



Modified abdominal packing method in “near miss” patients with postpartum hemorrhages

Postpartum kanamalı “near miss” hastalarda modifiye abdominal packing yöntemi

© Çetin Kılıççı¹, © Mesut Polat², © Mehmet Küçükbaş², © Mehmet Baki Şentürk¹, © Resul Karakuş¹, © Çiğdem Yayla Abide², © Evrim Bostancı Ergen¹, © İlter Yenidede¹, © Ateş Karateke²

¹Istanbul Zeynep Kamil Woman and Children Diseases Training and Research Hospital, Clinic of Obstetrics and Gynecology, İstanbul, Turkey

²Istanbul Medeniyet University, Göztepe Training and Research Hospital, Clinic of Obstetrics and Gynecology, İstanbul, Turkey

Abstract

Objective: To describe a more effective abdominal packing method in patients with disseminated intravascular coagulation following peripartum hysterectomy due to postpartum hemorrhage (PPH).

Materials and Methods: The present retrospective and descriptive study was conducted to document six cases with refractory pelvic bleeding who underwent a second surgery for PPH between January 2016 and December 2017 at İstanbul Zeynep Kamil Woman and Children Diseases Training and Research Hospital.

Results: Karateke packing was performed to control intra-abdominal massive hemorrhages of five women who were referred to our clinic due to PPH who had undergone peripartum hysterectomy and hypogastric artery ligation but hemostasis could not be provided. In addition, a case of hypovolemic shock due to placenta percreta rupture in a woman who had also undergone an emergency hysterectomy and hypogastric artery ligation, which had failed. Hemostasis was provided in all patients. No method-related complication developed.

Conclusion: Karateke packing is a very easy method to perform, it is more effective than the classic abdominal packing technique, with a low complication rate, and most importantly, life-saving in patients undergoing a peripartum hysterectomy due to PPH and thereafter experiencing diffuse hemorrhage.

Keywords: Abdominal packing, peripartum hysterectomy, near miss

Öz

Amaç: Postpartum kanama nedeni ile peripartum histerektomi yapılan ancak kanama kontrolü sağlanamayan hastalarda daha etkili bir abdominal packing yöntemi tariflemek.

Gereç ve Yöntemler: İstanbul Zeynep Kamil Kadın ve Çocuk Hastalıkları Eğitim ve Araştırma Hastanesi'nde Ocak 2016-Eylül 2017 tarihleri arasında doğum sonu kanama nedeniyle tekrarlayan cerrahi girişim uygulanan 6 pelvik kanamalı olguyu retrospektif, gözlemsel ve tanımlayıcı olarak inceledik.

Bulgular: Postpartum kanama nedeniyle kliniğimize refere edilen ve peripartum histerektomi ve hipogastrik arter ligasyonu yapılan; ancak kanama kontrolü sağlanamayan beş olgu ile plasenta perkreato rüptürü nedeniyle hipovolemik şokta olan ve acil histerektomi ve hipogastrik arter ligasyonu yapılan bir olgunun intraabdominal masif kanamalarını kontrol etmek için Karateke usulü packing yapıldı. Tüm hastalarda kanama kontrolü sağlandı. Yönteme bağlı komplikasyon gelişmedi.

Sonuç: Sonuç olarak Postpartum kanama nedeniyle peripartum histerektomi yapılan ve sonrasında hayatı tehdit eden diffüz kanamalarda Karateke packing yöntemi uygulanması oldukça kolay, klasik abdominal packing'ten daha etkili, komplikasyonu az ve herşeyden önemlisi hayat kurtaran bir yöntemdir.

Anahtar Kelimeler: Abdominal packing, peripartum histerektomi, near miss

PRECIS: Karateke packing method can be used as the last life-saving method in patients with postpartum hemorrhage.

