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Perineal eventration after abdominoperineal resection for rectal cancer: anatomical, surgical and clinico-pathological landmarks

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Abstract

Perineal eventration (PE) is a rare complication after the lower rectal cancer resection surgery, affecting the quality of life of the patient. In 5.5 years of evolution, out of 620 patients with rectal cancer treated by curative surgery, 176 patients with lower ampullary rectal cancer treated by abdominoperineal resection (APR) with the closure of the defect by direct suture of the perineal floor were selected. Ten (5.6%) of them were diagnosed with PE. This paper shows the results of a retrospective study, which compares the clinico-pathological and therapeutic aspects of a subgroup of 166 patients (subgroup I) with APR without PE and a subgroup of 10 patients (subgroup II) with PE. Starting from the question of whether aspects can influence the evolution of PE, we aimed to investigate the similarities and differences between these two groups, from the histological, clinical and therapeutic points of view. Regarding the tumor, node, metastasis (TNM) staging, we encountered the following aspects: for the subgroup II with PE, pT3 predominated, stages N0 and N1 were equal (50%) and the absence of metastases (M0) was found in all cases; in subgroup I, pT3 and N0 also predominated, followed by N1 and N2, and for stage M, M0 is predominant, followed by M1. For the clinical profile of the PE group, the symptoms were characteristic, with the presence of the usual triggering factors [hysterectomy, radiochemotherapy and wide resection surgery – extralevatorial APR]. The therapeutic approach revealed various aspects, including plastic surgery procedures (direct closure, meshes, flaps) used in pelvic reconstruction. The accurate surgical technique applied in order to achieve oncological safety allowed for a longer survival, which favored the appearance of PE in addition to the other favoring factors. Our results underlined the clinico-pathological profile of the two subgroups, without being able to establish a correlation with the appearance and evolution of PE. However, the clinico-pathological risk factors for this condition are not yet fully defined. Therefore, reports based on the experience in the diagnosis and treatment of PE should bring valuable data, aiming to create the knowledge framework for prevention.

Keywords: perineal eventration, pathology, reconstructive, rectal cancer, abdominoperineal resection, plastic surgery.

Introduction

Perineal eventration (PE) or postoperative perineal hernia is a rare, late complication of the abdomino-perineal rectal excision (abdominoperineal resection – APR) or of pelvic exenteration. PE is defined as the protrusion of the intraperitoneal contents in the perineum through a breach in the pelvic floor as a result of a previous surgery with major pelvic excision [1]. Despite all advances in rectal cancer therapy over the past 30 years, APR is still indicated in advanced lower rectal tumors which require surgical assistance to establish the diagnosis, identify the triggering factors, and choose the appropriate treatment options [2–4].

The incidence of PE due to APR or pelvic exenteration is estimated between 0.6–7% [5], with a strong impact on the quality of life of the patient with low rectal neoplasm. Several papers provide extensive information on safety issues after these surgeries. It was demonstrated that the crucial element that influences the risk of local recurrence is the distance from the anal margin to the tumor, and not the surgical technique [APR or sphincter-saving resection (SSR)] [6]. However, recent studies conducted by experienced surgeons show that, by rigorously following the technique, the results of APR are not inferior to SSR [6–9].

The surgical experience of the 1st Surgical Oncology Unit, Regional Institute of Oncology, Iaşi, Romania, includes, between May 2012–October 2018, 620 patients with rectal cancer treated by curative surgeries, with results consistent with the reports published in the mainstream. Based on this experience, a common question for the surgeon is whether PE is accompanied by local tumor recurrence, and what is the impact of the tumor pathological status on the evolution, including as a trigger for PE.

Aim

Starting from these premises, our study aimed at the comparative evaluation of the clinico-pathological profile of patients with APR, with and without PE, the analysis of anatomical elements affected during surgery, with repercussions in the occurrence of PE, and the techniques used in plastic surgery to repair PE: meshes and a variety of flaps, following decision algorithms in the reconstructive strategy of the perineal defect.

⊟ Patients, Materials and Methods

The study group included 176 patients diagnosed with low rectal cancer who underwent curative surgery – APR – with the closure of the defect by direct suture in the 1st Surgical Oncology Unit, Regional Institute of Oncology, Iași, during 5.5 years (May 2012–October 2018). The surgical technique consisted of the resection of the sigmoid colon, rectum, anus, along with the mesentery, mesorectum and perianal tissue, followed by permanent colostomy – Miles procedure. The patients were organized into two subgroups: subgroup I – 166 patients with an evolution without PE; subgroup II – 10 patients who developed symptomatic PE.

In order to establish the clinico-pathological profile of the cases, we analyzed the tumor histological characteristics [histological type, histological grade, tumor status, nodal status, systemic metastasis status, lymphovascular and perineural invasion, resection within oncological limits (post-excision circumferential margins)] [10].

For the analysis of the risk factors for the development of PE, we considered, as surgical features of APR, the type of excision performed, the appearance of the meso-rectum, and the coccyx preservation or its resection. The appearance of the mesorectum was evaluated according to the standard algorithm used in surgical practice [11, 12] (Table 1). In addition, other associated risk factors were analyzed, namely previous surgeries, and neoadjuvant therapy. Moreover, surgical features of PE therapy were also considered.

Table 1 – *Specimen grading in mesorectum assessment after abdominoperineal excision*

Grade	Quality	Description
G3 – Extra-levator plane	Good surgery	▪ Cylindrical shape of the specimen due to the presence of *levator ani* removed en bloc with the mesorectum and sphincters. ▪ Defects must be no deeper than 5 mm. ▪ No waisting of the specimen. ▪ Smooth CRM on slicing.
G2 – Sphincteric plane	Moderate surgery	▪ Waisted specimen. ▪ The CRM in this region is formed by the surface of the sphincter muscles which have been removed intact.
G1 – Intra-sphincteric plane	Poor surgery	▪ Waisted specimen and inclusion of deviations into the sphincter muscles, submucosa and complete perforations.

