OUR EXPERIENCE WITH INTRAOPERATIVE CELL SALVAGE DURING CESAREAN DELIVERY IN WOMEN WITH UTERINE MYOMAS – FOUR CASE REPORTS

Introduction
Myomas are the most common benign tumor of the genital organs of women of childbearing age. Cesarean section (CS) is more common in women with myomas than in those without them, their incidence being up to 49.1% [1]. The incidence of cesarean section is increased by 26% for every 10 mm increase in the diameter of myoma in the group of women with myomas of 50 mm or more [2]. In some cases, myomectomy during CS is inevitable, which further increases the risk of hemorrhage [1]. Peripartum hemorrhage occurs in 2.5% of women with uterine myomas [3]. Massive obstetric hemorrhage, defined as blood loss greater than 1.5 liter, a reduction in hemoglobin levels greater than 40 g/l, the need for transfusion of more than 4 units of packed red blood cells (RBC) or the occurrence of coagulopathy is the most common cause of maternal mortality and morbidity [4, 5].

Summary

Introduction. Cesarean section is more frequent in pregnant women with uterine myomas, and is usually complicated with perioperative hemorrhage. In some cases, cesarean myomectomy represents an inevitable surgery, adding risk of hemorrhage occurrence. Massive obstetric hemorrhage is the most common cause of maternal mortality and morbidity. The aim of this study was to show our experience and results of the implementation of intraoperative blood salvage during cesarean section in the patients with uterine myomas. Material and Methods. The study encompassed four patients with uterine myomas who had cesarean delivery at our Department in the period from 2010 to 2011. Results. Postoperative transfusion of packed red blood cells was given to one patient. No complications resulting form the intraoperative blood salvage were recorded in our research. Conclusion. Intraoperative blood salvage should be applied in patients with uterine myoma, and certainly in those who are planned for cesarean myomectomy and particularly in cases when massive intraoperative hemorrhage is expected. Key words: Cesarean Section; Myoma; Pregnancy; Uterine Myomectomy; Intraoperative Complications; Hemorrhage; Operative Blood Salvage

Sažetak
the application of this method in obstetrics [3, 9]. The first case of cell salvage in obstetrics was published in 1988 and a large number of studies on its use in obstetrics were published during the last decade [10, 11], which resulted from the technological progress in this field and the introduction of leukocyte depletion filter, which was applied in obstetric indications for the first time in 1999, as well as from better understanding of the pathophysiology of amniotic fluid embolism, the risks of administration of allogeneic blood, and increasing complexity of obstetric pathology [5, 11].

The process of intraoperative blood salvage consists of three phases: blood collection (aspiration of blood from the surgical field), blood processing (centrifugation and washing with heparinized saline solution) and reinfusion. The aspiration of blood from the operative field is performed by a dual lumen anticoagulation suction tube. The aspirate passes through the filter and is collected in the reservoir. From the reservoir, blood is pumped into the centrifugation bowl, where it undergoes centrifugation and washing. Following these processes, the supernatant is separated in the waste bag and the washed red cells are collected in the transfer bag. The erythrocytes obtained in this way can be re-infused immediately or within next 6 hours [9, 10].

The aim of this study was to present our experiences and results of applying intraoperative blood salvage during CS in patients with uterine myoma. “Dideco Electa Essential Concept” Cell Saver has been used at the Department for Gynecology and Obstetrics, Clinical Center of Serbia since 2009 and is handled by specially trained personnel (Figure 1).

**Material and Methods**

1. This retrospective study included patients with intraoperatively confirmed presence of uterine myoma who were hospitalized and delivered by CS at our Department from January 2010 to December 2011.

2. The sources of data were: the operating protocols from the operating room, patients’ files, data protocols and histopathology findings of myomas. The criterion for inclusion in the study was the presence of myomas confirmed by visual inspection of the uterus during CS and the application of intraoperative cell salvage device, i.e. cell saver, during CS.

