Modified Component Separation and pretreatment with Botulinum Toxin-A chemodenervation and/or progressive pneumoperitoneum.

Providencia García Pastor. Brunico, October 2018
functions of the abdominal wall
contain and protect the **viscera**, help active movements of the **trunk**, collaborate in the abdominal press → **defecation**, regulating the movement of the diaphragm → **lung ventilation**

Abd wall dynamics alts.  →  abd press failure, ventilatory alts., trunk movs.
**Lateral muscle contraction**-↓abdominal volume
Progressive **enlargement of the defect**
**Loss of skin** – atrophy, ulceration, infection
**Loss of domain** – hemidiaphragms atrophy and flatten, mesenteric and bowel edema

**Structural, functional and surgical problems**

Inability to perform surgery
Making unsatisfactory surgery → **recurrence**
Compartimental syndrome
... avoid tension repair

**Preoperative STRATEGY**

**CT scan evaluation**
- Measurement of hernia defect
- View integrity of muscular groups
- Measure abdominal and hernia volume
- View content sack and adhesions
- Compare and evaluate effectiveness of the preparation

**Components Separation** increases 12.2% of intraabdominal volume

**Preoperative**
- expanders
- botulinum toxin
- progressive pneumoperitoneum

**Intraoperative**
- IPOM, Rives, CS, TAR, Albanese
- visceral resection

Hadad I et al. Repair of massive ventral hernias with the separation of parts technique: Reversal of the “lost domain”. Am Surg. 2009;75:301-6
progressive preoperative pneumoperitoneum (PPP)

- Progressive increase IAP → adaptation (tolerance test)
- Stretching the retracted muscles of the abdominal wall
- Increase the capacity of the abdominal cavity
- Pneumatic adhesiolysis of loose adhesions
- Improves diaphragm anatomy and biomechanics. Improves ventilatory function.
- Improves intestinal and mesenteric circulation → ↓↓ chronic edema, ↓↓ "visceral volume"
- → peritoneum irritation: ↑↑ vascularization and healing response, ↑↑ macrophages


ambient air in the peritoneal cavity using a siphon system with yodipovidon filtered air
...news in PPP

Caldiron et al. 1990. Daily punctons with Verres + CO2
Naslound. 1996. Uses Port-a-cath to induce PPP
Bewawi. 1999. Uses Tenckhoff catheter
Martinez-Muniva et al. 2002. Uses doble lumen catheter + non filtered air

Is considered that a sac with a volume > 15-20% of abd volume requires respiratory adaptation before surgery


Progressive pneumoperitoneum increases the length of abdominal muscles

F. Dumont · D. Fuks · P. Verhaeghe · O. Brehant ·
C. Sabbagh · M. Riboulot · T. Yzet · J. M. Regimbeau

The aim of the prospective study presented here was to assess the effects of PPP on the size (height and width) of IHs, the width of the rectus abdominis and the length of the anterolateral muscles, as judged from pre- and post-PPP abdominal computed tomography (CT) scans.
A computerized tomography scan method for calculating the hernia sac and abdominal cavity volume in complex large incisional hernia with loss of domain

E. Y. Tanaka · J. H. Yoo · A. J. Rodrigues Jr. · E. M. Utiyama · D. Birelmi · S. Raslan

There is no consensus in the literature on the amount or type of gas that should be insufflated in PPP programs or even how long it should be maintained. We describe a technique for calculating the hernia sac volume (HSV) and abdominal cavity volume (ACV) based on abdominal computerized tomography (ACT) scanning that eliminates the need for subjective criteria for inclusion in a PPP program and shows the amount of gas that must be insufflated into the abdominal cavity in the PPP program (ranged from 26 to 73%). We conclude that ACT provides objective data for volume calculation of both hernia sac and abdominal cavity and also for estimation of the volume of gas that should be insufflated into the abdominal cavity in PPP.

Designed for **PPP criteria (>25%)**
**PPP volume (= hernia sac volume)**
CT scan to objectify changes induced by PPP

Part of air is reabsorbed.
Decreases 47% of visceral volume

Use large volumes of air a loss of about 45% volume of the injection occurs

→ at least DOUBLE the herniated volume

volume to inject should be 3-4 x of hernia volume:
to compensate for air losses
to "fill" the space left by visceral volume reduction and still maintain a "therapeutic" IAP

Original

Neumoperitoneo terapéutico preoperatorio en el tratamiento de la hernia incisional gigante.
Reducción del volumen visceral como explicación fisiopatológica de sus beneficios

Jaime Rappoport Stramwasser, Jaime Carrasco Toledo*, Juan Jorge Silva Solís, Marco Albán García y Francisco Papic Silva
Catheter insertion technique
Experiencia with PPP

2006-2009 (38 cases):

**Selection of cases**: indication according to the volume of the eventration (**clinical assessment**), cardiorespiratory history, age ...

several techniques for catheter insertion → we finally opted for the **Cavafix® placed in the patient's bed**, generally in the left-subcostal hypochondrium (Palmer).

insufflation **volume "on demand"** (patient tolerance, until the flanks are palpated softened), in a **hospitalization** regime for about **4 weeks**.