CRM: Circumferential resection margin.

The study has been approved by the Research Ethics Committee from Regional Institute of Oncology, Iași, based on the informed consent of the patients on the use of clinical and pathological data.

⊟ Results

Clinico-pathological characteristics

The main demographic and clinico-pathological characteristics of the cases under study are shown in Table 2.

Table 2 – *Basic characteristics of the studied patients*

Demographic and clinico-pathological parameters	Subgroup I		Subgroup II	
	#	%	#	%
Age [years]	63.5±12.3		68±10.5	
Gender				
Male	114	68.7	7	70
Female	52	31.3	3	30
Histological type				
Adenocarcinoma	152	91.5	10	100
Signet ring adenocarcinoma	2	1.2	0	0
Adenocarcinoma with mucinous areas	3	1.8	0	0
Mucinous adenocarcinoma	3	1.8	0	0
Tubular adenocarcinoma	2	1.2	0	0
Squamocellular carcinoma	1	0.6	0	0
Adenoma	1	0.6	0	0
Melanoma	2	1.2	0	0
pT status				
pT0	3	1.7	0	0
pT1	5	3.01	1	10
pT2	48	28.9	2	20
pT3	97	58.4	4	40
pT4	13	7.83	0	0
N status				
N0	92	55.42	5	50
N1	46	27.7	5	50
N2	28	16.86	0	0
M status				
M0	146	87.9	10	100
M1	20	12.04	0	0
AJCC staging				
0	49	29.51	2	20
I	34	20.48	2	20
II	60	36.14	1	10
III	20	12.04	5	50
IV	3	1.8	0	0
Lymphatic invasion				
Present	47	28.3	2	20
Absent	119	71.7	8	80
Vascular invasion				
Present	47	28.31	1	10
Absent	119	71.7	9	90
Perineural invasion				
Present	44	26.5	1	10
Absent	122	73.5	9	90
Resection within oncological safety limits – circumferential margins				
0 (≥1 mm)	135	81.32	10	100
1 (≤1 mm)	31	18.68	0	0
Therapeutic response after radiotherapy				
Complete	5	3	4	40

AJCC: *American Joint Committee on Cancer*; M: Metastasis; N: Lymph node; pT: Primary tumor.

For many cases in subgroup I (152 cases – 91.5%) and all cases in subgroup II, the histopathological exam showed classical aspects of adenocarcinoma. The subgroup I also included 14 cases – 11.5% diagnosed as histological variants of adenocarcinoma, squamocellular carcinoma, adenoma or melanoma.

In subgroup I, between one and 50 lymph nodes were sampled; lymph node metastases were identified in 74 cases, and absent in 92 cases. In subgroup II, between one and 20 lymph nodes were sampled; metastases in 1–3 regional lymph nodes were present in five cases and absent in the other five cases. Therefore, 50% cases in subgroup II were N0 and, respectively, N1, compared to 55.4%, respectively 27.7% in subgroup I; subgroup II had no case in stage N2 compared to subgroup I with 16.86%.

The rate of distant metastases revealed that all cases with PE in subgroup II did not have distant metastases (M0), compared to 87.9% in subgroup I; distant metastases (M1) were present only in subgroup I – 12.04%.

For the *American Joint Committee on Cancer* (AJCC) tumor, node, metastasis (TNM) stage, in subgroup I, stage II was the most frequent (36.14%), followed by stage I (20.48%) and then by stage III (12.04%); in subgroup II, stage III (50%) was encountered in half of the cases, followed by stage I (20%), and then by stage II (10%).

Preoperative radiotherapy resulted in a complete tumor response in three (1.8%) cases in subgroup I and in two (20%) cases in subgroup II.

There are close values of perineural and lymphovascular invasion in the two groups, with a slightly higher frequency in terms of the positivity rate in the control group.

The excision of the rectal tumor was performed in conditions of maximum oncological safety in subgroup I, with a percentage of negative circumferential margins of 81.32%, while in subgroup II the percentage reached 100%.

The PE incidence was 5.6% and the diagnosis was decided after a follow up of 42 months (12–72 months), with an average duration of 12.4 months (minimum 17 months, maximum 19 months).

Surgical risk factors for PE after the abdominoperineal excision of the rectum

To ensure a resection within the limits of oncological safety, the surgical procedure followed the principle of wide excisions, in apparent healthy tissue.

Type of excision

The analysis of the surgical resection technique for the primary tumor, which is cited as a factor triggering the development of PE, revealed that all PE patients (subgroup II) had extralevatorial APR with perineal time in the jackknife prone position in all situations, similar to subgroup I (98.8%), except for two (1.2%) patients in whom ischial APR was performed (Table 3).

Table 3 – *Type of excision*

Type of abdominoperineal excision	Subgroup I		Subgroup II	
	#	%	#	%
Extralevatorial	164	98.8	10	100
Ischial	2	1.2	0	0