Address for Correspondence/Yazışma Adresi: Çetin Kılıççı, MD,

Istanbul Zeynep Kamil Woman and Children Diseases Training and Research Hospital, Clinic of Obstetrics and Gynecology, İstanbul, Turkey

Phone: +90 505 644 94 85 E-mail: cetinkilicci@hotmail.com ORCID ID: orcid.org/0000-0002-9674-2505

Received/Geliş Tarihi: 07.04.2018 Accepted/Kabul Tarihi: 26.06.2018

©Copyright 2018 by Turkish Society of Obstetrics and Gynecology

Turkish Journal of Obstetrics and Gynecology published by Galenos Publishing House.

Introduction

Postpartum hemorrhage (PPH) is the most common cause of maternal death with high morbidity and mortality rates. The maternal mortality rate has fallen in most countries with advances in reaching blood and blood products, multidisciplinary approaches to cases, and the development of comprehensive protocols. In our country, this rate has fallen from 0.28% to 0.14% in last 10 years^(1,2). To maintain sufficient circulation and tissue oxygen supply in PPH, and to stop the hemorrhage simultaneously, interventions such as uterotonic agents, use of Bakri balloon tamponade, B-lynch suture, uterine artery or hypogastric artery ligation, uterine artery embolization, and when necessary, hysterectomy in addition to general obstetric procedures are life-saving^(3,4). The incidence of peripartum hysterectomy is 0.2/1000 deliveries in developed countries; however, this rate is 4.43/1000 deliveries in developing countries⁽¹⁾. Despite such efficient treatment options in PPH, repeat laparotomies may be required to control ongoing hemorrhage following a peripartum hysterectomy in patients administered massive transfusion and developing disseminated intravascular coagulopathy (DIC)⁽⁵⁾. Abdominal packing is a classic technique that is frequently performed in these “near miss” patients who have no other surgical option. Abdominal packing exerts a mechanical pressure over the low pressure venous and capillary vessels of intra-abdominal deperitonized pelvic surfaces and the surgery region and saves time for transfusion of necessary coagulation factors and blood and blood products such as platelets required for the provision of permanent hemostasis. Additionally, abdominal packing gains time for the clearance of mediators preventing intravascular coagulation by the kidney and liver, and treatment of metabolic problems such as DIC, hypothermia, acidosis, and hypovolemic shock occurring in a patient in the intensive care unit⁽⁶⁾. As it was indicated in the review of Touhami et al.,⁽⁷⁾ the decision for pelvic packing is generally taken in the event of the development of nonsurgically controllable hemorrhage associated with clinical and laboratory evidence of coagulopathy and not being able to replace blood loss sufficiently despite continuous hemorrhage after an emergency peripartum hysterectomy. Accordingly, the procedure of pelvic packing may be considered as a “rescue ending procedure”.

Indications for pelvic packing after emergency peripartum hysterectomy

- Hemodynamically unstable patient without optimal resuscitation^(8,9)
- Stabilization of the patient to enable transfer to an adequate structure⁽¹⁰⁾
- Post hysterectomy hemorrhage with a free interval^(8,11,12)
- Diffuse vaginal laceration related to pelvic bleeding^(13,14)
- Presence of extensive hematoma in the absence of the possibility of embolization^(11,14)

In this study, we aimed to describe a new packing method that we considered as a more effective method in hemorrhage cases requiring a peripartum hysterectomy due to PPH after delivery and in “near miss” patients in whom hemostasis could not be provided despite peripartum hysterectomy and who have no other surgical option and require more than one surgery to control the hemorrhage.

