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Should the visceral peritoneum at the bladder flap closed at cesarean sections? A post-partum sonographic and clinical assessment

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Abstract

Objective. To compare cesarean section (CS) using open or closed visceral peritoneum of the bladder flap (BF) in relation to fluid collection in vesico-uterine space (VUS) by ultrasound (US) and clinical outcome.

Material and methods. A prospective cohort of repeat CS in 474 in advanced first and second stage of labor was studied. All women underwent a Misgav Ladach CS, in local combined anesthesia. These were divided into two groups by surgical management of the BF at the time of CS: Group I ($n = 262$), with visceral peritoneum left open and Group II ($n = 212$), with visceral peritoneum closed. An US check for the fluid collections in the VUS was done in the third post-operative day. The two groups were also clinically compared for: intra-operative estimated blood loss, the need for post-CS pain killers, febrile morbidity and duration of hospital stay.

Results. Visceral peritoneum (VP) closure resulted in a significant increase blood collections in the VUS ($p < 0.05$). VP closure resulted in a significantly higher morbidity in all the following parameters. Rate of BFHs, post-operative fever, need for post-operative analgesia, require antibiotic administration and prolonged hospitalisation ($p < 0.05$).

Conclusions. VP suturing of women requiring CS for dystocia is associated to increased rate of blood collection in the VUS, which could possibly explain the higher rate of puerperal complications in these patients. These data clearly indicate that suturing the VP of the BF in women undergoing CS for dystocia is contraindicated. This data could be probably extrapolated to all cesarean deliveries.

Keywords: *Cesarean section, vesico-uterine space, bladder flap, ultrasonography, dystocia, hematoma*

Introduction

Cesarean section (CS) is the most frequently performed intra-peritoneal surgical operation world-wide. The vesico-uterine space (VUS) is the most frequent sub-peritoneal or extra-peritoneal area surgically encountered in obstetric and gynecologic surgery [1].

The VUS is an anatomical virtual space between the anterior uterine wall, posterior bladder wall and laterally, the vesico-uterine ligaments and the lateral ligaments of the bladder, and continuing with broad ligament space and sub-peritoneal pelvic space; the VUS is reported in International Anatomic Nomenclature as number A 10 102 504, also called 'excavatio vesico-uterina' [2]. It lacks importance to anatomists. In contrast the increasing CS rates and the debate on its management in both CS and gynecological surgery kept the VUS in as an area of interest to the Ob/Gyn surgeon.

In generally, the VUS can be easily dissected and sutured during surgical management of bladder flap (BF) in primary CS, because it is composed by sub-mucosal tissue, with few vessels. In contrast, in the

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repeat CS, the post-CS adhesions and the submesothelial fibrosis modify the VUS, so the surgical management of BF is more difficult and can be complicated.

A CS can be performed by either suturing or not suturing of the visceral peritoneum. This surgical decision evokes specific anatomical changes of the puerperal VUS, and result in different complications and complication rate based on this surgical decision [3].

In the CS performed without visceral peritoneum (VP) suturing, the VUS communicates with the large peritoneal cavity; thus, any spillage of fluid generated at the incision site during a CS the fluid will accumulate within the large peritoneal cavity, before the spontaneous restoring of the peritoneum in early puerperium [4].

In contrast, when VP is sutured, any retroperitoneal fluid generated in the BF does not drain into the peritoneum and may result in a bladder flap hematoma (BFH) or abscess, and if extensive, possibly, to post-CS broad-ligament edema, hematomas or abscesses [5].

In this prospective but non-randomised, series, we evaluated the effect of peritoneal closure on non-closure on the ultrasound images post-CS of BF, the uterine incision site and VUS. We also compared the clinical outcome of patients in these two groups and related it to the ultrasonic findings.

Material and methods

The study was performed in the Obstetric and Gynecologic Departments either of Santa Maria Hospital of Bari, Italy or of Vito Fazzi Hospital of Lecce, Italy on 474 women, who underwent a primary CS using the Misgav–Ladach technique, during 2004–2008.