The extralevatorial excision resulted in a larger defect in the perineal region (Figure 1). All of the perineal defects were closed by direct suture (Figure 2).
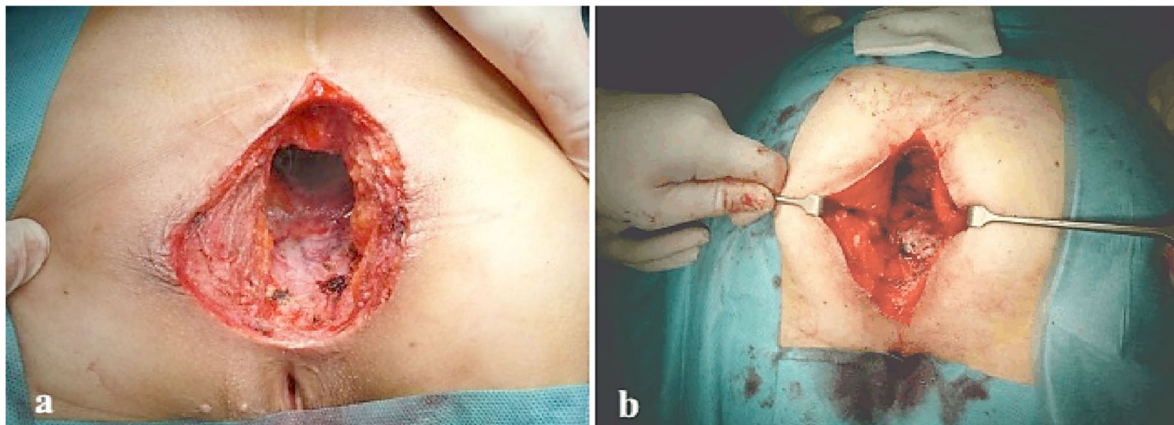

Figure 1 – *The perineal defect after the extralevator abdominoperineal excision of rectum in female (a) and male (b) patient.*

Figure 2 – *Primary suturing of the perineal defect.*

The appearance of the mesorectum

The appearance of the mesorectum, evaluated according to the standard algorithm, indicated an optimal quality of surgery, by excision in the mesorectal fascia plane, for 161 (96.9%) cases in subgroup I (34 qualified as G2 and 127 qualified as G3), and for all 10 cases from subgroup II (two qualified as G2 and eight qualified as G3) (Figures 3 and 4). Only five (3%) cases from subgroup I were classified as G1.

Coccyx resection

Wide-resection coccyx excision was performed in 102 (61.44%) patients in subgroup I and in five of the patients in subgroup II (50%).
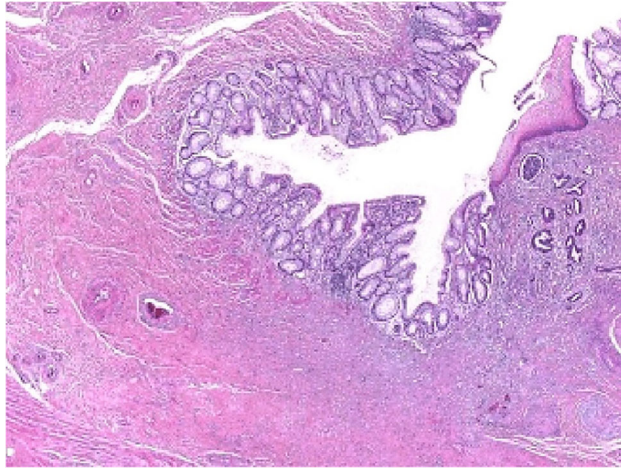
Figure 3 – *Mucus cells with no restant tumoral cells which infiltrate the muscular layer, radial excision border, TRG4 (surgery quality – mesorectum excision) (HE staining, ×25). HE: Hematoxylin–Eosin; TRG: Tumor regression grade.*
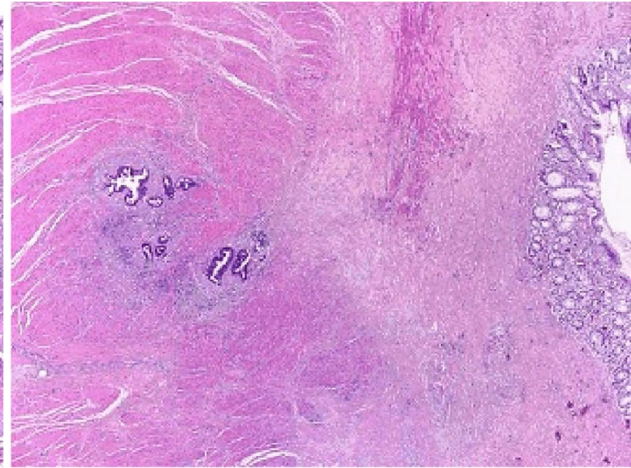
Figure 4 – *Tumoral core restant in the muscular layer, significant parietal fibrosis. re-epithelized tumoral bed, TRG3 (HE staining, ×25). HE: Hematoxylin–Eosin; TRG: Tumor regression grade.*

Complementary risk factors for PE

Other complementary risk factors were identified in the study group (Table 4). Total hysterectomy was reported in the medical history of the three patients with PE – subgroup I, as follows: one case with genital prolapse, and two cases with benign gynecological diseases. Long-term pelvic radiotherapy with a total dose of 50.5 Gy in 28 sessions was found in nine (90%) patients in subgroup II, compared to 68% in subgroup I, and seven (70%) patients from subgroup II were submitted to chemotherapy, compared to 50.6% of subgroup I.

Table 4 – *Risk factors for perineal eventration*

Risk factors	Subgroup I		Subgroup II	
	#	%	#	%
Hysterectomy	0	0	3	30
Neoadjuvant radiotherapy				
Yes	113	68	9	90
No	53	32	1	10
Neoadjuvant chemotherapy				
Yes	84	50.6	9	90
No	82	49.4	1	10

Surgical peculiarities in PE therapy after the abdominoperineal excision of the rectum

Surgical treatment for PE (subgroup II) was performed in eight out of 10 patients, within 2–5 months after diagnosis. In most cases (seven patients), perineal approach was chosen, whereas transabdominal approach was used in only one patient.

