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Placenta percreta: placental villous invasion or a form of adhesive disease?

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Abstract. *Introduction.* According to the International Federation of Gynecology and Obstetrics (FIGO) classification placenta percreta is the most severe form of placenta accreta spectrum (PAS) which is characterized by placental invasion through the entire myometrium and possible involvement of extrauterine tissues. The disease is associated with prior cesarean sections and placenta previa. This paper presents a clinical case of placenta percreta. The diagnosis was made based on ultrasound and MRI and confirmed intraoperatively. Histological examination revealed thinning of the uterine segment, fibrosis of the posterior wall of the bladder, and adhesions between the uterus and the bladder. We aimed to compare clinical, instrumental, and histological data and intraoperative imaging.

*Materials and method*s. Histological study was performed on paraffin sections (H&E and Mallory staining). We studied immunohistochemistry of cytotrophoblasts and syncytiotrophoblasts with antibodies to cytokeratin-8.

Results. MRI and ultrasound examination showed placental invasion extending beyond the serous lining of the uterus and involving the posterior wall of the bladder. At 37 weeks, elective cesarean section and surgical excision of the uterine wall with invaded villi were performed. Histological study revealed invasive cytotrophoblasts in the uterine wall and fibrous bladder wall. Involvement of the bladder wall was due to adhesions and the development of fibrosis.

Conclusion. Trophoblast and villous invasion did not extend beyond the uterus. Placenta percreta can be supposed to be one of the forms of pelvic adhesive diseases.

Keywords: cesarean section, uterine scar, healing of the uterine wall, placenta accreta spectrum, placenta percreta, invasion

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Placenta percreta: плацентарная ворсинчатая инвазия или вариант спаечной болезни?

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Резюме. *Введение.* В соответствии с классификацией Международной федерации акушеров и гинекологов (FIGO) placenta percreta является наиболее тяжелой формой приращения плаценты и характеризуется ее инвазией через всю стенку матки с возможным вовлечением окружающих

тканей. Данное состояние ассоциировано с предшествующим кесаревым сечением и предлежанием плаценты. Представлен клинический случай прорастания плаценты. Диагноз был поставлен на основании данных УЗИ и МРТ и подтвержден интраоперационно. При гистологическом исследовании выявлены истончение сегмента матки, фиброз и наличие спаек между маткой и мочевым пузырем. Цель исследования – сопоставление клинических, инструментальных данных, интраоперационной картины и данных гистологического исследования.

Материалы и методы. Гистологическое исследование проведено на парафиновых срезах (гематоксилин и эозин, окраска по Маллори). Иммуногистохимическое исследование цито- и синцитиотрофобласта осуществляли с применением антител к цитокератину-8.

Результаты. Данные МРТ и УЗИ показали инвазию ворсин плаценты, выходящую за пределы серозной оболочки матки и затрагивающую заднюю стенку мочевого пузыря. Плановое оперативное родоразрешение было выполнено на сроке 37 недель. Проведено хирургическое иссечение стенки матки с инвазированными ворсинами плаценты. Гистологическое исследование выявило инвазивные клетки цитотрофобласта в стенке матки и фиброз стенки мочевого пузыря. Прорастание и вовлечение стенки мочевого пузыря произошли за счет спаек и развития фиброза.

Заключение. Трофобласт и инвазия ворсин не распространялись за пределы матки. По нашему мнению, placenta percreta может быть одним из вариантов спаечной болезни органов малого таза.

Ключевые слова: кесарево сечение, рубец на матке, заживление стенки матки, спектр приросшей плаценты, placenta percreta, инвазия

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Introduction

The term “placenta accreta” was coined in the 20th century, when scientists F.C. Irving and A.F. Hertig defined it as “abnormal partial or complete attachment of the placenta to the wall of the uterus” [1]. Abnormal attachment and invasion of placenta villi manifest in their inability to separate from the wall of the uterus.

According to the FIGO (The International Federation of Gynecology and Obstetrics) classification, there are 3 major categories of placenta accreta spectrum (PAS) disorders according to the degree of invasiveness and local tissue destruction. Grade 1 is abnormally adherent placenta (pl. accreta) when villi adhere directly to the myometrium without the decidual interface. Grade 2 implies abnormally invasive placentation (pl. increta) when villi invade the myometrium. Grade 3 is abnormally invasive placentation (pl. percreta) when villi invade the full thickness of the uterine wall either to the serosa or beyond it. Grade 3 is subcategorized into grade 3a, where trophoblasts and placental villi are limited to and include the uterine serosa; grade 3b with placental invasion into the urinary bladder; and grade 3c, when placental villi invade other pelvic tissues [2]. PAS is a dangerous complication of pregnancy that is associated with a high risk of massive blood loss and increases maternal morbidity and mortality.