<table>
<thead>
<tr>
<th>N= 38</th>
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<tbody>
<tr>
<td><strong>age</strong></td>
<td>media 59 (47-78)</td>
<td><strong>sex</strong></td>
<td>M 21 (55%)</td>
</tr>
<tr>
<td><strong>Previous surg</strong></td>
<td>Vascular abd 11 (29%)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Gine-urol 10 (26%)</td>
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<td></td>
<td>Digestive 9 (23.6)</td>
<td></td>
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<td></td>
<td>Primary ing 5 (13%)</td>
<td><strong>Primary umb 2 (5,2)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Laparoscopy 1 (2,6%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Insufflation</strong></td>
<td>12 liters media (10-18)</td>
<td><strong>23 days</strong> media (19-27)</td>
<td><strong>Hospital</strong></td>
</tr>
<tr>
<td><strong>Adverse effects</strong></td>
<td>pain...</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 HAPs postop...</td>
<td><strong>ICU management</strong> →</td>
<td></td>
</tr>
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</table>
2010-2013: protocolization (34 cases).

use of **CT for volumetric measurement and anatomical study** of the abdominal wall,

**Indication**
- according to CT: transv diameter > 10 cm (W3-EHS), herniated vol > 20%, loss of domain.
- according to patient: study of respiratory functional capacity (indication with hernias more small if PFR alteration), associated cardiorespiratory pathology

**CT control before-after PPP**

- **muscle elongation and volume gain.** Average gain of **18%** (16-26)
- anatomical conditioning of the **diaphragm** that progressively acquires tone.
- **Adhesiolysis**, which we appreciated in surgery, and seen in the control CT

<table>
<thead>
<tr>
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<th>N= 34</th>
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<td>age</td>
<td>media 63 (48-79)</td>
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</tbody>
</table>

**Outpatient process**

<table>
<thead>
<tr>
<th>Previous surg</th>
<th>Vascular abd 10 (29,5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gine-urol</td>
<td>8 (23,5%)</td>
</tr>
<tr>
<td>Digestive</td>
<td>8 (23,5%)</td>
</tr>
<tr>
<td>Primary ing</td>
<td>5 (14,7%)</td>
</tr>
<tr>
<td>Primary umb</td>
<td>2 (6%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>insufflation</th>
<th>Laparoscopy 1 (2,9%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>insufflation</td>
<td>11 liters media (8-16)</td>
</tr>
<tr>
<td>Primary umb</td>
<td>2 (6%)</td>
</tr>
<tr>
<td>Adverse effects</td>
<td>Dolor…</td>
</tr>
<tr>
<td>CT scan control</td>
<td>Increase m 18% (16-26)</td>
</tr>
</tbody>
</table>

**Home Hospital Unit**
Botulinum toxin-A technique

Prospective 12p with hernia after open abdomen.
TBA (500 U Dysport®) EMG-guided in lateral abdomen muscles.

Muscular atrophy, relaxation and elongation, ↓ diameter hernia
Allows tension-free repair.
No Sdr Compartimental.

Cakmak M. y cols.

effect of TB-A in the abdominal muscles of rats with sepsis and abdominal compartment syndrome induced

TBA 5 IU diluted in 2cc abdominal cavity volume increase
→ intra-abdominal pressure decrease
- TB type A acts by chemodenervation of the underlying muscles,

- inducing reduction of muscle volume due to atrophy of the fibers (observed in 2-4 weeks and can be measured with echo-CT).

- AP: atrophy, necrosis and hyaline degeneration.

- reversible: the chemically denervated and atrophied muscle develops additional bonds to acetylcholine receptors → the nerve grows and reinvents the muscle, which progressively returns to its initial volume and functionality.

- preoperative preparation of wall surgery,

- intra-abdominal hypertension management,

- pain modulation after eventration surgery ...
2010: prospective study conducted in pigs
150 IU TBa one side- saline placebo on the other
After 3 weeks increase of 49% in advance of lateral muscles in Tba-vs SP

BotulinumToxin-A references for infiltration

anatomical reference

US-guided infiltration

Zielinski MD et al. Chemical components separation with botulinum toxin A: a novel technique to improve primary fascial closure rates of the open abdomen. Hernia 2012;
EMG-guided infiltration
our experience with BT-a.