Of 512 eligible patients, only 474 were enrolled after giving their informed and written consent to the study. The study was approved by institutional local ethics committees.

The including criteria for the study were healthy primipara at term with low-risk pregnancies. The indications for CS included: CS for macrosomia (>4500 g) at term, dystocia of labor in the first stage (cervical dilatation >5 cm) of labor and at second stage of labor.

The obstetric evaluation of dystocia was performed by both a midwife and seasoned obstetrician (with experience of >10 years). It was assisted pelvic score and intrapartum US.

The exclusion criteria were as follows: general and genitourinary infection sin labor, coagulopathies, anticoagulation treatment, hypertension and HELLP Syndrome and women with more than 36 h of rupture of membranes (to reduce the risk of chorioamnionitis).

Patients undergoing low transverse CS were subdivided by surgeons in to two groups. Group I included 262 cases of open visceral (not sutured) peritoneum. Group II included 212 women whose VP was closed (sutured)

The choice to assigning women to one group or the other was left to the choice of each surgeon. The surgery was otherwise performed with identical technique, in the same operating room with the same staff providing operative and post-operative care. Note that the surgery was performed by the same group of relatively experienced residents.

The surgeons followed the surgical steps of the standard Misgav–Ladach CS technique, using only a blood aspirator for intra-operative blood loss (measuring in ml). This technique includes the following steps:

Joel–Cohen laparotomic incision was performed by a superficial transverse cut in the cutis, about 3 cm below an imaginary line drawing between the iliac anterior-superior spines, cutting only through cutis. A small transverse opening was made in the fascia with the tip of a scalpel, and then, the fascia was opened transversely underneath the fat tissue and blood vessels by pushing the slightly open tip of a pair of straight scissor, first in one direction, and then in the other.

The fascia was then stretched caudally and cranially using the index fingers to make room for the next step, as the surgeon and his assistant each inserted their index and third fingers under the muscles, and stretch the muscles, blood vessels and the fat tissue by manual bilateral traction.

In general, in labor complicated by dystocia (in either advanced first stage or second stage of labor), free fluid is usually present on VUS. This fluid was aspirated, before the BF incision. The parietal peritoneum was opened transversely, using only both index fingers, to avoid the bladder that could be shifted upon its anatomical site.

The VP around the vesicouterine peritoneal serosa fold was lifted using an anatomical forceps. Using a scalpel, a small midline incision was performed, and the VP was opened initially by the tip of the scalpel and then, using both indexes, was stretched it in a lateral–lateral directions, till to detach it transversally by the uterine surface, opening the VUS.

The surgeons pushed down the BF by fingers or by using Doyen valves instead of auto-static divaricators, to discover the VUS, on the average for 4 cm laterally and 3 cm down.

The surgeon performed a minimal transversal incision (on the average of two cm) of the superior part of the low uterine segment (LUS) that, generally, quite thin in the presence of dystocia.

Then the surgeons stretched the LUS in a lateral–lateral directions softly, to avoid its lacerations, stopping before lateral uterine vessels.

During all these surgical manoeuvres, we always avoided the use of sponges in abdomen, as they are abrasive for the peritoneal surface and they could increase the risk of future adhesion development.

The obstetrician extracted the fetus and, after a spontaneous placental removal, the surgeon exteriorised the uterus and sutured the myometrium of LUS in single continuous simple layer, using absorbable stitches of Vicryl 0 (Polyglactin 910, violet color, 0, 35 pH Eur – M0 – 4 – 36.4 mm – ½ C, round needle, 70 cm, Ethicon, USA).

In both groups, the surgeons checked meticulously the hemostasis of the BF, during and after the suturing of the myometrium of the LUS.

In the first group of patients, the VP was not sutured, while in the Group II the VP was sutured in continues simple intra-folding suture, using Vicryl 00 (Polyglactin 910, violet color 30, 2 pH Eur – SH – 1 plus – 21.8 mm – ½ C, round needle, 70 cm, Ethicon, USA) and anatomical forceps, after an accurate hemostasis too.