In recent years, the rate of PAS has grown significantly from 1 in 1,200 [3] through 1 in 250 to 1 in 500 worldwide [4–6]. Observational studies in the United States reported the rate of 1 to 272 in 2016 [7]. The most thoroughly studied and proven factor leading to an increased PAS incidence is the number of previous cesarean sections (CSs) [2]. “Risk factors for PAS were 3%, 11%, 40%, 61%, and 67% for the first, second, third, fourth, and fifth CSs, respectively” [5]. Uterine scar dehiscence represents an incomplete disruption of the uterine wall at the site of previous cesarean delivery and typically occurs within the anterior lower uterine segment overlying the bladder [8–12].

Risk factors for PAS include a patient’s history of multiple uterine surgeries (myomectomy, hysteroscopy, curettage), uterine artery embolization, placenta previa, PAS [10], and metabolic disorders [11–12]. These risk factors can initiate inflammation and lead to incomplete regeneration of damaged tissues in the future [4].

Case report

Patient O., 37 years old, was admitted to the Department of Perinatal Pregnancy at Vidnovsky Perinatal Center in 2022 to receive therapy for prolonging pregnancy. On admission, she was at 33 weeks and 2 days of gestation.

The pregnant woman gave her consent to participate in a biomedical study (in compliance with the Declaration of

Helsinki) and publish pictures and personal information in this case report. The research was approved by the Local Bioethics Committee (protocol No. 231 dated 28.08.2023).

Parity and history of present illness

The patient had 5 pregnancies in total. In 2007, the first healthy baby (a girl, 2,900 grams) was delivered after spontaneous labor at 38 weeks. In 2012, the second healthy baby (a boy, 2,690 grams) was born after urgent spontaneous delivery. In 2013, the patient delivered the third healthy baby (a boy, 4,200 grams) at 38 weeks. The patient underwent an emergency CS due to a narrow pelvis. In 2020, the woman had the fourth pregnancy complicated by severe preeclampsia. The patient underwent operative vaginal delivery at 35 weeks and gave birth to a healthy girl (2,600 grams).

The last pregnancy was natural. The woman had a singleton pregnancy complicated by. placenta previa. The fetus was in the cephalic position. Ultrasound examination showed the patient to have placenta villi invaded the uterine scar and the bladder wall after previous CSs. The uterine scar was unstable and accompanied by the formation of a uterine hernia-like prolapse.

The first trimester was uncomplicated. Ultrasound examination at 13 weeks and 6 days visualized chorionic villi position on the uterine scar niche. No markers of preeclampsia were identified. Ultrasound examination at 19 weeks and 6 days showed a 1.6-mm myometrium in the area of the uterine scar dehiscence and revealed placenta previa.

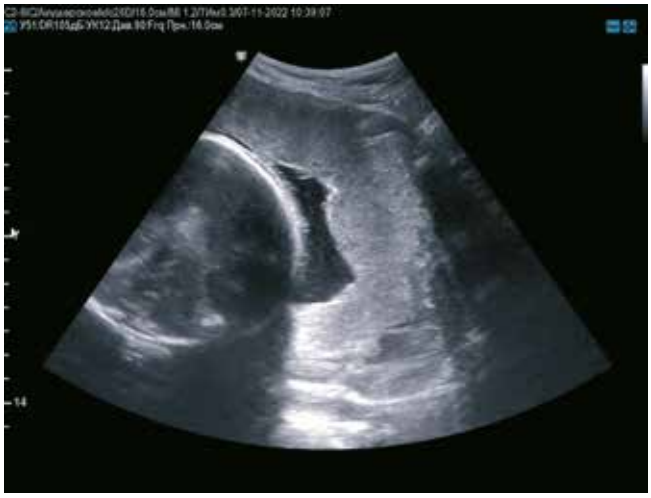
At 33 weeks, the patient was admitted to hospital because of elevated risk of premature labor. Having been hospitalized, the patient had an ultrasound examination and MRI done. Ultrasound examination was performed using a transabdominal and transvaginal device (MEDISON ACCUVIX A30-RUS 2014, Korea) and an ultrasound diagnostic device (Samsung-Medison WS80A-RUS 2019, Korea). The retroplacental myometrium was 158x133 mm large. Aberrant vessels penetrated the serosa of the bladder (Fig. 1). The placenta had diffuse thickening of up to 46 mm and was located along the anterior wall, its lower edge overlapping the area of the internal os. High risk of placental invasion into the bladder was detected.