Materials and Methods

The present retrospective, observational, and descriptive study was conducted to document patients who had a PPH between January 2016 and December 2017 at Zeynep Kamil Research and Training Hospital. The study protocol was approved by the Zeynep Kamil Women and Children Research Hospital local ethics committee (approval number: 120-2015). Informed consent was provided by all participants. A need for intervention had occurred due to a severe PPH in a total of 310 patients. One hundred sixty-four patients (53%) were referred from external centers. Surgical intervention was performed in the external center in 33 patients. The causes of PPH were as follows: postpartum atony in 212 patients, placental invasion anomalies in 81 patients, a uterine rupture in 7 patients, severe retroperitoneal hematoma secondary to lower genital tract injury in 8 patients, and uterine inversion in 2 patients. The causes of PPH and demographic characteristics of patients are shown in Tables 1 and 2. The following interventions were performed: Bakri balloon tamponade in 50 patients, pelvic devascularization and compression suture in 105 patients, local uterine resection in 33 patients, and peripartum hysterectomy in 122 patients.

Statistical Analysis

A new abdominal packing technique was performed as the final method in six patients undergoing surgery for at least a second time for PPH but not controlled with classic hemostatic methods for whom all surgical methods were exhausted. The data obtained from the study were analyzed using the Statistical Package for the Social Sciences software package (SPSS version 10.0) and the results are expressed as mean \pm standard deviation.

Results

The packing technique was performed in five women in whom hemostasis could not be achieved despite a peripartum hysterectomy, and in a patient who presented to the emergency department with the clinical picture of hypovolemic shock due to placenta percreta rupture. Relaparotomy had a severe risk for these 6 “near miss” patients. Therefore, to create a more effective compression considering that sufficient compression could not be provided, a new packing method (Karateke packing) was performed. The packing decision in these patients was made by the obstetric emergency bleeding team of our clinic. The demographic characteristics of these 6

patients are presented in Table 3. The packing technique used by the obstetric bleeding team was performed in the following steps: In Karateke packing, a 1 cm incision is performed in the posterior vaginal wall 1-2 cm from the sutured vaginal cuff, and a Bakri balloon is placed into the abdomen by pulling through the vagina. Six to seven soaked and squeezed near hot sponges are wrapped circularly around the balloon (Figure 1) and then the Bakri balloon is inflated with 500-1000 mL saline and put in traction through the vaginal route (Figure 2). Thus, abdomen of the patient becomes filled with sponges around the inflated Bakri balloon. The balloon

Table 1. Characteristics of the patients who underwent peripartum hysterectomy because of postpartum hemorrhage (n=310)

	Mean
Age	32.2±4.57
Gravida	3
Parity	2
Previous cesarean sections	
No	83 (27%)
Yes	227 (73%)
History of repeat C/S	85 (27%)
Gestational week	36
Mode of delivery	
Cesarean delivery	183 (59%)
Vaginal delivery	127 (41%)
Hospital stay (days)	10±5
Preoperative Hct, %	35 (12-47)
Preoperative platelet count	168742±66800

Hct: Hematocrit, C/S: Cesarean sections

Table 2. The causes of postpartum hemorrhages and patients requiring transfusion

Postpartum hemorrhage	n
Atony	212
Placenta accreta	81
Retroperitoneal hematoma	8
Uterine rupture	7
Uterine inversion	2
Massive blood cell transfusion	69 (5-30 Unit)
Platelet transfusion	32 (8-100 Unit)
Fibrinogen	86 (2-20 g)
rFVIIa*	2 (8-16 g)

*rFVIIa: Recombinant Factor VII a

exerts compression on the underlying sponges by means of vaginal traction and therefore the pressure is transferred to all surfaces of the surgical region at the same rate and efficiently. In this way, bleeding stops in vascular structures and hemostasis is provided (Figure 3). The distal part of the balloon, under sufficient traction, is fixed to the leg of the patient. Thereafter, the skin is closed without closing the abdominal fascial layers. To prevent Compartment syndrome and perfusion failure of the lower extremities, maintenance perfusion is allowed by releasing the tension on the shaft of the Bakri balloon minimally with 2 hour intervals during the postoperative period. In the event of continuance of bleeding, the balloon is inflated more, more traction is applied, and compression on the underlying sponges is increased. This procedure is continued until hemostasis is provided.