The hemostasis on hysterorraphy was always performed by single Vicryl 00 stitches.

After the hysterorraphy, the uterus was replaced in abdomen and all fluid was suctioned by aspirator. In all the patients, the parietal peritoneum was always closed by Vicryl 000.

Finally, the abdominal wall was closed by suturing fascia, without abdominal muscles suturing and the skin was closed with two or three mattress sutures and the space in between was apposed with non-traumatic forceps for 5 minutes.

All women got a prophylactic antibiotic dosage of Cefazoline 2 g I.V. had a combined spinal-epidural anesthesia (CSE) in the following scheme.

Before the execution of anesthesia, the anesthesiologists infused 500 ml of a plasma expander and a previous administration of 5 mg of ephedrine.

The CSE was executed at the L1-L2 intervertebral space, administering in spinal anesthesia 5 mg of levobupivacaine with 5 μg of sufentanil, and in peridural anesthesia 10–12 ml of 0.25% of levobupivacaine according to the patient's height.

All patients were checked for the following parameters: intrasurgical blood loss, febrile morbidity, the need for post-CS pain killers, ultrasonographic (US) evaluation of BF, duration of hospital stay and US examination for: BF, uterine incision site and fluid collections in the VUS in the third postoperative day; the choice to perform such exams in that day, comes from the necessity to decrease the patient discomfort and to detect the fluid collections presence, not immediately absorbed after surgical operation.

The puerperal febrile morbidity was defined as a temperature of 38°C or higher occurring on any 2 of the first 7 days postpartum; so, all patients were checked to exclude the puerperal fever, monitoring and recording the daily temperature during hospitalisation and at home.

The US collection patterns in open and closed VP CS and in the VUS were targeted in the following way: an oval symmetric region of distinct echogenicity between the LUS and posterior bladder wall in uterine incision site, <1.5 cm of diameter (uterine incision site); an hypoechoic symmetric/asymmetric area, generally asymptomatic, with indistinct limits almost rounded, present in or adjacent to the uterine incision site, between 2 and 3.5 cm of diameter of size, also called sub acute BFH; a fluid-filled collections, often symptomatic, contained scattered low-level internal echoes (or hypoechoic images, caused the blood prevalence) of ≥ 3.5 cm of diameter, called BFH [6].

All these US parameters are described in Table I. The clinicians, blinded to the surgical groups, checked all the asymptomatic BFH by US after 30, 60, 90 and 120 days, while the symptomatic BFH with fever, abdominal pain and dysuria, were checked by US and clinical findings till to recovery.

All the US examinations were performed by a Toshiba Aplio Instruments and GE Voluson 730 Instruments, with 3.5–5 Mhz trans-abdominal and trans-vaginal probes in all the patients.

Table I. The bladder flap, uterine incision and suturing site, bladder flap hematoma ultrasound findings in post-CS open and closed visceral peritoneum [6].

Bladder flap measure	US pattern	Clinical findings
<1.5 cm of diameter (uterine incision and suturing site)	An oval symmetric region of distinct echogenicity between the LUS and posterior bladder wall in uterine incision site	Normal
2–3.5 cm of diameter (called sub-acute bladder flap hematoma or sub-acute BHF)	An ipoechoic area with indistinct limits almost rounded, present in or adjacent to the uterine incision and distinct from the normal incision site	Asymptomatic
≥ 3.5 cm of diameter (called BHF)	Fluid-filled collections contained scattered low-level internal echoes	Symptomatic

The results were analysed using SAS software (version 8); differences in parameters between the two groups were analyzed using the Student *t*-test for continuous variables and chi-square tests for nominal variables, considering the actual *p*-value as significant (<0.05), with dates presented as mean $\pm$ standard deviation or median range.

Results

The demographic characteristics of the two groups of women were similar, as reported in Table II.

The instrumental and clinical follow-up detected a significant difference between the two groups, connected with clinicians caring for patients post-operatively and US signs of fluid collection development on VUS, detected in the Group II.