MRI was performed with MAGNETOM Verio (Siemens AG, Erlangen, Germany) with the power of 3T clinical imaging and standard surface coils. Scanning was performed according to the routine protocol [13–14]. We received T2-weighted images obtained in three mutually perpendicular planes, a slice thickness being 3–4 mm and the field of view being 32–42 cm; T2-weighted images with signal suppression from adipose tissue in the axial plane; T1-weighted images in sagittal and axial planes; T1-weighted images with suppression of MR signal intensity from adipose tissue in any plane; and diffusion-weighted images. The results were interpreted with a unified scoring system MAPI-RADS (Morbidly Adherent Placenta Imaging Reporting and Data System) [15] (Fig. 2A–C).

Ultrasound examination and MRI detected changes associated with neoangio- and vasculogenesis including large retroplacental blood vessels in combination with local thinning of the uterine wall in its anterior area adjacent to the bladder and hernia-like protrusion of the uterine wall, or “uterine window” (Fig. 2A–C).

MRI revealed placenta percreta of class 5 (according to MAPI-RADS). Considering the depth of the placental invasion and the high risk of intraoperative massive blood loss,

A



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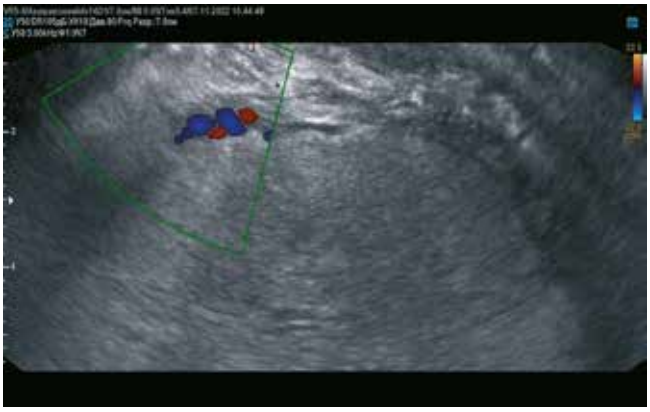

Fig. 1. Ultrasound signs of placenta percreta.
A – protrusion of the placenta beyond the uterine wall, absence of retroplacental myometrium, B – aberrant vessels located perpendicular to the wall of the bladder

Рис. 1. Ультразвуковые признаки placenta percreta.
А – распространение плаценты за стенку матки, отсутствие ретроплацентарного миометрия, В – аберрантные сосуды расположены перпендикулярно стенке мочевого пузыря

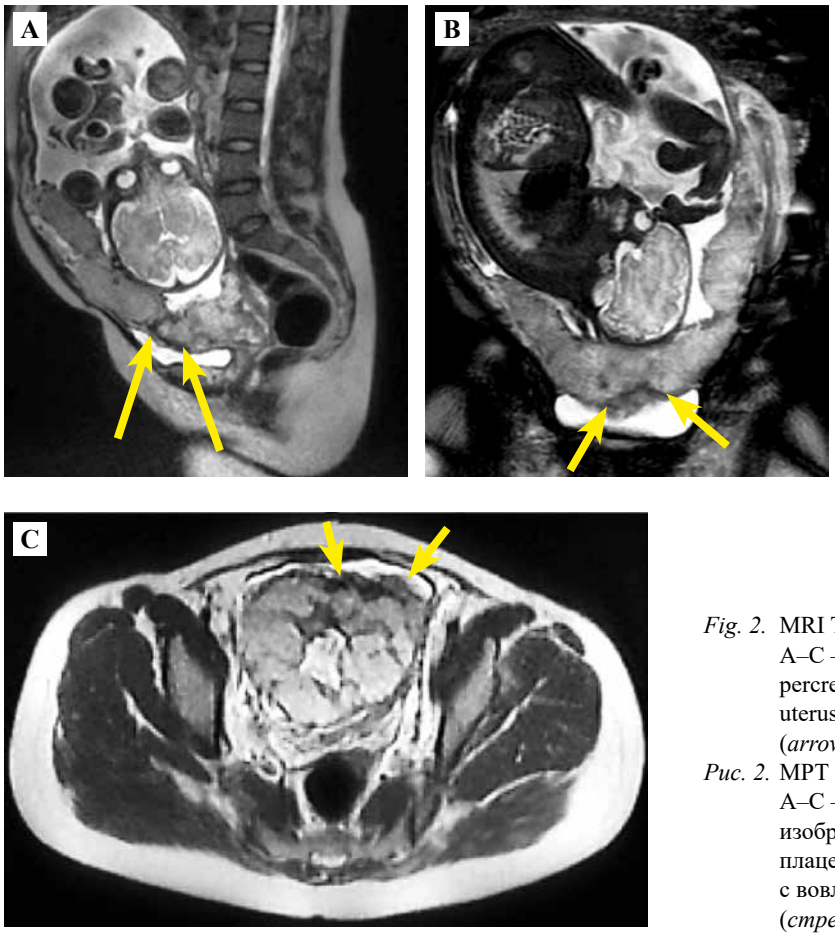

Fig. 2. MRI T2WI in the Cor, Sag, and Ax planes.
A–C – the zone of deep placenta increta. Placenta percreta spreads beyond the serous membrane of the uterus involving the posterior wall of the bladder (*arrows*)