The depacking procedure was performed in all patients after coagulation parameters returned to the normal range



Figure 1. Soaked and squeezed near-hot sponges are wrapped circularly around the balloon

Table 3. Characteristics of the patients requiring multiple surgeries and abdominal packing following peripartum hysterectomy (n=6)

	Mean
Age	33.33±4.27
Gravida	4
Parity	3
Gestational week	37±2
Mode of delivery	
Cesarean delivery	3
Vaginal delivery	3
Hospital stay (days)	10±5

and cessation of intra-abdominal hemorrhage following blood and blood products replacement. Preoperative and postoperative laboratory parameters of all our patients are shown in Table 2. In our first patient who received Karateke packing, bilateral hypogastric artery ligation, and B-Lynch suture were performed via laparotomy due to postpartum uterine atony and there was no intra-operative bleeding. A peripartum hysterectomy was performed with a second laparotomy because 2000 mL/h bleeding occurred through the drain of the patient in the intensive care unit postoperatively. Upon continuance of intra-abdominal diffuse bleeding, classic packing was performed perioperatively with 6 pads and the abdomen was closed. At the postoperative 1st hour, the total drained fluid volume was 1500 cc in the drain bag, and a third laparotomy was performed. Karateke packing was performed as the final intervention because there was no surgical option to control the bleeding in the 3rd surgery. In this patient, blood loss of 500 mL/24 h was observed through the drain in the intensive care unit postoperatively.

Peripartum hysterectomy and hypogastric artery ligation were performed in three of our patients due to postpartum atony and peripartum hysterectomy, and bilateral hypogastric artery ligation was performed in one of our patients due to uterine

atony and broad ligament hematoma. Upon observation of severe bleeding through the drains of patients followed up in the intensive care unit postoperatively, Karateke packing was performed in a second surgery.

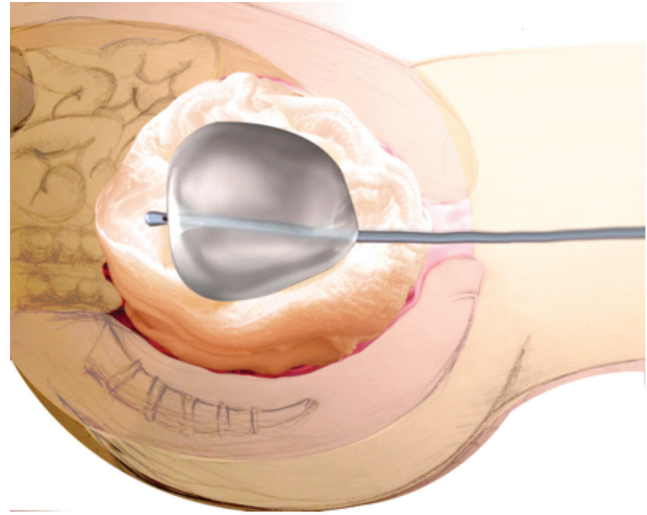


Figure 2. Bakri balloon is inflated with 500-1000 mL saline and put in traction through the vaginal route

Table 4. Clinical features of the patients requiring multiple surgeries and abdominal packing following peripartum hysterectomy (n=6)

