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Use of Botulinum Toxin Type A Before Abdominal Wall Hernia Reconstruction

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Abstract
Background Abdominal wall hernia repair after open abdomen management represents a surgical challenge, particularly due to muscle tension and lateral retraction. This study was designed to propose the use of Botulinum Toxin Type A (BTA) before abdominal wall hernia repair.
Methods A prospective study of patients with abdominal wall hernia after open abdomen management was undertaken between September 2007 and January 2009. Bilateral BTA application was performed under electromyographic guidance at the abdominal wall. Transverse abdominal wall defect measurement was practiced at weekly intervals: clinically, in the first two patients, and with CT scan in the following 10 patients. Surgical closure was scheduled if no further hernia defect reduction was noted. Patients were followed at monthly hospital visits.
Results In the first two patients, a hernia defect reduction of 50 and 47.2%, respectively, was documented by the third week after BTA application, with no further reduction. In the 10 patients under CT scan hernia defect measurement, when comparing the initial mean transverse defect measure and at 4 weeks after BTA application (13.85 $\pm$ 1.49 cm vs. 8.6 $\pm$ 2.07 cm), an overall mean reduction of 5.25 $\pm$ 2.32 cm was observed ($p < 0.001$; 95% confidence interval, 3.59–6.91). Hernia repair was performed, with no recurrences at a mean follow-up of 9.08 months.
Conclusions BTA application before abdominal wall hernia repair seems to be useful. The lateral muscles paralysis achieved and transverse hernia defect reduction allows a minimal tension closure. To our knowledge, this is the first report of BTA application before abdominal wall hernia reconstruction.

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Introduction

Open abdomen surgery after laparotomy is a therapeutic alternative in conditions, such as abdominal sepsis or trauma. Resulting abdominal wall defects represent a surgical challenge due to lateral muscle retraction. Several techniques for such hernia repair have been described [1, 2]. Muscle relaxation secondary to flaccid paralysis after BTA injection is well documented. The duration of such effect is no more than 6 months [3]. Lateral abdominal wall muscular paralysis and consequent relaxation leading to a transverse hernia defect reduction might facilitate surgical reconstruction.

Materials and methods

A prospective study of patients with abdominal wall hernia after open abdomen management was undertaken between September 2007 and January 2009. All patients had a total abdominal midline hernia defect. Lateral abdominal wall musculature electromyography (EMG) was performed (XLTEK Electromyograph, XCALIBUR LT model. Bristol

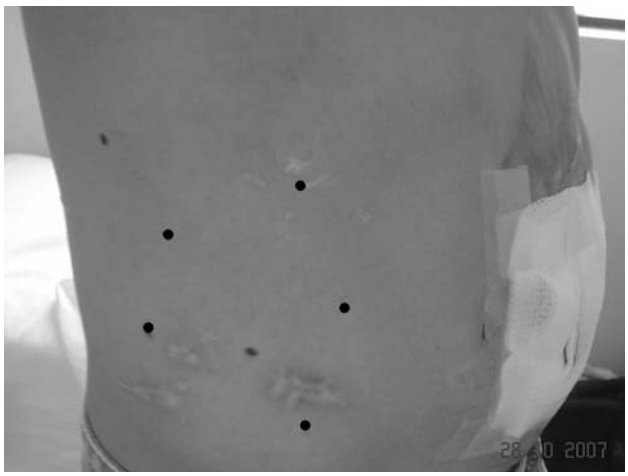

Fig. 1 EMG-guided sites of BTA application on right flank (*black dots*) of one of the patients. BTA application was performed on the left flank under EMG-guidance as well

Circle, Oakville, Ontario, Canada.). A myoject needle (TECANeedles, MyoJect Disposable Hypodermic Needle Electrode, VIASYS Healthcare, Madison, WI, USA) was used to identify the maximal EMG recording points. Five points were identified at each side: two over the mid-axillary line, between the costal border and the superior iliac crest, and three over the external oblique muscle (Fig. 1). Fifty units of BTA (Dysport, IPSEN, France) were applied through the myoject needle at each point (250 units at each side, for a total of 500 units per patient). In the first two patients, transverse abdominal wall defect clinical measurement was performed at weekly intervals. In the following ten cases, to document a more objective measurement of the abdominal wall defect, CT scan was performed before BTA application and 4 weeks after. Surgical closure was scheduled when no further defect reduction was documented. Postoperative follow-up was performed at monthly hospital visits.

Operative technique

Through an elliptical incision, scar tissue and previous incision were removed. Skin flaps were dissected laterally into both flanks. Hernia sac was dissected and excised completely. Entrance to peritoneal cavity and lysis of adhesion between subjacent viscera and anterior abdominal wall was achieved. Midline rectus muscles fascial borders were identified bilaterally. Abdominal wall reconstruction was practiced with simple closure or components separation [4]. Procedures for bowel continuity reestablishment were performed when indicated.

Descriptive statistics, including means and standard deviations, were used to describe the study population continuous variables. Differences between the initial and week-4 transverse hernia defect measures were assessed with a paired Student's t test; p value < 0.05 was defined as significant. Statistical analysis was performed using SPSS for Windows, version 12.0 (SSPS Inc., Chicago, IL).