Рис. 2. МРТ T2VI в плоскости Cor, Sag, Ax.
A–C – зона глубокого врастания плаценты. На МРТ изображении определяется распространение плаценты за пределы серозной оболочки матки с вовлечением задней стенки мочевого пузыря (*стрелки*)

a planned abdominal delivery was performed at 37 weeks of pregnancy using proprietary technique, which involves combining homeostatic tourniquets and a Zhukovsky double-balloon obstetric catheter (Fig. 3A–D) [16]. (Further description of the improved methodology of organ preserving operations was given in the article "A method of surgical delivery of patients with placenta ingrowth in the uterine scar" [16].)

A midline laparotomy and CS in the area of the uterine fundus were performed. A healthy full-term baby with the Apgar score of 7–8 points was removed from the uterine cavity (a boy; 3,890 g; 51 cm). There was no separation of the placenta. Both the uterus and the bladder were sewed up in two rows each with separate vicryl sutures. Intraoperative blood loss was 1,547 ml. The patient had two 1,000-ml doses of autoplasma transfused. Intraoperatively, 1,281 ml of blood were collected and 336 ml of autologous red blood cells were reinfused.

We did CS under epidural anesthesia with subsequent transition to endotracheal anesthesia at the stage of metroplasty. Midline laparotomy having been performed, a segment of the thinned myometrium was sent to the laboratory for further examination. Local prolapse of the uterine wall (200×200 mm) with a pronounced vascular network was visualized (Fig. 3 A, B). The first tourniquet was applied above the uterine hernia-like prolapse in the area of the trigone. The mobilization of the bladder was difficult due to placental invasion and severe tissue fibrosis. Below the uterine prolapse, the second uterine tourniquet was placed to grasp the bladder in the area of the trigone. The uterine hernia-like prolapse with an area of placental invasion was excised. Sixty millimeters of the posterior wall of the bladder were resected (Fig. 3 C). The postoperative period was uncomplicated and lasted 7 days.

The extracted placenta with myometrium fragments attached to it were sent for further examination (Fig. 3 D).

Gross examination

Without membranes and the umbilical cord, the placenta weighed 420 g and was 18×14×2.5 cm large. At the edge, where the myometrium was attached to the maternal surface of the placenta, it was 60×40 mm and its thickness varied from 15 mm to less than 1 mm at the serous uterine layer. Adjacent to the removed uterine wall, there was a grayish area similar to the mucous membrane of the bladder.

Histological examination

For histological examination, the samples of myometrium and placenta were fixed in 10% buffered formalin (#60-001/S, BioVitrum LLC, Russia). The samples were washed, dehydrated, and embedded in Histomix Extra