In the first group with open visceral peritoneum, US monitoring of the 474 women showed 8 (3%) asymptomatic BFH (of 2–3.5 cm of diameter), probably for the interposition of the omentum between the flaps of the VUS and 114 in the group II, with suturing of VP (53.7%), while there were not symptomatic BFH in the Group I, while 14 were seen in the Group II ($p < 0.0001$).

The intra-surgical blood loss was 219 ml in the Group I vs. 243 ml of the Group II ($p < 0.01$), and the intraoperative LUS lacerations were 12 in the Group I vs. 10 in the Group II without statistical difference. The instrumental and clinical outcome was worsen in the first week in the Group II with VP suturing, as the post-CS fever was only in five cases of the first group vs. 33 patients of the second group, so as analgesic administration (16 of Group I vs. 46 of Group II), antibiotic administration (8 of Group I vs. 33 of the Group II, by large spectrum treatment) and duration of hospital stay (3 days vs. 5 days of the second group). These dates are represented in Table III. The patient US with asymptomatic BFH at US were: 5 in the Group 1 (62.5%) and 72 in the Group II (63.1%), without statistical differences; the time need for the BFH disappearance was 59 ± 6.1 days for the open peritoneum group and 90 ± 14.1 days for the second group, with statistical difference ($p < 0.01$) (Table IV). About the 14 patients of the Group II with symptomatic BFH at the US and clinical monitoring, seven of these were treated by laparoscopy for fever, abdominal pain and dysuria, on average, after 60 days of large spectrum antibiotic treatment, five were successfully treated by antibiotics and two patients missed from follow up.

The laparoscopic treatment was performed in the following way: by a transversal incision of 2 cm with bipolar forceps, the surgeons cut the peritoneum and decollated the bladder wall from the BFH, than, once exposed the cavity surface of BFH, they washed it by povidone-iodine solution and performed biopsies, suturing up the peritoneum. At the end of the procedure, a catheter was placed inside the pelvis for drainage in three women; the total operative laparoscopic time was of 39 ± 4.2 min, with a short blood loss (<40 ml), no postoperative complications and regular dismissal in the 24 h after laparoscopy.

Table II. The homogeneous demographic characteristics of 474 post-CS patients, subdivided in two groups by open and closed visceral peritoneum.

	262 CS by open visceral peritoneum (Group I)	212 CS by closed visceral peritoneum (Group II)	*p*-value
Age, year ($\pm$SD)	27.8 ± 4.1	28.2 ± 3.1	NS*
Parity ($\pm$SD)	0.4 ± 0.2	0.5 ± 0.1	NS*
BMI ($\pm$SD)	24.1 ± 1.8	23.9 ± 1.7	NS*

*NS, not significative.

Discussion

The authors report a significantly higher rate of BFHs, post-operative fever, need for post-operative analgesia, post-operative febrile morbidity, require

Table III. The instrumental and clinical follow up of 474 women to monitor the post-CS outcome in the first week.

	262 CS by open visceral peritoneum (Group I)	212 CS by closed visceral peritoneum (Group II)	*p*-value
Asymptomatic BFH (2–3.5 cm) in LUS	8 (3%)	114 (53.7%)	0.0001
Symptomatic BFH ($\geq$3.5 cm) in LUS	0	14 (6.6%)	0.0001
Intra-surgical blood loss (ml $\pm$ SD)	219 ± 40.1	243 ± 37.2	>0.01
Intra-operative LUS lacerations	12 (4.58%)	10 (4.71%)	NS*
Post-CS fever (no. of patient with fever $\pm$ SD)	5 ± 2.4	33 ± 13.8	<0.01
Analgesic administration (no. of patient $\pm$ SD)	16 ± 9.1	46 ± 14.2	<0.01
Antibiotics administration (no of patient $\pm$ SD)	8 ± 3.9	33 ± 13.8	<0.01
Duration of hospital stay (no. of days $\pm$ SD)	3 ± 0.9	5 ± 2.6	<0.01

*NS, not significative.