3. The indications for CS were defined on the basis of the primary indication for operation. The duration of operation was assessed on the basis of anesthetic list in the patient’s file in minutes from the skin incision to the skin closure. Experience of the surgeon was evaluated on the basis of his years of practice in gynecology and obstetrics.

4. The type, localization and number of myomas was determined based on the operative notes in the patient’s file. The size of myoma was defined by the diameter of the largest myoma according to the measurements made by the pathologist on the enucleated myoma, ultrasound measurement before surgery or evaluation given by the surgeon in the operative note. In cases of multiple fibroids, the diameter of the largest fibroid was taken into account. Intraoperative hemorrhage was assessed on the basis of the findings from the operative notes.

5. The hemogram parameters before and after surgery were defined by the values of red blood cells, hemoglobin and hematocrit before operation and on the first postoperative day. Blood transfusion during and after operation was defined as heterologous transfusion and/or autologous trans-

**Abbreviations**

CS – cesarean section
No – number
RBC – red blood cells

**Figure 1. Dideco Electa Essential Concept Cell Saver**

*Slika 1. Dideco Electa Essential koncept spasavanja krv*
fusion when the cell saver was applied for intraoperative blood salvage.

6. Febrile morbidity was defined as measured body temperature ≥38 °C in two consecutive measurements ≥ 6 hours, with the exception of postoperative day zero [3, 9]. Positive culture of the lochia, wound infections, and urinary tract infection after operation were determined according to the microbiological findings of wound swabs, urine and lochia samples. The existence of a hematoma in the uterus and abdominal wall hematoma after operation was determined by visualizing the hematoma during the postoperative ultrasound examination. Uterine subinvolution was defined as the need for providing therapy with uterotonics after the third postoperative day. Postoperative anemia was defined as hemoglobin values at discharge ≤100 g/l [1].

7. The duration of treatment in the intensive care unit and the total duration of postoperative hospitalization were defined by the number of days of treatment in the intensive care unit, or the number of postoperative days from the operation to the discharge from hospital, while the day of operation was taken as day zero.

**Results**

The patients are presented as the patient number (No) 1, number 2, number 3 and number 4. None of the patients had any comorbidity such as diabetes and pregnancy induced hypertension. Fetus was in cephalic presentation in all four patients. **Table 1** shows the characteristics of patients.

The patients No 1, 2 and 4 were 30-39 years old, while the patient No 3 was 46 years old, and her pregnancy was achieved by in vitro fertilization with an oocyte donation. All patients were delivered by CS in term pregnancy. The patient No 4 was tertipara who had two previous CS and myomectomy before the index pregnancy. The other three patients were nulliparous, without previous surgery on the uterus. The patient No 2 was delivered by emergency CS, while others were delivered by elective CS. Myomectomy was not performed in two women: the patient No 1 had an intramural myoma on the posterior wall of the uterus with a diameter of 150 mm and the patient No 2 who had a pedunculated anterior wall myoma 110 mm in diameter. The operation in both patients lasted 65 minutes. Cesarean myomectomy was performed in two women with multiple fibroids, the largest ones...
being on the anterior uterine wall of the uterus, measuring 45 mm in diameter in one woman and 90 mm in diameter in another. Additional incision on the uterus was therefore required in both cases. Operations on the patient No 3 and No 4 took 105 minutes and 90 minutes, respectively. Microbiological analysis of intraoperative swab of the uterus in the patient No 3 showed the presence of *Escherichia coli*, while in other three patients the finding was sterile. Body weight of all four infants was below 4000 grams. The length of work experience of the surgeon who operated the patient No 1 and No 4 was 27 years and of the surgeon who operated the patient No 2 and No 3 was 19 years. Intraoperative hemorrhage was present in all patients, all patients were given oxytocin intravenously in doses of 10 to 20 IU, and the patient No 2 was given prostaglandin F2α during operation. No injury of the fetus, digestive and urinary organs occurred during operation.