The peculiarities related to the surgical technique in the reconstruction of the pelvic defect were the following:

▪ for the two cases with small volume defects, without tension, we applied the restoration of the musculo-aponeurotic plane in anatomical planes;

▪ for the six cases with significant volume defects, with potential tension, we performed as follows: in three cases, the restoration of the musculoaponeurotic plane by the reverse procedure, with the identification and individualization of the two musculoaponeurotic planes followed by suture with non-absorbable monofilament thread – Mayo technique; in two cases, reconstruction of the transperineal pelvic floor with synthetic mesh (trans-perineal double layer mesh – one case, Polypropylene transabdominal mesh covered with greater omentum – one case); in one case, the reconstruction of the pelvic defect was performed using a rotated gluteal flap.

Plastic surgery techniques were also used for the reconstructive treatment of PE. Thus, the reconstruction of the pelvic floor with dual layer synthetic mesh or with fixed mesh was performed. The usage of dual layer mesh, the most used technique, consisted in fixing it to the Waldeyer fascia in the rear, anterior – prostatic capsule and to the lateral pelvic wall (Figure 5). The reconstruction of the pelvic floor with a mesh by trans-perineal approach allowed the evaluation of the pelvic cavity and the easier fixation of the mesh to the resistant elements mentioned above; one of the difficulties of this technique was to avoid the narrowing of the pelvic ureters and the inability to pediculate the greater omentum to cover the net. We also accomplished the reconstruction of the pelvic defect with the rotated flap of the right large gluteal muscle; the subgluteal incision allowed the rotation of the musculocutaneous flap thus formed in order to restore the perineal defect with a reduced tension on the tissues (Figure 6).

The postoperative evolution was satisfactory during a follow-up of four months–three years, without immediate local complications. Only one patient treated with trans-abdominal application of propylene mesh covered by greater omentum showed pelvic ureteral stenosis with bilateral grade II/III ureterohydronephrosis, one year after surgery, and was treated with double *J* ureteral stent mounting, with subsequent favorable evolution. None of the cases reported the recurrence of eventration or local tumor recurrence.

Figure 5 – *The treatment of eventration with dual layer mesh fixed by perineal approach, with opening of the hernial sac and examination of the contents (a), followed by the fixing of the mesh to the pelvic walls (b); after fixing the mesh (c), the surface fascia is closed and the remaining cavity below it (d) must be drained; appearance at three weeks postoperatively is normal (e).*
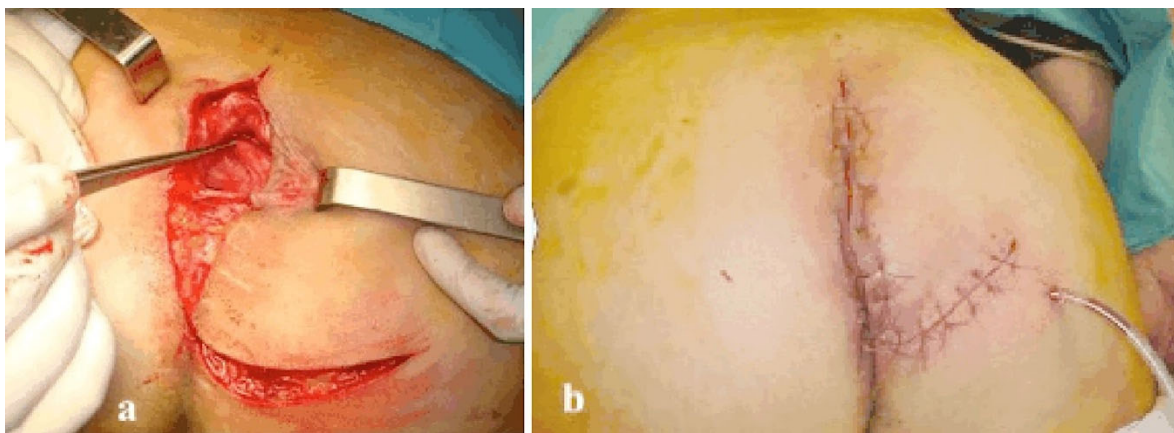

Figure 6 – *Treatment of eventration with rotation flap of greater gluteal muscle: picture during the surgery where the forceps indicates the eventration sac (a) and immediately after surgery (b).*

⊟ Discussions

The present study allows several aspects to be highlighted regarding the clinico-pathological and therapeutic profile in patients with PE after APR compared to patients with APR without PE, which may influence the quality of life of patients treated with APR for rectal cancer.

PE is a late and rare complication of APR for lower rectal cancers; PE following APR in the extralevatorial plane has an increased incidence due to the larger perineal defect resulted through this technique and to the perineal radiotherapy that causes a delayed healing. The incidence of PE after excisions that create larger defects can reach 26% [13]. Studies in the literature indicate the incidence

of PE less than 1% after APR and 3% after pelvic exenteration, but most studies cite the incidence between 0.5–1% [14, 15], while in our study the incidence was 5.6%. The number of cases reported in the mainstream is relatively small. Mjoli *et al.* [16], in a 2012 review, cites 45 cases; a study completed in the same year by Martijnse *et al.* [17] reaches 100 cases over a period of 70 years (1944–2012). In our work, all patients in subgroup II (PE) and 98% of patients in subgroup I were treated with extralevatorial APR, which is used to increase oncological safety and reduce the risk of intra-operative tumor perforation [18]. Therefore, our work is to be considered by comparing it to these studies. Despite the small number of cases in our study, that did not

allow a more complex statistical analysis, we consider that the descriptive data are valuable and relevant to the objectives pursued.

Age and gender

The average age for the occurrence of PE is estimated at 70 years. In our PE group, the average age was 68±15 years, five years older than that of subgroup I of 63.5± 12.3 years with male/female (M/F) ratio of 7/3 compared to subgroup I, where for men the percentage was 68.6% and for women 31.3%.

PE affects both genders, predominantly women by the conformation of the small pelvis, pre-existing prolapses, weakening of the pelvic floor by pregnancy and birth [14, 19], but in our cases, contrary to the above, males prevailed – the M/F ratio being 7/3.