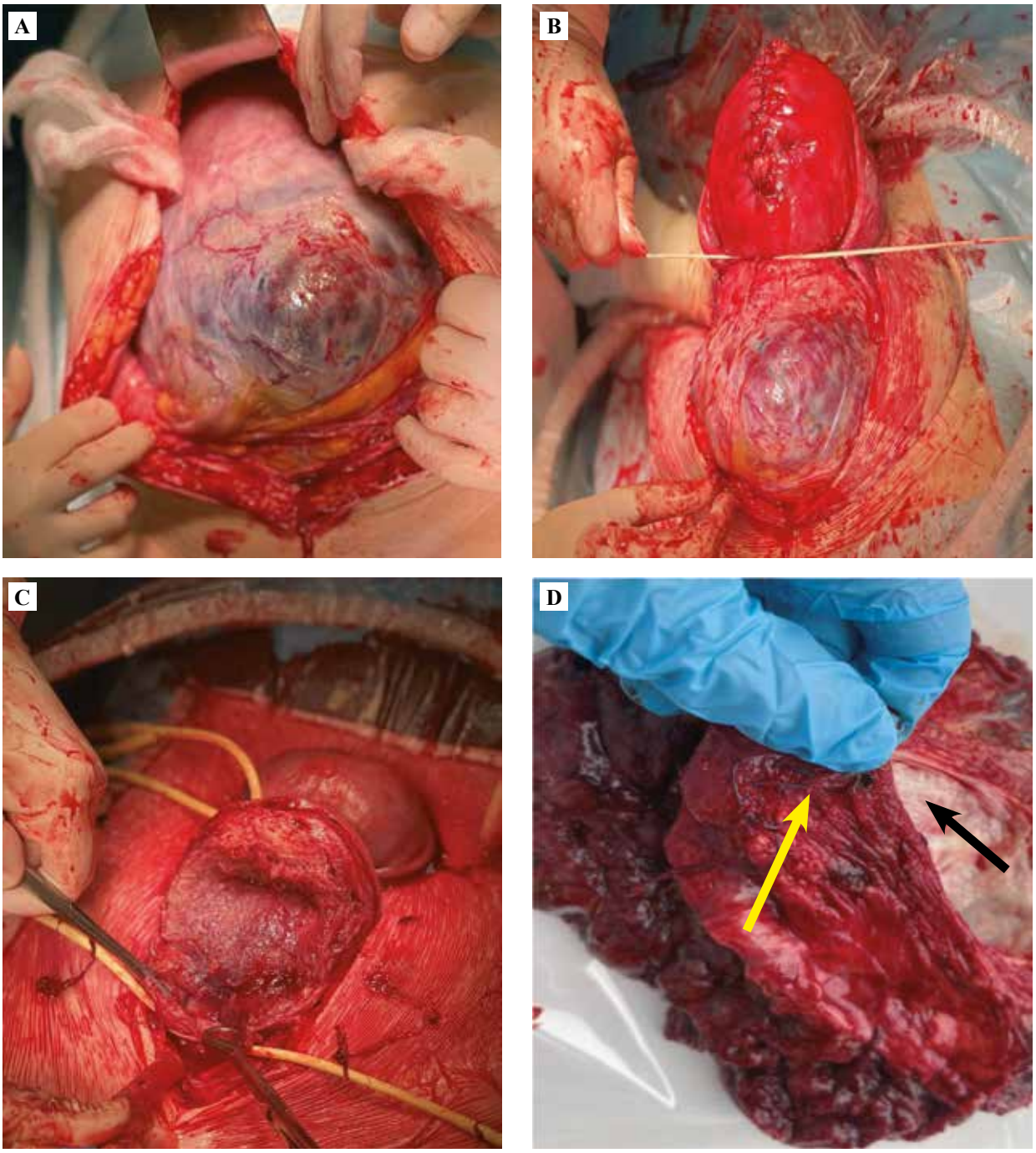

Fig. 3. Proprietary surgical technique for PAS. Intraoperative view.
A – intraoperative view of a hernia-like prolapse of the uterine wall. B – The first tourniquet was placed over the area of invaded placental villi into the uterine scar in the fundus area. C – the bladder was mobilized up to the border of the healthy tissue. The site of placental villi invaded into the myometrium was excised between two tourniquets, then bladder resection was performed. Note that there was no bleeding between tourniquets. D – maternal surface of the placenta with attached myometrium zone (placental villi invaded into the myometrium), as well as a resected area of the bladder (*yellow arrow* shows the posterior wall of the bladder; *black arrow* shows the mucous layer of the bladder)

Рис. 3. Авторская методика хирургического лечения PAS. Интраоперационный вид.
A – интраоперационный вид грыжеподобного выпячивания стенки матки. B – первый турникет наложен на область инвазии ворсин плаценты в рубец в области дна матки. C – мочевой пузырь мобилизован до границы здоровых тканей. Участок внедрения ворсин плаценты в миометрий иссечен между двумя наложенными турникетами; выполнена резекция мочевого пузыря. Обращает на себя внимание отсутствие между турникетами кровотечения.
D – материнская поверхность плаценты с прикрепленной зоной миометрия (ворсины плаценты внедряются в миометрий), резецированный участок мочевого пузыря (*желтая стрелка* указывает на заднюю стенку мочевого пузыря; *черная стрелка* указывает на слизистую оболочку мочевого пузыря)

paraffin (#10342, BioVitrum LLC, Russia) after 24 hours of fixation. The 4-μm thick paraffin slides were prepared with a rotary microtome (Sakura, Japan), deparaffinized and rehydrated in a graded ethanol series, washed in water, and stained with hematoxylin and eosin (#07-006, BioVitrum LLC, Russia) and Mallory trichrome kit (#21-036, BioVitrum LLC, Russia). Then they were dehydrated and placed in Vitrogel (#12-005, BioVitrum LLC, Russia) for further microscopic examination.

Immunohistochemical study

The sections from the paraffin blocks were mounted on lysine-coated glass slides (Menzel-Gläser Polysine®, Thermo Scientific, USA) and rehydrated. Then they underwent heat-induced antigen retrieval in citrate solution (pH 6.0) and were blocked (1h at RT in 10% goat serum + 0.1% Tween-20 in Tris-buffered saline) and incubated overnight at 4ºC with primary antibodies specifically interacting with the antigen on the section. Finally, they were washed with a phosphate buffer. We found the products of interaction of primary antibodies with the antigen using the horseradish peroxidase conjugate specifically bound to secondary anti-species antibodies. We used Novolink™ Polymer Reagent Kit (Leica Biosystems, Germany) to detect bound primary antibodies (#RE7150, Leica, UK), counter-staining with Mayer's hematoxylin solution (BioVitrum LLC, Russia, article No. 05-002/S), dehydration in a graded ethanol series, and mounting with Vitrogel (BioVitrum LLC, Russia, article No. 05-002/S). An aqueous solution of 3.3-diaminobenzidine tetrahydrochloride was used to stain the product of immunohistochemical reactions.