Results

Twelve patients were included during study period. In the first two cases, an important reduction in the transverse defect measure was found after BTA application, with no further reduction at week 4 (Table 1). In the following ten cases under CT scan measurement, when comparing the initial mean transverse hernia defect measure and at 4 weeks after BTA application (13.85 ± 1.49 cm vs. 8.6 ± 2.07 cm), an overall mean reduction of 5.25 ± 2.32 cm was observed ($p < 0.001$; 95% confidence interval (CI), 3.59–6.91). Simple closure technique was performed in six cases, and components separation technique in the remaining six cases, with an overall complication rate of 16.67%; a case of seroma formation managed under US-guided drainage, and a colocutaneous fistula, which closed with conservative treatment. No mortality was documented. After a mean follow-up of 9 months, no recurrences have been observed. Table 2 summarizes clinical and demographic characteristics of the ten cases with CT scan measurement. Figures 2 and 3 show the CT scans of case 3, before BTA application and 4 weeks after.

Discussion

Abdominal wall hernia reconstruction after open abdomen management represents a surgical challenge. The

Table 1 Demographic and clinical characteristics of patients with abdominal wall hernia after open abdomen management

Transverse hernia defect weekly measures (cm)											
Case	Age (year)	Gender	Background	Initial	1	2	3	4	Reduction (%)	Closure technique	Follow-up (months)
1	26	Male	Trauma	20	14	12	10	10	50	Simple closure	18
2	67	Male	Trauma	36	26	22	19	19	47.2	Comp. separation	18

Clinical transverse hernia defect measurements, initial and 4 weeks after BTA application

Comp. separation Components separation

Table 2 Demographic and clinical characteristics of patients with abdominal wall hernia after open abdomen management

Transverse hernia defect measures (cm)									
Case	Age (year)	Gender	Background	Initial	Week 4	Reduction	Closure technique	Complications	Follow-up (months)
1	57	Male	AP	15.5	10.5	5	Comp. separation		13
2	55	Male	AA	12	7	5	Simple closure		11
3	30	Male	Trauma	14.5	11	3.5	Comp. separation	Seroma	10
4	31	Male	Trauma	16.5	6	10.5	Simple closure		7
5	29	Male	AD	13.5	8	5.5	Comp. separation	EC fistula	7
6	41	Male	AD	13.5	6.5	7	Simple closure		7
7	22	Male	Trauma; EC fistula	13	10	3	Comp. separation		5
8	28	Male	Trauma	12	9	3	Simple closure		5
9	17	Male	AP, Pseudocyst	13	6.5	6.5	Comp. separation		4
10	33	Male	Trauma	15	11.5	3.5	Simple		4
Mean	34.3			13.85	8.6	5.25*			7.3
SD	13.07			±1.49	±2.07	±2.32			±3.09

CT scan transverse hernia defect measurements, initial and 4 weeks after BTA application

* $t = 7.14$; 95% CI 3.59–6.91; p value < 0.001, derived from paired Student's t test

EC fistula enterocutaneous fistula, *AP* acute pancreatitis, *AD* acute diverticulitis, *AA* acute appendicitis, *Comp. separation* components separation, *SD* standard deviation, *CI* confidence interval

Fig. 2 Case 4 CT scan previous to BTA application, showing a 16.5-cm transverse hernia defect at mesogastric level

Fig. 3 Case 4 CT scan 4 weeks after BTA application, showing a 6-cm transverse hernia defect

postoperative hernia rate after primary surgery is 2–20% [1], whereas the ventral hernia recurrence rate is reported to be 30–70% [1, 2, 5]. Surgical techniques consisting of myofascial release, local tissue flaps, free flaps, and the use of synthetic materials have been reported [6–12]. The ideal objective is to perform a tension-free closure, with abdominal wall dynamic stability and optimizing aesthetic appearance [13]. Planned ventral hernia is an alternative for seriously ill patients due to abdominal sepsis or trauma [12]. After a laparotomy, there is a disturbance of the abdominal wall dynamic forces. The midline is the most frequent site of post-incisional hernia formation. Although multifactorial, the most important cause is the lateral retraction and migration of midline structures. Lateral myofascial contraction develops a continued unopposed force, enhancing the hernia defect [14–16]. Several techniques consisting of myofascial release have been described [2–9, 12–15]. The subsequent myofascial relaxation provided by the lateral abdominal muscles, particularly the external oblique, allows midline rectus muscle approximation and hernia defect closure with less tension. Cakmak et al. [17] reported the effect of BTA-induced abdominal muscle paralysis on intra-abdominal pressure in rats. In our series, BTA application produced a lateral abdominal wall

muscle relaxation, particularly over the external oblique muscles. Maximal relaxation developed at the third week of toxin application. BTA-induced flaccid paralysis contributed to a diminished transverse hernia defect and consequently to a less-tension abdominal wall reconstruction, encouraging the authors to report these results. During follow-up, no bulging over the oblique muscles has been observed. The ideal BTA dosage is to be determined. To our knowledge, this is the first report of BTA application before abdominal wall hernia reconstruction.

Conclusions

BTA application before abdominal wall hernia reconstruction seems to be useful. The lateral muscles paralysis achieved and a transverse hernia defect reduction allows a less tension closure.

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