None of the patients had wound infection and/or dehiscence, urinary tract infection, postoperative hemorrhage, hematoma in the uterus and/or in the abdominal wall and bacteremia, nor was it necessary to enlarge the scope of surgery and perform relaparotomy. Data on the postoperative course and reported complications are shown in Table 2.

The patients who did not undergo cesarean myomectomy postoperatively were not treated in the intensive care unit; they did not require postoperative hospital treatment and were discharged on the fourth postoperative day. The patient No 1 had uterine subinvolution. Antibiotic treatment was corrected postoperatively according to the antibiogram in the patient No 2 because of *Escherichia coli* found in the uterine microbiological swab. The postoperative course of the patient No 3 was complicated by intestinal sub-occlusion; she was, therefore, treated in the obstetric intensive care unit for 7 days and her postoperative hospital treatment lasted 11 days in total. The patient No 4 was treated for one day in the intensive care unit. This patient was febrile postoperatively (two days after the application of allogeneic RBC transfusion), and her postoperative hospital treatment lasted 11 days in total. Administration of allogeneic blood was avoided in three patients. All the women studied, except for the patient No 4, who had received RBC after operation, had hemoglobin levels below 100 g/l at discharge.

Hemogram values before and after operation, as well as the volume of intraoperatively salvaged and transfused blood are shown in Table 3. All hemogram parameters were reduced postoperatively in all patients, and the volume of autologous blood transfused was 400-700 ml. The mean preoperative and postoperative hemoglobin and erythrocyte values were 103.80 g/l and 4.00×10⁹, and 94.38 g/l and 3.37×10⁹, respectively. There was no statistically significant difference between these values (for hemoglobin levels *p*=0.059; for erythrocyte *p*=0.132; in both cases, *p*> 0.05). The lowest postoperative hemogram values were recorded in the patient No 4, and the decrease in hemoglobin levels in this patient was the highest (15.71 g/l), although she received the greatest amount of salvaged blood intraoperatively.

### Table 2. Complications registered in studied patients

<table>
<thead>
<tr>
<th>Complication</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of days of intensive care unit treatment/ Broj dana lečenja u jedinici intenzivne nege</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Number of postoperative days in hospital/ Broj dana postoperativnog bolničkog lečenja</td>
<td>4</td>
<td>4</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Postoperative transfusion (ml)/ Postoperativna transfuzija (ml)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>260</td>
</tr>
<tr>
<td>Febrile morbidity after operation/ Febrilno stanje posle operacije</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Hemoglobin&lt;100 g/l at discharge/ Hemoglobin&lt;100 g/l pri otpustu</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Uterine sub-involution/ Subinvolucija uterusa</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Intestinal sub-occlusion/ Crevna subokluzija</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>–</td>
</tr>
</tbody>
</table>