To detect epithelial cells, we carried out an immunohistochemical study with primary mouse monoclonal antibody to cytokeratin 8 (cat# DB098-RTU, DB Biotech, Košice, Slovakia). The presence of brown staining cells indicated positive immunohistochemical reaction. To check for negative immunohistochemical reaction, the sections were subjected to standard immunohistochemical procedure without being incubated with primary antibodies. We performed microscopic examination using the Leica microscope system which consists of Leica DM2500 microscope, Leica DFC290 video camera image microscopy, analysis software, and Image Scope M (Leica, Germany).

On histological examination, we determined that the lower uterine segment was thinned to the serous coat of the uterus and had invaded villi and an uneven layer of borderline fibrinoid. In the decidual lamina, there were vast deposits of fibrinoid and few decidual cells (Fig. 4). In the myometrium of uteroplacental area, we found multiple villi with dystrophic changes, including the loss of basophilia of nuclei coated in fibrinoid ("villi – shadows"), with cytotrophoblast remnants (Fig. 4–5). Mature intermediate villi dominated in the villous tree and corresponded to the gestational age.

We revealed a moderate local lymphoid infiltration and vasculitis (signs of chronic cystitis) in the bladder wall and observed small foci of squamous metaplasia in the transitional epithelium. We also detected separate muscle bundles, edematous serous membrane with local microvascular thrombosis and/or adjacent retroplacental hematoma zone, and a large retrochorial hematoma reaching the serous uterine membrane (Fig. 4–5).

On immunohistochemical examination with primary antibody to cytokeratin-8, we detected invasive cytotropoblast cells in the uterine wall located up to the subserosal layer, including those reaching the adventitia of the walls of subserosal vessels (Fig. 5 A, B), as well as multinucleated giant cells (Fig. 5 C). Multinucleated giant cells are known to be associated with invasion cessation because in normal pregnancy, they are located at the border of invasion [17].

We also found large deposits of fibrinoid in the uteroplacental region. The fibrinoid is known to be a combined product of coagulation of plasma proteins and trophoblastic secretion [18]. We detected an increased amount of fibrinoid, multiple hemorrhages, and damaged areas in the uteroplacental region, which significantly damaged the normal structure of the myometrium [19]. In addition, multiple placental villi were found to be covered with fetal fibrinoid, and trophoblast cells were CK+. Trophoblast cells were the only ones to survive in the uterine wall.

Discussion

The obtained results question how invasive placentation should be interpreted according to the latest FIGO classification. Ultrasound and intraoperative data have shown close interactions between the wall of the uterus and the bladder. Histological examination did not confirm the presence of trophoblast cells and placental villi in the bladder wall or the parametrium, but showed fibrosis of the wall. We assume that it is not placenta percreta but it is the formation of adhesions between the uterine wall and the bladder. The wall of the bladder was attached to the wall of the uterus with connective tissue that has proliferated, which may be considered a form of pelvic adhesive disease. The structures smaller than 1 mm are thought to be visualized on weekly ultrasound examination and MRI. Visual examination methods are not likely to determine the thinned layer of the myometrium, and a false impression is created that the placental villi extend beyond the uterine wall. Should these lesions be classified as a controversial form of placenta percreta? Or should this form be left as a clinical one for diagnosis using instrumental methods (ultrasound and MRI) in order to assess surgical complexity and the risks of bleeding? Ultrasound and MRI data allow one to evaluate not only the depth of placental invasion into the myometrium, but also how much blood vessels of the uteroplacental area and the pelvis are involved and adhesions and collaterals between organs form. The operation with two tourniquets and Zhukovsky double-balloon obstetric catheter may be used at different depths of placental invasion.