Table IV. The US long term follow up of the patients with asymptomatic BFH, to monitor the post-CS outcome.

	8 by open visceral peritoneum (Group I)	114 CS by closed visceral peritoneum (Group II)	*p*-value
Patients in follow up	5 (62.5%)	72 (63.1%)	NS*
Time need for the disappearance of asymptomatic BFH (days ± SD)	59 ± 6.1	90 ± 14.1	*< 0.01*

*NS, not significative.

antibiotic administration and prolonged hospitalisation in Group II, by serosal repair, compared to Group I, by not suturing of it.

The possible explication of these findings become by a anatomical description of the VUS, a virtual space already described in gynecology [6], few detailed in obstetric, well-studied in oncological gynecology, as it is sub-divided in an upper (vesico-uterine space) and lower area (vesico-vaginal space) [7].

The upper area, laterally, continues into sub-peritoneal space of broad ligament; the lower part of the VUS, after surgical opening of the vesico-uterine septum during radical hysterectomy, is composed by vesico-cervical and vesico-vaginal spaces [8], and the lateral borders of VUS confine with the lower part of the broad ligaments, called also lateral parametrium [7]; Katahira et al. [9] saw, in radical hysterectomy, that the vesico-uterine ligament detected in the upper part of VUS is rich of ganglion cells that turn in the bladder [9].

To well understand the clinical implications of the study results, it is mandatory to understand the anatomy and the puerperal modification of the VUS, as it is connected to a LUS development in pregnancy and cervical ripening and dilatation during labor, delivery and cervical remodelling in puerperium; when the cervix is proximal to the complete dilatation on the advanced first stage and at the end of the second stage of labor, the VUS is short and laterally extended, and it is undistinguishing the upper and lower part of the VUS.

Generally, the VUS is opened during CS by the BF formation, before the hysterotomy and the anatomy of the intra-pelvic fasciae [8], especially of the VUS ligaments, changes in pregnancy, particularly in advanced first stage or in prolonged second stage of labor.

It is recommended for obstetrics to distinguish the VUS during CS, because most of injuries to the nerves occur during the VUS modifications in the arrest of labor, and this nervous damage could evoke puerperal urinary symptoms such as dysuria by the LUS modifying, the bladder is physiologically in extra pelvic positioning during labour, covering the LUS and during the advanced stage of labour, the bladder fold coincides to the limit between the upper uterine segment and the LUS.

By these evidences appear that few authors had interest on the problem of the possible complications of the BF at uterine incision site and the fluid collection development in VUS, after a CS by suturing or not of visceral peritoneum, in term of puerperal morbidity, in fact the process of uterine scar remodelling was poorly investigated in literature, a part a research of Hamar et al. [11] on the uterine scar thickness.

In the post-CS uterus, the incision and detachment of bladder by uterus modifies the VUS and leads to a space (or a pocket) between the anterior uterine wall and posterior bladder wall, called BF or *open pocket* VP (Figure 1) [12].

By an examination of the literature, Stark [13] affirms that the closuring of VP possibly leads to a pocket formation on the VUS, with a subsequent hematoma formation, while Nagele et al. [14] report that the higher rate of clinically asymptomatic febrile cases in the closed parietal peritoneum, probably due to the formation of sub-peritoneal pockets resulting from the suture, and these pockets could fill with blood and wound secretions from the uterine incision and serve as nutrient media for bacteria.

Woo et al. [15] investigated the pelvis after CS and vaginal delivery by MRI and found that a BF adjacent to the low transverse uterine suture is formed by suture of the loose reflection of the peritoneum (serosa) that covers the uterus; Maldjan et al. [16] evaluated these collections by MRI in uterine incision sites, demonstrating findings consistent with asymptomatic and sub-acute hematoma, as a usual finding in post-CS women by closed visceral peritoneum.

On the contrary, the VP suturing in CS leads to a *closed pocket* VP (Figure 2), site of allocation of fluid collections, in literature called BFH [17–21].