Pathological characteristics

The histological examination and staging are important criteria for the diagnosis, in addition to the clinical elements and complex complementary investigations. Our study allowed a comparison between the clinico-pathological profile in the two subgroups, with similarities and differences. Therefore, some details are worth mentioning regarding the TNM staging. T0 tumors (with no sign of the primary tumor) were found in three (1.7%) cases in subgroup I and 0 cases in subgroup II. The most common were T3 tumors, both in subgroup I (97 cases – 58.4%) and in subgroup II – four (40%) cases, followed by more numerous T2 tumors in subgroup I – 28 (28.9%) cases, compared to subgroup II – two (20%) cases; T1 tumors were less represented in both groups – five (3.01%) cases in subgroup I and one case (10%) in subgroup II.

Comparing the lymph node status in the two groups, it was found that half of the PE cases (five patients – 50%) in subgroup II did not have regional lymph node metastases, compared to 92 cases representing 55.42% in subgroup I. On the other hand, the remaining five (50%) patients with PE in subgroup II were staged as N1, compared to subgroup I with 46 (27.7%) cases diagnosed N1. N2 stage was absent in subgroup II and present only in subgroup I for 28 (16.5%) cases. No subgroup had N3 and N4 stage lymph node metastases. Lymph node status is a proven predictor [10] for local recurrence. However, a favorable lymph node status in terms of local recurrence (negative lymph nodes) in patients with neoadjuvant treatment may witness aggressive radiation therapy, which may affect the perineal region in terms of effective healing ability. In this regard, further studies should consider the assessment of the pre-therapeutic lymph node status in patients receiving neoadjuvant treatment and the identification of those patients in whom regional lymph nodes that were thought to be positive are revealed as negative. In addition, the total number of lymph nodes identified in the resection piece should be regarded as a marker of the aggressiveness of the neoadjuvant treatment and, consequently, a potential risk factor for the occurrence of PE, according to the previously mentioned idea. The rate of distant metastases reveals the absence of metastases (M0) in all PE cases (subgroup II) and their absence in subgroup I in 146 (87.9%) cases.

Distant metastases (M1) were present only in subgroup I – 20 (12.04%) cases. The absence of regional tumor recurrences revealed that the applied surgical technique was effective, achieving the oncological safety that is particularly emphasized at present.

All in all, the pathological aspects and the oncological safety surgery of the excision influenced the prolongation of the lifespan, which allowed the appearance of PE.

Clinical profile of patients with PE

PE occurs most frequently in the first year after proctectomy, while in our study, the time of occurrence of PE was 12.4 months (7–19 months).

Most cases are asymptomatic, so they should be actively detected at the postoperative follow-up clinical examination. Symptomatic PE is manifested by perineal swelling caused by coughing or voluntarily, externalized by the effort of abdominal pressure; the patient accuses sensation of pressure and/or perineal fullness and perineal swelling [14, 15]. The raised or sitting position accentuates the symptoms. In our study, the clinical signs were manifested by altered perineal relief and perineal pain in all patients, followed by transit disorders and trophic disorders in the area of the hernial sac.

Favoring factors studied in the literature [20] are related to the personal background (female, history of hysterectomy, obesity, malnutrition), anatomical and surgical aspects, preoperative perineal irradiation, chemo-therapy, and surgical conditions, such as: primary non-suturing of the perineal wound and/or post-surgery infections. In our study, we identified the following factors: hysterectomy (three cases), pelvic irradiation (nine cases) and chemotherapy (seven cases). In our study, the predominance of males is noted, contrary to the data in the literature where females predominate [14, 19]. We also underline the absence of postoperative complications immediately after APR, previously reported [17].

The higher incidence of PE could also incriminate the surgical technique – extralevatorial APR – as a triggering factor, by creating a larger defect. In this sense, in 98.8% of the cases studied in subgroup I and in all cases in subgroup II, extralevatorial APR was performed. The repair after excision was performed by direct closure of the pelvic defect without postoperative complications. Coccygeal excision is also an element that could be involved in the occurrence of PE; this factor is classified as a change in the anatomical profile of patients included in the study. According to a recent study by Simpson *et al.* [12], links were established between the quality of resection in lower rectal cancers and the dimensional values of the pelvis (sacrococcygeal distance/depth, sacrococcygeal angle, interspinous diameter, antero-posterior inlet, antero-posterior outlet, in addition to other pelvic measurements). However, data needed for an elaborate study with viable results regarding the relationship between the above-mentioned dimensional values and the occurrence of PE are based on the availability of magnetic resonance imaging (MRI) examination for all patients.

As a large part of the patients in our study group did not have the MRI examination, it was not possible to

make a comparison between the two subgroups. We can only comment that in the small number of PE patients with an MRI exam performed on admission, a dynamic of the dimensional values mentioned above was observed. A hypothesis worthy of further studies is that the values above the reference values of bitrochanterian, bi-ischial and bispinous diameters are related to the occurrence of PE (considering, for larger groups, the coefficient of variability by gender, finally establishing a reference value) [12].

Surgical treatment in patients with PE: the value of anatomical tools

Regarding the quality of the surgical act by evaluating the appearance of the mesorectum after the initial resection (APR), our data confirm that a wide excision could be a favorable factor for PE, due to the weakening of the pelvic floor.

The good quality of the surgical act is evaluated by G2 and G3 classes and present mostly in the cases included in the study. However, an excision in the fascia involves a significant lack of substance at the perineal level, which could also be a risk factor for the development of PE.

In the context of abdominoperineal excision, in some cases, the resection of the coccyx was necessary, which, by forcibly increasing the diameters of the pelvic bone structure, may represent a risk factor for the appearance of PE, although it is a procedure used to facilitate the access and promote the externalization of the resected piece. This could be considered the drawback of this surgical technique.