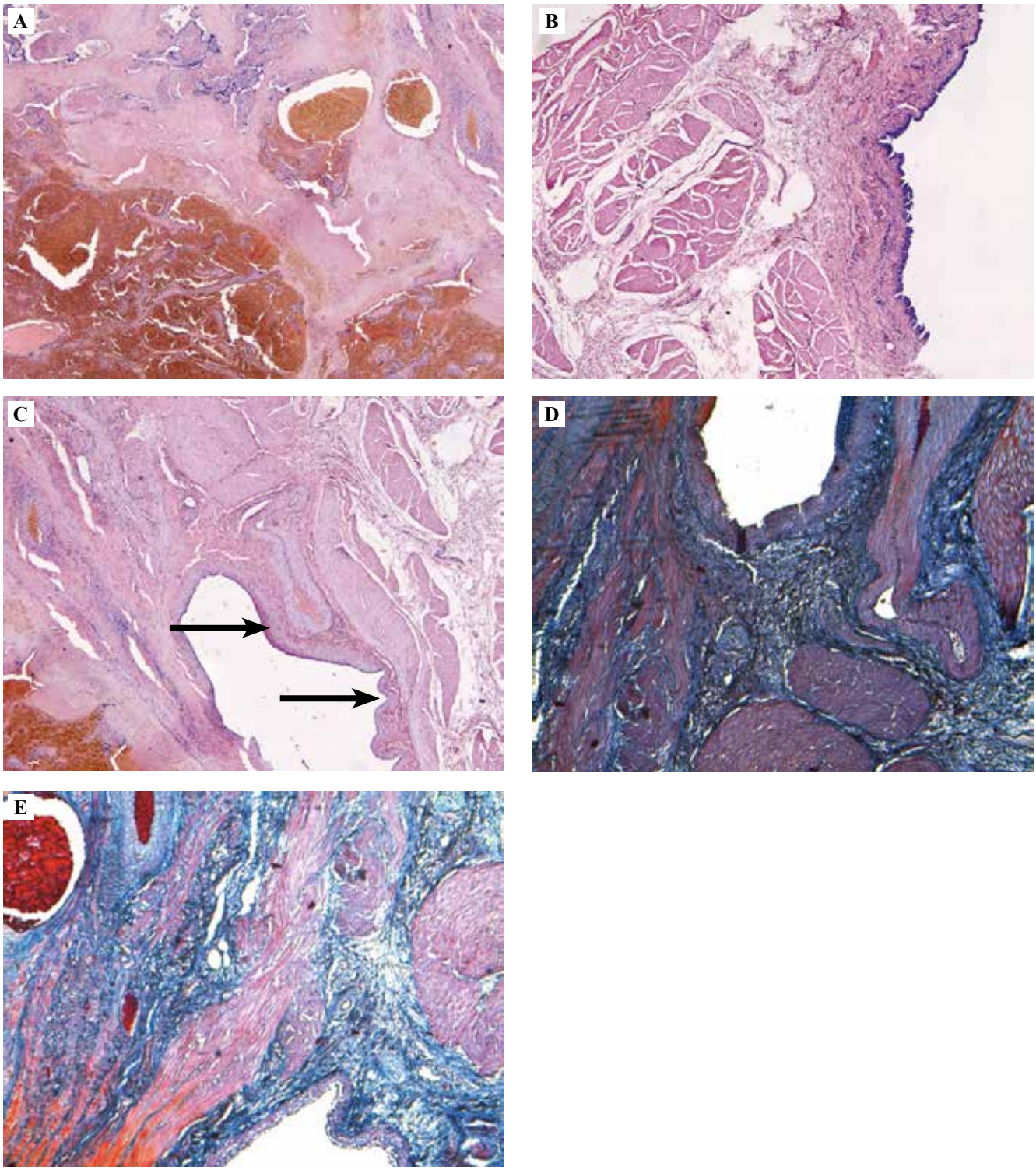

Fig. 4. Histological examination of the uteroplacental region.
A – uteroplacental region with the attached bladder wall, B – The mucous membrane of the bladder is lined with transitional epithelium, C – the lumen of the vessel (*arrows*). D, E – the area where the bladder wall attaches to the thinned uteroplacental segment; the area of fibrosis is visible. A–C – H&E stain, ×50. D, E – Mallory staining: smooth muscle cells (purple), connective tissue (blue), ×50

Рис. 4. Гистологическое исследование маточно-плацентарной области.
А – маточно-плацентарная область с прикрепленной стенкой мочевого пузыря, В – слизистая оболочка мочевого пузыря выстлана эпителием переходного типа, С – просвет сосуда отмечен *стрелками*. D, E – область прикрепления стенки мочевого пузыря к истонченному маточно-плацентарному сегменту, виден участок фиброза. А–С – окраска гематоксилином и эозином, ×50. D, E – окраска по Маллори: гладкомышечные клетки были фиолетовыми, соединительная ткань – синей, ×50

