not satisfactory. It could be assumed that the rate of relapse is lower when a prosthesis is used, but there are no reliable studies to ratify this.

One important and demonstrative factor in relapse is tension in the suture line. This unit's technique not only achieves, following the technique principles described by Ramírez, a reduction in tension at the two levels described, but also provides a fascial reinforcement with positioning of large partial or complete submuscular prostheses. This is a novel idea which modifies Ramírez's technique (when Ramírez described his original technique he did not use prostheses; in his recent publications he describes the use of partial prostheses, but this is a technique quite different from that described here).

This team considers the technique described here to be a new contribution to the surgical community and a worthwhile option for treatment of this complex disease, since it conserves the anatomy and physiology of the abdominal wall and reinforces its biomechanics. In addition, the good health and excellent receptivity of the treated patients is notable; no relapses have occurred. As far as the authors are aware, this group cannot be compared with any other given the heterogeneity of their presentations, and only the procedure itself can be shown.

Figure 7 – Preview (a) and results after 3 months (b).

Table – Summary of data

Demographic	January 2003-December 2007: 100 cases (63% females, 37% males) average age: 58 years	
Location	90 midline, 4 pararectal, 4 mixed (midline plus parastomal hernia)	
Size	82% (10-15 cm), 14% (>15 cm), 4% (loss of domain)	
Previous surgery	30% bariatric, 25% gynaecological, 25% colon, 20% other (umbilical hernia, EII, vascular, etc)	
Technique	Standard technique as described, with progressive reduction of average operating time (155 min in first 50 cases, 130 min currently)	
Morbidity	Premature	Late
	12% seroma, 8% cutaneous border ischaemia	6% pain in osseous fixation points, improved with time
Mortality	One patient	
Checks	Satisfaction grade: very good Reincorporation of regular activity: average 2 months No relapses to date	

REFERENCES

1. Detrie P. Tratado de técnica quirúrgica: pared abdominal. Tomo IX. Barcelona: Toray-Masson; 1972.
2. Barroetaveña J, Herszage L. Cirugía de las eventraciones. El Ateneo: Buenos Aires; 1988.
3. Carbonell Tatay F. Nuevo método de operar en la eventración compleja: separación anatómica de componentes modificada. VIII Reunión de la sección de pared abdominal y suturas de la AEC. 2005. Santiago de Compostela. España. Libro de Programa y Comunicaciones del Congreso.
4. Goñi Moreno I. Eventraciones crónicas y hernias voluminosas. Preparación para neumoperitoneo progresivo. Procedimiento original. Soc Argent Cir. 1946;30:1041–53.
5. Goñi Moreno I. Eventraciones crónicas y hernias de gran volumen, tratamiento pre-operatorio por el neumoperitoneo progresivo; técnica original. Surgery. 1947;22–6:945–53.
6. Herszage L. In: Schumpelick V, Kinsnorth A. Incisional hernia. Berlín: Springer-Verlag; 1999.
7. Larson GM, Vandertoll DJ. Principios para la reparación de la hernia ventral y defectos dermoepidérmicos de la pared abdominal. Clin Quir Nort. 1984;2:325–41.
8. Mayagoitia Gónzalez JC. Hernias de la pared abdominal. Tratamiento actual. México: Mc Graw Hill; 2004.
9. Santora TA, Roslyn Jl J. Hernia incisional. Clin Quir Nort. 1993;3:597–613.
10. Vidal Sans J. Eventraciones. Ed. Biblioteca C y H. Ciencias y humanidades. Medicina. Barcelona: Ed. Víctor Pozanco 2004.
11. Vidal Sans J. Una historia de la cirugía de las eventraciones. Protagonistas y acontecimientos más relevantes de su época. Barcelona: Víctor Pozanco; 2007.
12. Zavaleta DE, Uriburu JV. Consideraciones técnicas sobre las eventraciones infraumbilicales y en particular sobre el empleo de los injertos. Rev As Med Argent. 1951;65: 373–5.

13. Ramírez O, Ruas E, Dellon A. "Components separation" method for closure of abdominal wall defects: An anatomic and clinical study. Plast and Reconstr Surg. 1990;86:519–26.
14. Moreno Egea A, Torralba JA, Morales G, Aguayo JL. Reformulación conceptual de la técnica de reparación doble: una solución sencilla para defectos muy complejos de la pared abdominal. Cirugía Española. 2006;80:101–4.
15. Wöllfler A. Zür radikaloperation des freien leistenbruches. In: Billroth T, editor. Beitrage zür Chirurgie. Stuttgart; 1892. p. 552.
16. Knudson M, Morabito D, Paienert G, Shackleford S. Use of low molecular weight heparin in preventing thromboembolism in trauma patients. J Trauma. 1996;41:446–59.
17. Medrano Montero E, Ramírez Pupo R, Medina Meriño C, Miranda Lorenzo D. Medición de la presión intraabdominal para la vigilancia postoperatoria de la cirugía abdominal. Rev Cubana Cir. 2007;46(4).
18. Lichtenstein IL, Shulman AG, Amid PK, Monitor MM. The tension-free hernioplasty. Am J Surg. 1989;157:188–93.
19. Amid PK. Classification of biomaterials and their related complications in abdominal wall hernia surgery. Hernia. 1997;1:15–21.
20. Fernández Lobato R, Martínez Santos C, Ruiz de Adara JC, Fradejas JM, Ortega P, Moreno Azcoitia M. Aplicación del adhesivo de fibrina Tissucols en eventraciones complejas. Cir Esp. 2002;71:80–4.