PE reconstruction treatment is surgical and depends on the general condition of the patient, the oncological evolution, the size of the muscle defect and the local septic condition; the indications for surgical treatment are as follows: pain and discomfort in a sitting position, skin erosion, urination difficulties and bowel occlusion. In subgroup II under study, eight of the 10 cases received surgical treatment, observing these indications and the patient's choice.

Numerous techniques are described for the reconstruction of PE with issues related to the surgical approach and the types of reconstruction. Thus, the approach can be transabdominal [21], perineal [15] or high and low combined [22], each with advantages and disadvantages regarding the exposure of the operative area and the positioning of a prosthetic or muscular reinforcement.

In our work, the perineal approach was preferred in most patients (seven out of 10 patients, subgroup II) because it is a simpler and faster method; it does not require significant viscerolysis; the repair can be performed by simple myorrhaphy or by reconstruction with muscle flaps; it allows the excision of the hernial sac and perineal closure. The abdominal approach was used in one case – generally it is preferred in the case of a recurrence, scarred or irradiated perineum or with the existence of concomitant eventration of the anterior abdominal wall [14, 19, 23].

Regarding the reconstructive techniques, in subgroup II, the following were used: (*i*) closing the defect with the restoration of the musculoaponeurotic plane in anatomical planes or in reverse; (*ii*) reinforcement techniques with synthetic material – dual layer mesh or propylene mesh covered with greater omentum; (*iii*) plastic surgery techniques – reconstruction by musculocutaneous flaps.

The use of synthetic meshes can cause postoperative adhesions. The use of prosthetic material is avoided in case of local septic contamination or perineal irradiation. The alternative measure in these situations is to use a muscle flap [24]. The vertical *rectus abdominis* musculocutaneous (VRAM) flap is preferred especially in the abdominal approach. Other muscular or musculocutaneous flaps can also be used, such as: large gluteal muscle flap, *gracilis* flap, *fascia lata*. The use of a muscular flap to fill the cavity after pelvic radiotherapy and after the initial APR decreases the risk of scarring complications [25, 26].

The use of a well-vascularized flap helps to heal the wound because it brings healthy, non-irradiated tissue and a new vascular network into the pelvic defect. [27] The ideal characteristics of a flap are to provide safety, to have a good sensitivity for a normal function, to ensure a durable, tension-free skin coverage, to fill the pelvic cavity and the perineal wound with well-vascularized tissue and with enough volume to reconstruct the pelvic diaphragm with minimal morbidity at the donor site. Musculocutaneous flaps are preferred because muscle is needed to fill the three-dimensional complex defect [28]. The VRAM or oblique *rectus abdominis* musculocutaneous (ORAM) flap have sufficient muscle volume to fill the defect. The right abdominal muscle creates adequate support for the abdominal viscera and provides enough volume for filling. The VRAM flap associates a potential risk of hypotonia of the abdominal wall, favoring dehiscence, hypotonia and hernia, thus not always representing an optimal choice [29]. It does, however, have a lower rate of major complications compared to thigh flaps [30]. If the VRAM flap is contraindicated, the *gracilis* flap and the gluteus maximus flap or the gluteal fold flap can be used as a useful alternative. The *gracilis* flap does not have the necessary volume to fill large cavernous defects, but is ideal for the reconstruction of vulvar and vaginal defects. Sometimes, the *gracilis* flap can be used for superficial perineal defects, providing a satisfactory volume [31]. The gluteal flap is ideal for reconstructing the dead areas of large perineal defects. It is a robust flap with dual vascular network, derived from the superior and inferior gluteal arteries. The *gluteus maximus* muscle provides a large volume of tissue, it is situated in the vicinity of the perineal region and will obliterate the dead space associated with the defect in a satisfactory manner. This muscle is one of the thigh extensors for activities, such as: running, climbing, and sometimes the flap can be accompanied by functional disorders of these activities.

It is recommended to use decision-making algorithms to choose the best option, in cooperation with the plastic surgeon. Repairing a post-excisional soft tissue defect yields a dichotomic approach; the purpose is the restoration of form and function in a specific anatomical region. In this reconstructive endeavor, the surgeon is assisted in estimating the defect coverage using a decision algorithm supplied by the reconstructive scale principles [32–35].

In some cases, where reconstruction is not possible at a given time, or when the surgeon desires to stimulate granulation tissue formation in order to achieve a smaller defect, negative pressure wound therapy (NPWT) can be applied. NPWT is a simple and safe technique, with a low rate of complications. It can be used for patients with associated diseases, who cannot benefit from complex surgeries. Subatmospheric pressure is adapted to patient tolerance and anatomical region. NPWT stimulates the contraction of the wound edges and granulation tissue formation, aspects that can increase the success rate of the following reconstruction [36].

In our study, the muscle flap reconstruction technique was used in a case of subgroup II where the rotated flap of the right large gluteal muscle was used with excellent results. The various techniques used in our cases for the treatment of PE had excellent results with a zero-recurrence rate of PE and local tumor relapse during the follow-up period.

⊡ Conclusions

PE is a rare complication after the lower rectal cancer resection surgery, affecting the quality of life of the patient. The clinico-pathological risk factors for this condition are not yet fully defined. Therefore, reports based on the experience in the diagnosis and treatment of PE should bring valuable data, aiming to create the knowledge framework for prevention.

Conflict of interests
The authors have nothing to disclose.