### Table 3. Hematological results and volumes of intraoperatively salvaged blood in studied patients

<table>
<thead>
<tr>
<th>Hematological results and volumes of intraoperatively salvaged blood in studied patients/Hematokriti i zapreminu koje su intraoperativno spasene krvi kod ispitivanih pacijentkinja</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin before operation (g/l)/ Hemoglobin pre operacije (g/l)</td>
<td>104</td>
<td>110</td>
<td>105</td>
<td>96.21</td>
</tr>
<tr>
<td>Hemoglobin after operation (g/l)/ Hemoglobin posle operacije (g/l)</td>
<td>101</td>
<td>96</td>
<td>100</td>
<td>80.5</td>
</tr>
<tr>
<td>Erythrocytes before operation (×10⁹)/ Eritrociti pre operacije (×10⁹)</td>
<td>3.99</td>
<td>3.71</td>
<td>3.91</td>
<td>4.39</td>
</tr>
<tr>
<td>Erythrocytes after operation (×10⁹)/ Eritrociti posle operacije (×10⁹)</td>
<td>3.55</td>
<td>3.31</td>
<td>3.76</td>
<td>2.86</td>
</tr>
<tr>
<td>Hematocrit before operation (%)/ Hematokrit pre operacije (%)</td>
<td>32.9</td>
<td>34.0</td>
<td>31.6</td>
<td>34.0</td>
</tr>
<tr>
<td>Hematocrit after operation (%)/ Hematokrit posle operacije (%)</td>
<td>30.0</td>
<td>29.2</td>
<td>30.7</td>
<td>29.2</td>
</tr>
<tr>
<td>Volume of intraoperatively salvaged and transfused blood (ml)/ Zapremina intraoperativno spasene i transfuzijom date krvi (ml)</td>
<td>670</td>
<td>400</td>
<td>450</td>
<td>700</td>
</tr>
</tbody>
</table>
The decision regarding transfusion in young women is complex and should depend on the cause of anemia, its extent and possible chronicity, compensatory abilities of the patient, cardiopulmonary condition and the risk of further blood loss. Potential risks of blood transfusion must be balanced in relation to the expected benefits of its use. Although most of the existing recommendations for administration of blood transfusions are defined on the basis of hemoglobin and hematocrit values, the approach should be individualized, and clinical assessment should be based on the general condition of the patient [12]. However, the decision about transfusion is based on laboratory values of hemoglobin and hematocrit in most cases [13].

The therapeutic goal of transfusion is to improve tissue oxygenation in accordance with the needs of the recipient. Bearing in mind the risks of allogeneic blood use, modern medicine provides three ways to avoid its administration: preoperative autologous donation, acute normovolemic hemodilution and intraoperative blood salvage [5, 12]. Despite many advantages of preoperative autologous donation, it is not the method of choice in obstetric practice for the following reasons: in most cases, the extent of obstetric hemorrhage significantly exceeds the amount of blood that can be taken preoperatively; it can not be used in emergency situations, which are relatively common in obstetrics and it is unacceptable in certain populations for religious reasons [13]. The application of this method in obstetrics is recommended only in exceptional cases such as rare blood groups and the presence of irregular antibodies in pregnant women with a high risk of peripartum hemorrhage, multiple pregnancies, repeat CS (three or more), CS in second stage of labor, low preoperative hemoglobin values, uterine myoma and thrombocytopenia [12, 13]. The relative contraindications for intraoperative blood salvage are the contaminated and septic operative fields, suspected malignancy, β thalassemia, sickle cell anemia and the presence of infectious diseases that are transmitted through the blood [13]. According to the recommendations of the British Committee for Standards in Hematology, the application of the cell saver is indicated in operations with the clear operating field and the expected blood loss of more than 20% of blood volume, in operations that are associated with allogeneic transfusions in more than 10% of cases or where the average number of transfused blood units is greater than one [14]. The recommendation of the American College of Obstetricians and Gynecologists is that intraoperative blood salvage should be used in all patients when profuse bleeding is expected [15]. The Association of Anesthetists of Great Britain and Ireland recommends intraoperative blood salvage during CS in women with large and/or multiple uterine fibroids [12, 13].

The patients presented in this study had other risk factors for perioperative hemorrhage, besides myoma, and the consequent need for blood transfusions, such as age and myomectomy during CS in the patient No 3 and No 4. Escherichia coli detected in the uterus in the patient No 2 and prolonged surgery in the patient No 3. Namely, the patient No 4 had had three surgical procedures on the uterus (myomectomy and two CSs) before the index operation as well as the lowest preoperative and postoperative values of hemogram. Thus, despite intraoperative blood salvage, she received a single unit of RBC postoperatively. In the files of this patient neither were the indications for postoperative transfusion precisely defined, nor was the existence of possible clinical symptoms of anemia recorded. This is the only patient who had hemoglobin levels higher than 100 g/l at discharge, and we can not exclude the possibility that she would have recovered successfully without that single unit of RBC she had received. The justification of this transfusion cannot be ascertained, which is not a rare event in obstetric patients. The other three patients had hemoglobin levels below 100 g/l at discharge, but none of them had the value less than 90 g/l.