Asymptomatic during the entire time. Good acceptance. Paralysis starts in 3-4 days, max expansion 30 days. 20% increase of abdominal volume (median)
No effects on mov. trunk or breathing. Reversible in 4-6 months.

CT scan control
- Thinning lateral abd muscles (atrophy)
- Elongation of the lateral abd muscles
- Increase the continent: ↑↑compliance

our objective: large defects
<table>
<thead>
<tr>
<th>No.</th>
<th>Age</th>
<th>Sex</th>
<th>Operation</th>
<th>Previous Surgery</th>
<th>Abdominal Compliance</th>
<th>Reparation Technique</th>
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<tbody>
<tr>
<td>1</td>
<td>v-56</td>
<td>a</td>
<td>LMsi</td>
<td>DA-peritonitis</td>
<td>18% → PPP</td>
<td>CS</td>
</tr>
<tr>
<td>2</td>
<td>v-67</td>
<td>a</td>
<td>LMsi</td>
<td>Aneurism AA</td>
<td>16% → PPP</td>
<td>CS</td>
</tr>
<tr>
<td>3</td>
<td>m-68</td>
<td>a</td>
<td>LMI</td>
<td>DA-peritonitis</td>
<td>22%</td>
<td>CS</td>
</tr>
<tr>
<td>4</td>
<td>m-47</td>
<td>a</td>
<td>LMI</td>
<td>H+DA</td>
<td>28%</td>
<td>CS</td>
</tr>
<tr>
<td>5</td>
<td>v-42</td>
<td>a</td>
<td>LMsi</td>
<td>Umb hernia (3x)</td>
<td>25%</td>
<td>CS</td>
</tr>
<tr>
<td>6</td>
<td>v-55</td>
<td>a</td>
<td>LMsi</td>
<td>dehisc anas-VAC</td>
<td>21%</td>
<td>CS</td>
</tr>
<tr>
<td>7</td>
<td>m-49</td>
<td>a</td>
<td>Diaphragm Hernia</td>
<td></td>
<td>37%</td>
<td>Diaphragm repair + antirreflux</td>
</tr>
<tr>
<td>8</td>
<td>v-61</td>
<td>a</td>
<td>Inguino-escrotal Hernia</td>
<td></td>
<td>32%</td>
<td>Stoppa</td>
</tr>
<tr>
<td>9</td>
<td>v-45</td>
<td>a</td>
<td>LMsi</td>
<td>PTTS necrohemorr</td>
<td>23%</td>
<td>CS</td>
</tr>
<tr>
<td>10</td>
<td>m-62</td>
<td>a</td>
<td>LMsi</td>
<td>dehisc anast</td>
<td>28%</td>
<td>CS</td>
</tr>
<tr>
<td>11</td>
<td>v-68</td>
<td>a</td>
<td>LMsi</td>
<td>Aneurism AA</td>
<td>22%</td>
<td>SC</td>
</tr>
<tr>
<td>12</td>
<td>m-52</td>
<td>a</td>
<td>LMsi</td>
<td>Umb hernia (2x)</td>
<td>26%</td>
<td>CS</td>
</tr>
<tr>
<td>13</td>
<td>v-43</td>
<td>a</td>
<td>LMS</td>
<td>Trauma</td>
<td>24%</td>
<td>CS – level II</td>
</tr>
<tr>
<td>14</td>
<td>m-63</td>
<td>a</td>
<td>LMI</td>
<td>oncol gine</td>
<td>26%</td>
<td>STOPPA modified</td>
</tr>
<tr>
<td>15</td>
<td>v-62</td>
<td>a</td>
<td>Lmsi</td>
<td>DA-peritonitis</td>
<td>25%</td>
<td>CS</td>
</tr>
<tr>
<td>16</td>
<td>v-56</td>
<td>a</td>
<td>LMS- DPC</td>
<td></td>
<td>22%</td>
<td>CS – level II</td>
</tr>
</tbody>
</table>
... max effect: increases 37%

♀ 61 years: **Morgagni diaphragmatic hernia**

<table>
<thead>
<tr>
<th></th>
<th>Previous</th>
<th>Post TB</th>
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<tbody>
<tr>
<td>Ø AP</td>
<td>155,4</td>
<td>182</td>
</tr>
<tr>
<td>Ø TR</td>
<td>209,9</td>
<td>243</td>
</tr>
<tr>
<td>P-D</td>
<td>297,5</td>
<td>298</td>
</tr>
<tr>
<td>thickness</td>
<td>32,7</td>
<td>18,5</td>
</tr>
<tr>
<td>length</td>
<td>143,6</td>
<td>223,5</td>
</tr>
<tr>
<td>volumen</td>
<td>5037 cc</td>
<td>6900 cc</td>
</tr>
</tbody>
</table>
... 32% increase. Inguino-escrotal hernia
Conclusions  BT-A