Microscopically, the BFH contains: fibrin, clots, essudate, tissue reaction or oedema, serous fluids or partial wound separation [18] and, sometimes, bacteria climbed from vagina; in this pocket, these elements could evoke a pseudo-inflammatory phenomenon that could lead to abscess [5,20].

These evidences result that this pocket could fill with blood and wound secretions from the uterine incisions and serve as nutrient media for bacteria, with a possible post-CS fever development.

The objective of this investigation was to evaluate the post-cesarean fluid collections, by US, in the area of the BF in a group of women in whom the BF was

managed differently at the time of surgery, showing which methods evoked complications.

Statistical evaluation confirmed the serosal repair during CS with significantly higher rate of BFHs, need for post-operative analgesia, post-operative febrile morbidity and prolonged hospitalisation; moreover, the authors showed that the US evaluation in post-CS instrumental management can be a safe, cheapest and repeatable non-invasive method to study the uterine incision site, the BF and the BFH, and the literature on is rich of reports.

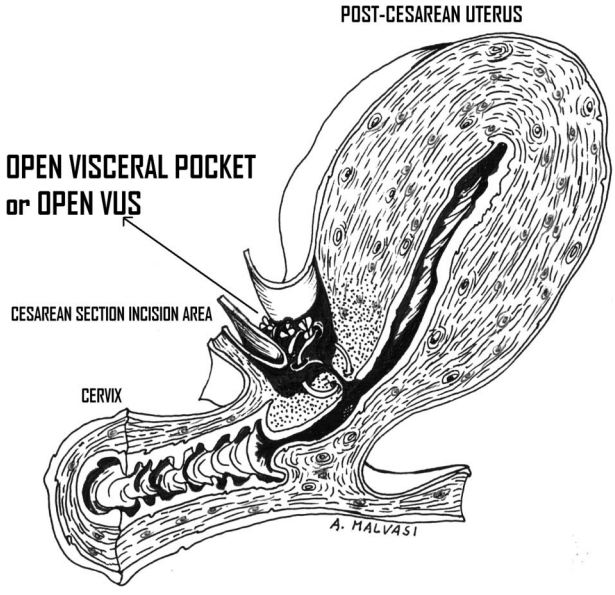

Figure 1. Sagittal section of puerperal post-CS uterus in third post-operative days by non-suturing of VP (or open BF or open VUS).

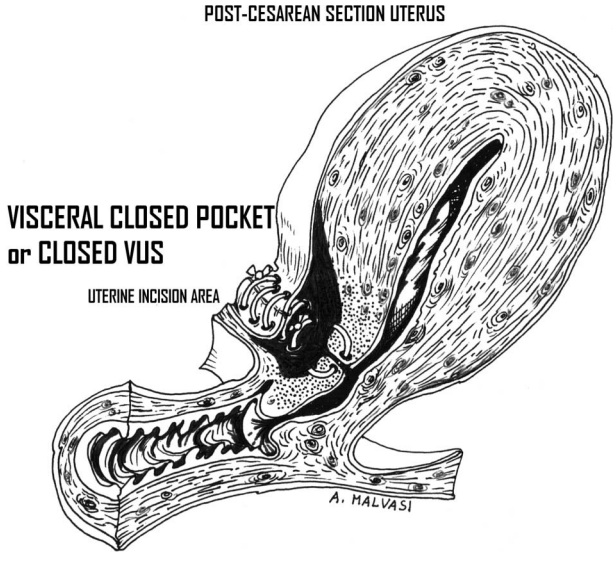

Figure 2. Sagittal section of puerperal post-CS uterus in third post-operative days by suturing of VP (or closed BF or closed VUS).

The post-CS fluid collections in the VUS and in the incision site zone were distinguished in three echo-patterns: normally, Beker et al. [18] described an oval symmetric region of distinct echogenicity between the uterus and posterior bladder wall in uterine incision site.