Diagnosis	Operations	Bleeding after hysterectomy	Transfused blood products	Complications	Hospital stay (days)
Preeclampsia, abruptio placenta -postpartum atony	1. B-lynch + hypogastric artery ligation 2. Hysterectomy + classic abdominal packing	1300 mL/h	RBC: 16 FFP: 28 Platelet: 100 WBC: 14 Fib: 20	Acute tubular necrosis + Sheehan's syndrome	20
Abruptio placenta-postpartum atony	Hysterectomy + hypogastric artery ligation	1000 mL/h	RBC: 5 FFP: 8 Platelet: 8 Fib: 4	-	6
Postpartum atony	Hysterectomy + hypogastric artery ligation	1500 mL/h	RBC: 12 FFP: 16 Platelet: 32 Fib: 16	Reversible acute tubular necrosis	12
Abruptio placenta-postpartum atony	Hysterectomy + hypogastric artery ligation	1000 mL/h	RBC: 9 FFP: 12 Platelet: 10 Fib: 16	-	10
Placenta percreta-uterine rupture	Hysterectomy + hypogastric artery ligation	1000 mL/h	RBC: 19 FFP: 20 Platelet: 24 Fib: 16	Maternal death	3
Postpartum atony	Hysterectomy + hypogastric artery ligation	750 mL/h	RBC: 8 FFP: 10 Platelet: 9 Fib: 16	-	6

RBC: Red blood cell, FFP: Fresh frozen plasma, Fib: Fibrinogen, WBC: White blood cell



Figure 3. Bleeding stops in vascular structures and hemostasis is provided

Table 5. Laboratory values before vs after abdominal packing

	Preoperative	Postoperative
Hemoglobin, g/dL	4.86±0.7 (4-6)	7.33±1.21 (6-9)
Hematocrit	17±3 (12-22)	21.8±3 (19-27)
Platelet count, count/mm ³	66.500±26.000	116.000±38.000
INR	1.78±0.1 (1.6-2)	1.28±0.17 (1.1-1.6)
Fibrinogen	108±33.8 (70-150)	230±33.8 (198-260)

INR: International normalized ratio

Our last patient was brought to our emergency outpatient clinic directly, she was unconscious with fixed dilated pupils due to placenta percreta rupture at the 34th gestational week of pregnancy. Peripartum hysterectomy and bilateral iliac artery ligation were performed in this patient in an emergency laparotomy. Upon continuance of diffuse bleeding from the peritoneal surfaces and surgical site, Karateke packing was performed. Active bleeding was not observed through the drain in the intensive care unit postoperatively. However, the patient was diagnosed as having cerebrovascular hypoxia at the postoperative 3rd day and died of cardiac arrest on the same day. The clinical characteristics of these patients are presented in Tables 4 and 5.

Discussion

Pelvic packing techniques can be divided into 2 types: pads or roller gauze (sterile pads bound by suture threads or wrapped in a sterile bag) and balloon pack (Foley catheter or Bakri balloon). There is a difference in physical structure between these 2 types with practical consequences. First, it is easier

and faster to assemble and apply the balloon pack because it is ready to be inflated and used immediately, but the pack formed by pads needs to be arranged and connected. Second, it is easier to adjust to match the size of the balloon packs to the size of the hemorrhagic areas with inflation or deflation of the balloon, but the addition or withdrawal of a pad from the constituted pack may be complicated⁽¹¹⁾. Our packing method is important in regards to being the first to apply two methods in combination, as reported by Touhami et al.⁽⁷⁾. The strength of our study is that all of the patients referred to our clinic from external centers comprised “near miss” patients who require massive blood transfusion due to delayed surgical intervention. Classic abdominal packing is not sufficient to stop bleeding. The success of the treatment depends on the success of concurrent medical treatment, intensive care support therapy, and particularly the blood and blood product replacement protocols used. Karateke packing combines the methods defined by Naranjo-Gutiérrez et al.⁽¹⁰⁾ and Charoenkwan K.⁽¹¹⁾. Karateke packing is more efficient than the classic packing technique and is simpler and more easily applied compared with the method defined by Naranjo-Gutiérrez et al.⁽¹⁰⁾. In a study, packing was performed due to postpartum bleeding associated with uterine atony but hypogastric artery ligation was not performed in one of three patients in whom the Kittipat method was performed⁽¹¹⁾. At the same time, a complicated clinical picture such as DIC did not accompany this case. Therefore, the efficiency of the method defined by Kittipat in patients developing DIC and requiring massive blood and blood product transfusions such as ours is controversial⁽¹¹⁾. There is no consensus in the literature regarding the number of sponges required to provide hemostasis related with packing. If the sponges are not squeezed sufficiently, bleeding may continue and packing may result in failure. In the study performed by Deffieux et al.,⁽¹⁵⁾ the authors failed to determine the required number of pads in a successful packing treatment. In Karateke packing, the compression strength exerted on the area of bleeding can be increased with the same number of sponges by increasing the traction force and volume of the intra-abdominal balloon. Thus, mechanical pressure applied to bleeding foci can be increased without having to perform relaparotomy to increase the number of sponges. Deffieux et al.⁽¹⁵⁾ reported the success rate of abdominal packing as 62% in their study. Packing failed in 38% of cases and death occurred in 13⁽¹⁶⁾. In our series, hemostasis was provided with Karateke packing in all 6 patients including a patient in whom bleeding could not be controlled with classic abdominal packing. David Richardson et al.⁽¹⁶⁾ reported that the mortality rate decreased by one-third when abdominal packing was performed in the early period after liver injury. However, the success rate of classic packing would be low in “near miss” patients who are referred in a complicated condition like in our patients. Besides that, Compartment syndrome, which is commonly mentioned in the literature when intra-abdominal pressure exceeds