References

[1] Drissi F, Duchalais E, Venara A, Meurette G, Lehur PA. Eventrations périnéales: diagnostic, prise en charge, prévention [Perineal hernias: diagnosis, management, prevention]. E-mémoires de l'Académie Nationale de Chirurgie (ANC), 2017, 16(2):065–068. https://doi.org/10.14607/emem.2017.2.065

[2] West NP, Finan PJ, Anderin C, Lindholm J, Holm T, Quirke P. Evidence of the oncologic superiority of cylindrical abdomino-perineal excision for low rectal cancer. J Clin Oncol, 2008, 26(21):3517–3522. https://doi.org/10.1200/JCO.2007.14.5961 PMID: 18541901

[3] Nagtegaal ID, van de Velde CJH, Marijnen CAM, van Krieken JHJM, Quirke P; Dutch Colorectal Cancer Group; Pathology Review Committee. Low rectal cancer: a call for a change of approach in abdominoperineal resection. J Clin Oncol, 2005, 23(36):9257–9264. https://doi.org/10.1200/JCO.2005.02.9231 PMID: 16361623

[4] Faucheron JL, Rullier E. Cancer du rectum. Monographie de l'Association Française de Chirurgie (AFC), Ed. Arnette, Paris, 2009.

[5] Aboian E, Winter DC, Metcalf DR, Wolff BG. Perineal hernia after proctectomy: prevalence, risks, and management. Dis Colon Rectum, 2006, 49(10):1564–1568. https://doi.org/10.1007/s10350-006-0669-0 PMID: 16946992

[6] Wibe A, Syse A, Andersen E, Tretli S, Myrvold HE, Søreide O; Norwegian Rectal Cancer Group. Oncological outcomes after total mesorectal excision for cure for cancer of the lower rectum: anterior *vs.* abdominoperineal resection. Dis Colon Rectum, 2004, 47(1):48–58. https://doi.org/10.1007/s10350-003-0012-y PMID: 14719151

[7] Chuwa EWL, Seow-Choen F. Outcomes for abdominoperineal resections are not worse than those of anterior resections. Dis Colon Rectum, 2006, 49(1):41–49. https://doi.org/10.1007/s10350-005-0227-1 PMID: 16283562

[8] Marr R, Birbeck K, Garvican J, Macklin CP, Tiffin NJ, Parsons WJ, Dixon MF, Mapstone NP, Sebag-Montefiore D, Scott N, Johnston D, Sagar P, Finan P, Quirke P. The modern abdominoperineal excision: the next challenge after total mesorectal excision. Ann Surg, 2005, 242(1):74–82. https://doi.org/10.1097/01.sla.0000167926.60908.15 PMID: 15973104 PMCID: PMC1357707

[9] Tekkis PP, Heriot AG, Smith J, Thompson MR, Finan P, Stamatakis JD; Association of Coloproctology of Great Britain and Ireland. Comparison of circumferential margin involvement between restorative and nonrestorative resections for rectal cancer. Colorectal Dis, 2005, 7(4):369–374. https://doi.org/10.1111/j.1463-1318.2005.00767.x PMID: 15932561

[10] Amin MB, Edge S, Greene F, Byrd DR, Brookland RK, Washington MK, Gershenwald JE, Compton CC, Hess KR, Sullivan DC, Jessup JM, Brierley JD, Gaspar LE, Schilsky RL, Balch CM, Winchester DP, Asare EA, Madera M, Gress DM, Meyer LR (eds). American Joint Committee on Cancer (AJCC) Cancer Staging Manual. 8th edition, American College of Surgeons, Springer International Publishing, 2017.

[11] Scripcariu DV, Lupaşcu CD, Huţanu I, Filip B, Aniţei MG, Ferariu D, Moscalu M, Scripcariu V. Factors influencing the pathological quality of the surgical specimen in rectal cancer – a retrospective single-centre study. Rom J Morphol Embryol, 2018, 59(1):257–267. PMID: 29940636

[12] Simpson G, Marks T, Blacker S, Smith D, Walsh C. Sacro-coccygeal dimensions and curvature are associated with resection quality in rectal cancer excision. Tech Coloproctol, 2020, 24(10):1063–1070. https://doi.org/10.1007/s10151-020-02273-y PMID: 32594270

[13] Sayers AE, Patel RK, Hunter IA. Perineal hernia formation following extralevator abdominoperineal excision. Colorectal Dis, 2015, 17(4):351–355. https://doi.org/10.1111/codi.12843 PMID: 25413255

[14] Beck DE, Fazio VW, Jagelman DG, Lavery IC, McGonagle BA. Postoperative perineal hernia. Dis Colon Rectum, 1987, 30(1):21–24. https://doi.org/10.1007/BF02556914 PMID: 3803102

[15] So JB, Palmer MT, Shellito PC. Postoperative perineal hernia. Dis Colon Rectum, 1997, 40(8):954–957. https://doi.org/10.1007/BF02051204 PMID: 9269813

[16] Mjoli M, Sloothaak DAM, Buskens CJ, Bemelman WA, Tanis PJ. Perineal hernia repair after abdominoperineal resection: a pooled analysis. Colorectal Dis, 2012, 14(7):e400–e406. https://doi.org/10.1111/j.1463-1318.2012.02970.x PMID: 22308975

[17] Martijnse IS, Holman F, Nieuwenhuijzen GAP, Rutten HJT, Nienhuijs SW. Perineal hernia repair after abdominoperineal rectal excision. Dis Colon Rectum, 2012, 55(1):90–95. https://doi.org/10.1097/DCR.0b013e3182334121 PMID: 22156873

[18] Holm T, Ljung A, Häggmark T, Jurell G, Lagergren J. Extended abdominoperineal resection with gluteus maximus flap reconstruction of the pelvic floor for rectal cancer. Br J Surg, 2007, 94(2):232–238. https://doi.org/10.1002/bjs.5489 PMID: 17143848

[19] Etienne JC, Bouillot JL, Alexandre JH. Eventrations périnéales après amputation du rectum. A propos de trois observations [Perineal eventration after amputation of the rectum. Apropos of 3 cases]. J Chir (Paris), 1988, 125(2):75–80. PMID: 3366816