Also Koutsougeras et al. [6,18] reported in their study an asymptomatic an hypoechoic area, symmetric or asymmetric, with indistinct limits almost rounded, present in or adjacent to the uterine incision and distinct from the normal incision site, with a diameter of 2–3.5 cm, probably connected to a small hematomas or serous collection with not clinical significance, called asymptomatic BFH (Figure 3).

The VP closuring frequently evokes, in early puerperium, small fluid collections in the upper part of the VUS, as evaluated by Faustin et al. [22], who reported that if these collections, the fluid-filled collections contained scattered low-level internal echoes, are more than 3.5 cm of diameter, they are significantly symptomatic and more likely connected to the postoperative morbidity (Figure 4).

Because the US pockets generally contains edema (in prevalence), blood, clots, fibrin and tissue reaction, during the post-CS restoring period, they could interfere with the healing process, probably with a negative effect in the extra peritoneal VUS, particularly in the mesothelial and sub mesothelial recovery.

Probably, those women who underwent serosal repair are much more likely to be diagnosed with US pockets, with more frequent complications in puerperium, and the dates of this study show that it is better to unsuturing the VP during CS, after the second stage of labor, either to prevent the closed pocket bladder formations, or to avoid the fluid collections in the VUS, favouring the healing of this extra peritoneal space.

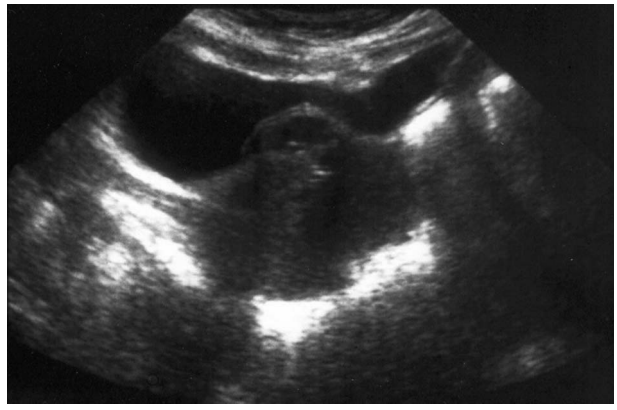

Figure 3. Transabdominal sonographic sagittal section by puerperal uterus post-CS in third days, with the suturing of visceral peritoneum; it shows the sonographic pattern of sub acute BFH (or asymptomatic BFH) in the VUS.

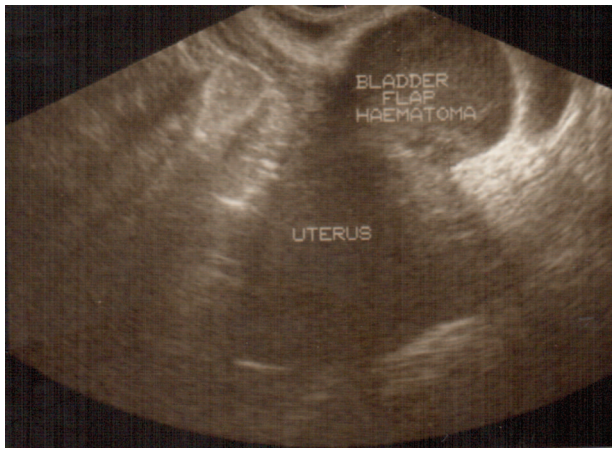

Figure 4. Transvaginal sonographic sagittal section by puerperal uterus post-CS in third days, with the suturing of visceral peritoneum; it shows the sonographic pattern of symptomatic BFH in the VUS.

In fact, some surgeons do not open the VUS in CS after prolonged second stage of labor, to avoid the BF formation [23–25].

Conclusion

The dates suggest to avoid the VP suturing during CS because the VUS, a virtual cavity, if it is open it rests a virtual space, if closed it becomes a pocket of edema, blood, clots, fibrin and tissue reaction, which lead to an asymptomatic and symptomatic BF, interferes with healing process.

So, in the dystocic CS, the VP repair could evoke post-operative morbidity [26]; on the contrary, after an accurate hemostasis, the open VP does not create these anatomical pathological collections, without clinical complications.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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