the limit of 20 mm Hg, may develop and this is a serious complication that requires relaparotomy^(17,18). In our method, both abdominal fascial layers are not closed and decompression can be provided by releasing the distal tip of the Bakri balloon or by lowering the volume of the balloon when compartment syndrome develops. Symptoms of Compartment syndrome occurred in none of our patients. The depacking procedure is another important problem in abdominal packing. There is no consensus in the literature on this subject. However, it was reported that performing depacking after 24-48 hours reduced the recurrence rate of bleeding. Nicol et al.⁽¹⁹⁾ reported that less bleeding occurred if depacking was performed after 24-48 hours; however, Caruso et al.⁽¹²⁾ reported that risk for bleeding increased when sponges were removed earlier than 36 hours. Keeping sponges intra-abdominally for a long time may provide hemostasis but it can cause intra-abdominal adhesions and serious intra-abdominal infection. Abikhalel et al.⁽²⁰⁾ reported that the rate of abdominal abscess and death was lower when abdominal sponges were kept *in situ* less than 72 hours in 35 women with abdominal injuries. In our patients, the depacking procedure was performed when the bleeding through abdominal drain stopped and DIC laboratory findings regressed (international normalized ratio: <1.2, fibrinogen: >200, hemoglobin: >7). To prevent bleeding from the tissue while removing sponges adhered to visceral organs and surgical site, sponges should be soaked with a hot saline solution, ensured to be separated from the tissue, and removed with slow and gentle movements. The limitation of our method is the need for relaparotomy for the removal of the balloon and sponges.

Conclusion

Karateke abdominal packing is a very easy method to perform, more effective than the classic abdominal packing technique, with a low complication rate, and most importantly, life-saving in patients undergoing a peripartum hysterectomy due to PPH and thereafter experiencing diffuse hemorrhage.

Ethics

Ethics Committee Approval: The study was approved by the Zeynep Kamil Women and Children Research hospital local ethic committee (approval number 120-2015).