[20] Narang SK, Alam NN, Köckerling F, Daniels IR, Smart NJ. Repair of perineal hernia following abdominoperineal excision with biological mesh: a systematic review. Front Surg, 2016, 3:49. https://doi.org/10.3389/fsurg.2016.00049 PMID: 27656644 PMCID: PMC5011127

[21] Klarenbeek BR, Veenhof AA, Bergamaschi R, van der Peet DL, van den Broek WT, de Lange ES, Bemelman WA, Heres P, Lacy AM, Engel AF, Cuesta MA. Laparoscopic sigmoid resection for diverticulitis decreases major morbidity rates: a randomized control trial: short-term results of the Sigma Trial. Ann Surg, 2009, 249(1):39–44. https://doi.org/10.1097/SLA.0b013e31818e416a PMID: 19106674

[22] Li J, Zhang W. How we do it: repair of large perineal hernia after abdominoperineal resection. Hernia, 2017, 21(6):957–961. https://doi.org/10.1007/s10029-017-1685-9 PMID: 29027023

[23] Berthoux L, Labib A, Clough KB, Girodet J, Salmon RJ. Hernie périnéale après amputation abdomino-périnéale. Role de l'épiplooplastie et/ou de l'irradiation [Perineal hernia after abdominoperineal amputation. Role of epiploplasty and/or irradiation]. J Chir (Paris), 1992, 129(12):550–552. PMID: 1299670

[24] Pörneczi B, Varga G, Bursics A. Gracilis muscle repair of a postoperative perineal hernia. Tech Coloproctol, 2006, 10(4):364–365. https://doi.org/10.1007/s10151-006-0311-0 PMID: 17219044

[25] Devulapalli C, Jia Wei AT, DiBiagio JR, Baez ML, Baltodano PA, Seal SM, Sacks JM, Cooney CM, Rosson GD. Primary *versus* flap closure of perineal defects following oncologic resection: a systematic review and meta-analysis. Plast Reconstr Surg, 2016, 137(5):1602–1613. https://doi.org/10.1097/PRS.0000 000000002107 PMID: 26796372

[26] Chessin DB, Hartley J, Cohen AM, Mazumdar M, Cordeiro P, Disa J, Mehrara B, Minsky BD, Paty P, Weiser M, Wong WD, Guillem JG. Rectus flap reconstruction decreases perineal wound complications after pelvic chemoradiation and surgery: a cohort study. Ann Surg Oncol, 2005, 12(2):104–110. https://doi.org/10.1245/ASO.2005.03.100 PMID: 15827789

[27] Kroll SS, Pollock R, Jessup JM, Ota D. Transpelvic rectus abdominis flap reconstruction of defects following abdominal-perineal resection. Am Surg, 1989, 55(10):632–637. PMID: 2529805

[28] Smith HO, Genesen MC, Runowicz CD, Goldberg GL. The *rectus abdominis* myocutaneous flap: modifications, complications, and sexual function. Cancer, 1998, 83(3):510–520. https://doi.org/10.1002/(sici)1097-0142(19980801)83:3<510 ::aid-cncr20>3.0.co;2-y PMID: 9690544

[29] Lejour M, Dome M. Abdominal wall function after rectus abdominis transfer. Plast Reconstr Surg, 1991, 87(6):1054–1068. https://doi.org/10.1097/00006534-199106000-00007 PMID: 1827922

[30] Nelson RA, Butler CE. Surgical outcomes of VRAM *versus* thigh flaps for immediate reconstruction of pelvic and perineal cancer resection defects. Plast Reconstr Surg, 2009, 123(1): 175–183. https://doi.org/10.1097/PRS.0b013e3181904df7 PMID: 19116551

[31] Shibata D, Hyland W, Busse P, Kim HK, Sentovich SM, Steele G Jr, Bleday R. Immediate reconstruction of the perineal wound with gracilis muscle flaps following abdominoperineal resection and intraoperative radiation therapy for recurrent carcinoma of the rectum. Ann Surg Oncol, 1999, 6(1):33–37. https://doi.org/10.1007/s10434-999-0033-4 PMID: 10030413

[32] Sheckter CC, Shakir A, Vo H, Tsai J, Nazerali R, Lee GK. Reconstruction following abdominoperineal resection (APR): indications and complications from a single institution experience. J Plast Reconstr Aesthet Surg, 2016, 69(11):1506–1512. https://doi.org/10.1016/j.bjps.2016.06.024 PMID: 27538340

[33] Sinna R, Alharbi M, Assaf N, Perignon D, Qassemyar Q, Gianfermi M, Deguines JB, Regimbeau JM, Mauvais F. Management of the perineal wound after abdominoperineal resection. J Visc Surg, 2013, 150(1):9–18. https://doi.org/10. 1016/j.jviscsurg.2013.02.001 PMID: 23434360

[34] Saleh DB, Liddington MI, Loughenbury P, Fenn CW, Baker R, Burke D. Reconstruction of the irradiated perineum following extended abdomino-perineal excision for cancer: an algorithmic approach. J Plast Reconstr Aesthet Surg, 2012, 65(11): 1537–1543. https://doi.org/10.1016/j.bjps.2012.05.011 PMID: 22749765

[35] Tamaş C, Pintilie CT, Atănăsoae IV, Corduneanu AM, Dabija I, Olaru FŞ, Hreniuc IM, Tecuceanu A, Munteanu I, Dobre C, Moraru DC, Ianole V, Tamaş I, Costan VV. Surgical reconstruction of post-tumoral facial defects. Rom J Morphol Embryol, 2018, 59(1):285–291. PMID: 29940639

[36] Pertea M, Velenciuc N, Poroch V, Ciobanu P, Boanca M, Grosu OM, Lunca S. Efficacy of negative pressure therapy (NPWT) in the management of wounds of different etiologies. Rev Chim (Bucharest), 2018, 69(8):1980–1986. https://doi. org/10.37358/RC.18.8.6458

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