Uterine subinvolution in the patient No 1 was due to the presence of fibroids. Apart from anemia at discharge, the patient No 2 had no other postoperative complications reported. Intestinal sub-occlusion recorded in the patient No 3 cannot be correlated with intraoperative blood salvage. Fever observed in the patient No 4 could be a consequence of allogeneic transfusion as well as of myomectomy. The fact that fever developed in this patient after she had received the allogeneic transfusion suggests that it could not have been caused by the intraoperative blood retransfusion. Intraoperative blood salvage does not completely exclude the need for the administration of allogeneic blood in cases of profuse intraoperative bleeding.

The efficacy of intraoperative blood salvage defined as the percentage of patients who completely avoided the use of allogeneic blood ranges from 6 to 97.1% in the literature [15]. In our study, the use of allogeneic blood was avoided in three cases. Most authors agree that the use of intraoperative blood salvage reduces the need for allogeneic blood transfusions [16]. Prolonged hospitalization in the patient No 3 and No 4 was not the result of the use of cell salvage.

Complications caused by the use of intraoperative blood salvage described in the literature were not reported in any of the studied patients [12, 13, 16, 17].

Cell savers are unable to distinguish maternal from fetal red blood cells; therefore, Rh alloimmunization of the mother is a real risk of the application of this procedure. Aspiration of fetal red blood cells and their retransfusion in the maternal circulation increases the risk of maternal Rhesus alloimmunization in cases of incompatibility between the mother and the fetus. This can be pre-
vented by the anti-D immunoglobulin. The required dose is calculated by determining the volume of fetal red blood cells transfused to the mother, using the Kleihauer-Betke test [16, 17]. All the women in our study had the positive Rh factor. Clinically relevant antibodies can be generated to other erythrocyte antigens as well, which can lead to a hemolytic disease in the newborn, but the risk of such alloimmunization is considered to be similar to the one during vaginal delivery [15, 16]. Adverse events observed after intraoperative blood salvage are: hypotension, disseminated intravascular coagulation, haptoglobin, adult acute respiratory distress syndrome, hypocalcaemia, hypomagnesaemia and hypoproteinaemia [12, 13, 17]. The only fatal outcome after the application of the salvaged blood in obstetrics is the case report published in 2000 by Oei et al, who concluded that the cause of death was amniotic fluid embolism [18]. The cited authors presented a patient with significant obstetric morbidity, who, due to her religious beliefs, refused the transfusion of allogeneic blood. She was delivered by an emergency CS due to preeclampsia and HELLP (Hemolysis, EL: elevated liver enzymes, LP: a low platelet count) syndrome, with consequent anemia (the hemoglobin level before surgery was 71 g/l and the platelet count was $48 \times 10^9/l$) and coagulopathy. The cell saver without leukocyte filter was used during the operation, and a cardiac arrest occurred immediately after the retransfusion of the salvaged blood. The authors of papers published later expressed their disagreement with the presented conclusion, thus it has not been generally accepted in the literature published after this death could be attributed to the intraoperative blood salvage [4, 9, 10].

So far, only one randomized study on elective application of intraoperative blood salvage during CS has been published, which showed a significant reduction in number of patients who required transfusions in the study group [16, 17]. Multicentre cohort study published by Rebarber et al. has not proved the existence of differences between the groups in terms of infectious complications, the incidence of disseminated intravascular coag-}

**References**

1. Sparić R. Miomektomija tokom carskog reza-intraopera-
3. Machado LS, Gowri V, Al-Riyami N, Al-Kharusi L. Cae-
5. King M, Wrench I, Galimberti A, Spray R. Introducti-
7. Sparić R, Dokić M, Argirović R, Kadija S, Bogdanović Z, Milenković V. Incidence of postpartum post-cesarean hysterecto-
8. McDonnell NJ, Kennedy D, Long LJ. Gallagher-Swans MC, Paech MJ. The development and implantation of an obstetri-