Informed Consent: Consent form was filled out by all participants.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: Ç.K., Design: M.P., M.K., Data Collection or Processing: Ç.K., Ç.Y.A., E.B.E., Analysis or Interpretation: R.K., A.K., Literature Search: M.B.Ş., Writing: İ.Y., Ç.Y.A., Ç.K.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Tapisiz OL, Altınbas SK, Yirci B, Cenksoy P, Kaya AE, Dede S, et al. Emergency peripartum hysterectomy in a tertiary hospital in Ankara, Turkey: a 5-year review. Arch Gynecol Obstet 2012;286:1131-4.
2. Say L, Chou D, Gemmill A, Tunçalp Ö, Moller AB, Daniels J, et al. Global causes of maternal death: a WHO systematic analysis. Lancet Glob Health 2014;2:323-33.
3. Badawy SZ, Etman A, Singh M, Murphy K, Mayelli T, Philadelphia M. Uterine artery embolization. The role in obstetrics and gynecology. J Clin Imaging 2001;25:288-95.
4. No authors listed. Diagnosis and management of postpartum hemorrhage: ACOG technical bulletin Number 143-July 1990. Int J Gynaecol Obstet 1991;36:159-63.
5. WHO recommendations for the prevention and treatment of postpartum hemorrhage. Geneva: World Health Organization; 2012.
6. Moore FA, Moore EE, Sauaia A. Blood transfusion. An independent risk factor for postinjury multiple organ failure. Arch Surg 1997;132:620-4.
7. Touhami O, Bouzid A, Ben Marzouk S, Badis Channoufi, ElMagherbi H. Pelvic Packing for Intractable Obstetric Hemorrhage After Emergency Peripartum Hysterectomy: A Review. Obstetrical and Gynecological Survey 2018;73:2.
8. Dildy GA, Scott JR, Saffer CS, Belfort MA. An effective pressure pack for severe pelvic hemorrhage. Obstet Gynecol 2006;108:1222-6.
9. Howard RJ, Straughn JM Jr, Huh WK, Rouse DJ. Pelvic umbrella pack for refractory obstetric hemorrhage secondary to posterior uterine rupture. Obstet Gynecol 2002;100:1061-3.
10. Naranjo-Gutiérrez LA, Oliva-Cristerna J, Ramírez-Montiel ML, Ortiz MI. Pelvic packing with vaginal traction for the management of intractable hemorrhage. Int J Gynaecol Obstet 2014;127:21-4.
11. Charoenkwan K. Effective use of the Bakri postpartum balloon for posthysterectomy pelvic floor hemorrhage. Am J Obstet Gynecol 2014;210:586.
12. Caruso DM, Battistella FD, Owings JT, Lee SL, Samaco RC. Perihepatic packing of major liver injuries: complications and mortality. Arch Surg 1999;134:958-62.
13. Agostini A, Mazza D, Bereder JM. Value of pelvic tamponade in persistent hemorrhage after hemostasis hysterectomy. Gynecol Obstet Fertil 2001;29:613-5.
14. Logothetopoulos K. An absolute safe blood stiling method for vaginal and abdominal gynecological operations. Zentralbl Gynakol 1926;50:3202-4.
15. Deffieux X, Vinchant M, Wigniolle I, Goffinet F, Sentilhes L. Maternal outcome after abdominal packing for uncontrolled postpartum hemorrhage despite peripartum hysterectomy. 2017;12:e0177092.
16. David Richardson J, Franklin GA, Lukan JK, Carrillo EH, Spain DA, Miller FB, et al. Evolution in the management of hepatic trauma: a 25-year perspective. Ann Surg 2000;232:324-30.
17. Kendrick JE 4th, Leath CA 3rd, Melton SM, Straughn JM Jr. Use of a fascial prosthesis for management of abdominal compartment syndrome secondary to obstetric hemorrhage. Obstet Gynecol 2006;107:493-6.
18. Santhosh MC, Pai RB, Sachidanand R, Byrappa V, Rao RP. Inferior Venacaval compression due to excessive abdominal packing. Braz J Anesthesiol 2014;64:199-200.
19. Nicol AJ, Hommes M, Primrose R, Navsaria PH, Krige JEJ. Packing for control of hemorrhage in major liver trauma. World J Surg 2007;31:569-74.
20. Abikhalel JA, Granchi TS, Wall MJ, Hirshberg A, Mattox KL. Prolonged abdominal packing for trauma is associated with increased morbidity and mortality. Am Surg 1997;63:1109-12.