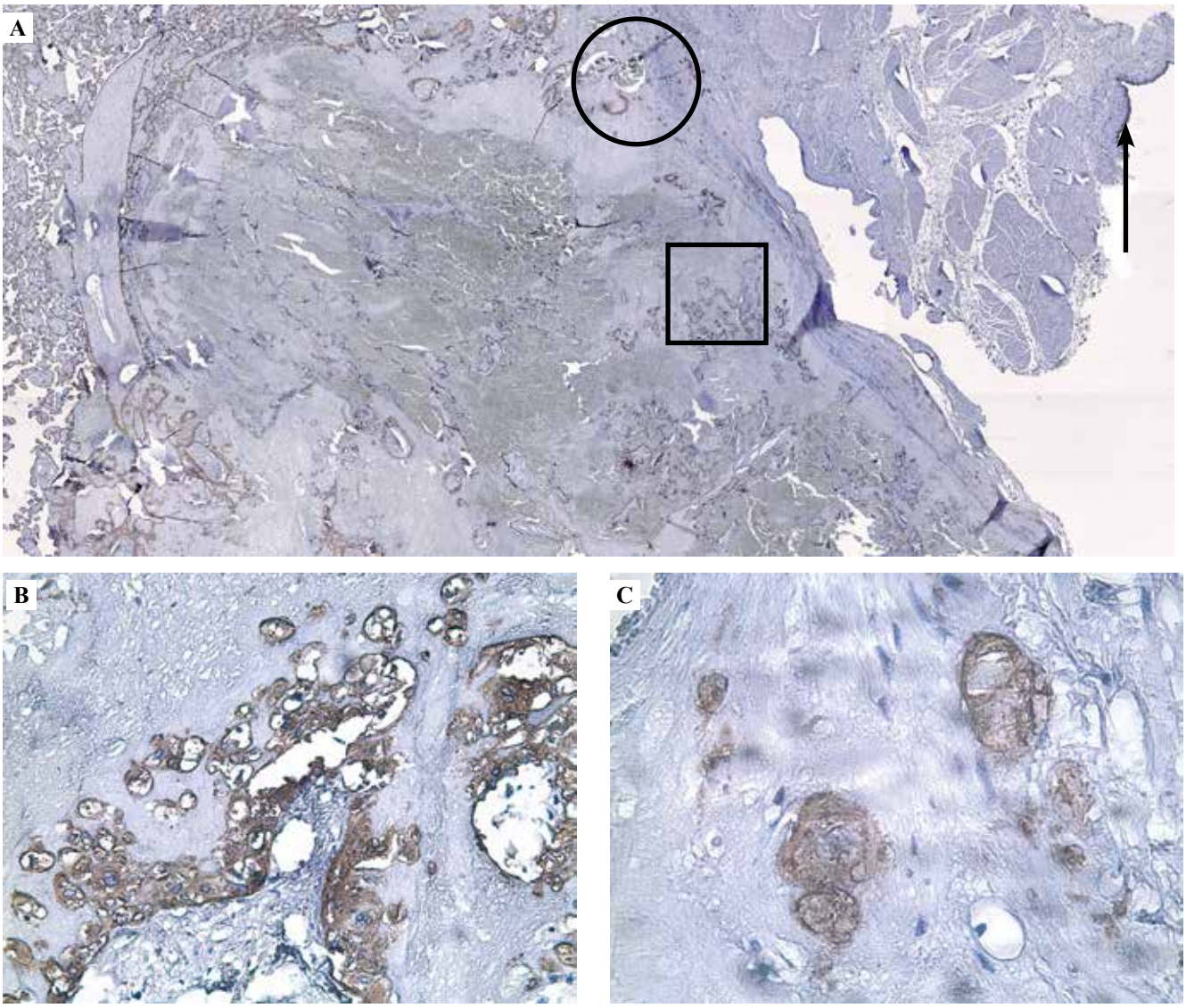

Fig. 5. Immunohistochemical staining with primary antibodies to cytokeratin-8 (CK8).
A – uteroplacental region with the attached bladder wall. Invasive trophoblast at the border between the uterus and the bladder (*arrow*, brown), ×50. B – preserved placental villi and trophoblast cells in a fibrinoid in the uterine wall (brown staining), (the area in the square in Fig. A), ×200. C – CK8+ trophoblast cells and multinucleated cells in the vascular wall of the myometrium, (the area in the circle in Fig. A), ×400

Рис. 5. Иммуногистохимическое окрашивание с использованием первичных антител к цитокератину-8 (CK8)
A – маточно-плацентарная область с вовлеченной задней стенкой мочевого пузыря. Инвазивный трофобласт на границе матки и мочевого пузыря (отмечен *стрелкой*; окрашен в коричневый цвет), ×50. B – сохранившиеся ворсины плаценты и клетки трофобласта, замурованные в фибриноид, в стенке матки (коричневое окрашивание) (отмечено квадратом на рис. A), ×200; C – клетки трофобласта CK8+ и многоядерные клетки в стенке сосуда (отмечено кругом на рис. A), ×400

Conclusion

Pathologists should use an integrated approach taking into account the findings of visual diagnostic methods (ultrasound and MRI), intraoperative view, and histological data. This case report showed a new comprehensive approach to morphological verification of PAS. Such clinical cases should be thoroughly analyzed to be considered in the future when making amendments to the FIGO classification.

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