**Thinning and elongation** of the lateral abdominal muscles
Discreet reducing the **size** of the hernia defect
**Ease** of ventral hernia repair - hernioplasty x muscular chemodenervation and flaccid paralysis

→ Allows **mobilization and advancement** of muscular flaps with minimum tension.
→ Facilitates **refuncionalization** (not permanent weakens the wall).
→ **Improves conditions** for planning surgery and does not exclude other **additional resources**

......But

**not useful enough**
when large hernia with **loss of domanin** / **respiratory disfunction**

- **No effect** on diaphragm re-funcionalitly
- **No effect** on visceral volumen reduction
Since 2013 our protocol includes the use of both therapies sequentially for these “big” cases:
infiltration with toxin followed by pneumoperitoneum

with fewer volumes, faster onset and better tolerated → outpatient

with greater performance in the CT control

Application of BT-a according to previous protocol (ambulatory process)
At 21 days → admission for CT control + pneumoperitoneum catheter insertion
Discharge the next day → HHU - outpatient consultation: Insuflation PPP scheduled
- daily / 4x week
- total volume: 3-4 times the volume of the hernia sac
- duration of PPP 1 week. Ends 3-4 days before the surgical procedure

Enter the day before the intervention. CT and RF tests
<p>| | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Insufflation</strong></td>
<td><strong>6,5 liters med (5-8)</strong></td>
<td><strong>7 days med (6-9)</strong></td>
</tr>
<tr>
<td></td>
<td>HHU Outpatient consultation</td>
<td></td>
</tr>
<tr>
<td><strong>Adeverse effects</strong></td>
<td>Pain… better tolerated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RFcontrol → Difficulty Valsalva / constipation</td>
<td></td>
</tr>
<tr>
<td><strong>CT scan Control</strong></td>
<td>Increase m 55 % (42-88)</td>
<td>Elongation-atrophy muscular Diaphragm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adhesiolysis ↓↓ visceral vol</td>
</tr>
</tbody>
</table>
Conclusions  BT-a and / or PPP

BT-a → Novel and effective technique for large defects
No side effects. Good patient acceptance. Easily reproducible
Maintains the suture line without tension for 6 months
Always use prosthetic ± supplementing with intraop measures (CS)

Alone or as an adjunct of pneumoperitoneum - PPP

→ ↑↑ power combining both effects and decreases time
→ propose the combination of both techniques when large / loss of domain / respiratory

HV / abd V <20% or transv diameter >10 cm (W3 EHS) → BT-a 1 month before
HV / abd V >20% (any diameter) → BT-a + PPP
PPP adds combination of both power effects and decreases time.
Stoppa Hernioplasty

Reduction of the hernia contents without difficulty
No abdominal hyperpressure
No problems with redundant scrotum (involution)
Diagnóstico: TC ABDOMINO-PÉLVICO  Centro: HOSPITAL LA FE

Fecha Informe:

Facultativo/ especialista:

Pruebas solicitadas:

<table>
<thead>
<tr>
<th>Código/Fecha examen</th>
<th>Descripción</th>
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<tbody>
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<td>TC ABDOMINO-PÉLVICO</td>
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</table>

Texto: JUICIO CLÍNICO: Control preoperatorio post-toxina + neumoperitoneo
TÉCNICA: TC de Pared abdominal sin CIV, en Maniobra de Valsalva

INFORME:

Se compara con estudio previo obteniendo los diámetros de la cavidad abdominal en la misma localización.

VOLUMEN CAVIDAD ABDOMINAL en estudio previo: 8.224 cc
VOLUMEN CAVIDAD ABDOMINAL actual tras tto: 13.555 cc
INCREMENTO GLOBAL DE VOLUMEN DE CAVIDAD ABDOMINAL: 64%
conclusions

The use of PPP is a useful tool in preparation of patients with hernias that have loss of domain

Induces anatomical, biomechanical and physiological changes that reduce risk of complications.

Must be supplemented by an appropriate surgical procedure: techniques with prosthetic material and sometimes with some other aggregates procedures (relaxing incisions, component separation).

The BT-a injection technique is excellent in preparation of big defects repair where it’s impossible the defect closure with standard maneuvers.

Muscular atrophy-relaxation → increases abdominal compliance

Absence of adverse effects, reversible effect and minimal discomfort.

It serves as an adjunct in cases of very large hernias with loss of domain prior to the PPP.

The use of both techniques enhances the effects with minimal risk or side effects.
It should be considered in managing catastrophic abdomens where, besides a large defect, we need to prepare the biomechanics of the abdominal wall and the patient's respiratory function.

It would be necessary to standardize protocols, so to measure and compare results
... and the next

garciaprov@hotmail.com