

The potential use of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) in a Brazilian hospital.

O uso potencial do Balão de Oclusão Endovascular da Aorta para Ressuscitação em um hospital brasileiro.

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ABSTRACT

Aim: To evaluate the potential use of REBOA in a Brazilian hospital. **Methods:** We performed a retrospective analysis of all requests for emergency surgical evaluation for patients with suspected massive hemorrhage, hospitalized in a private Brazilian general hospital, from April 1, 2017 to March 31, 2018. Inclusion criteria for REBOA eligibility were: suspected abdominal and/or pelvic bleeding, hemorrhagic shock and older than 18 years of age. Exclusion criteria were: older than 70 years of age, and pre-existing terminal disease or significant comorbidities. **Results:** 90 evaluations were requested during the study period. However, according to our inclusion/exclusion criteria, only on 14 occasions (15.6%) there was a recommendation for the use of REBOA. Gynecological/obstetric conditions were the indication in 11 cases (78.6%) and elective oncologic surgery in three cases (21.4%). **Conclusions:** The use of REBOA is not common in our country, but it can be an essential tool, and perhaps the last resource in extremely severe conditions until the definitive surgical, endovascular or endoscopic treatment is performed.

Keywords: Emergency Medical Services. Shock, Hemorrhagic. Resuscitation. Balloon Occlusion. Endovascular Procedures.

INTRODUCTION

Hemorrhagic shock is a global problem, and bleeding is estimated to be the cause of 1.9 million worldwide deaths per year. Bleeding causes vary, and can be a consequence of trauma, postpartum hemorrhage, gastrointestinal bleeding, perioperative hemorrhage and ruptured abdominal aneurysms¹⁻⁴.

Proper management of patients with massive bleeding includes identifying the sources, followed by immediate measures to minimize blood loss, restore tissue perfusion and achieve hemodynamic stability. When bleeding is immediately stopped, patients usually recover with little or no morbidity⁵.

The Resuscitative Endovascular Balloon Occlusion of the Aorta (known as REBOA) was first described in the Korean War. This technique aims

to occlude the aorta at the bleeding site, inflating a small balloon inserted through the cannulation of the femoral artery. It is used as a temporary option until controlling bleeding through surgery, endoscopy or embolization⁶⁻⁹.

Initially, the aortic balloon was placed by using larger diameter catheters (12-14 Fr). Recently, the development of implantable balloons by using 7 Fr catheters has led to greater enthusiasm for its use. Considering the recent evolution of endovascular technology and its clear benefit in the management of vascular diseases, such as abdominal aortic aneurysm, the use of this technique has been chosen for hemorrhage control, mainly related to trauma, but also in cases of post-partum, as well as postoperative and gastrointestinal bleeding¹⁰⁻¹².

Retrospective studies have evaluated the rate of trauma patients in prehospital care, who could have benefited from this technique.

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When comparing the high mortality rate, due to bleeding at the site of the accident, with the rare complications of REBOA, the risk-benefit ratio is positive^{13,14}.

The present study aims to assess the proportion of patients in a hospital setting, with hemorrhagic shock, who could benefit from this technique during the bleeding episode. Also, we have carried out a literature review on REBOA use, and we have evaluated the feasibility of implementing this tool in Brazil.

METHODS

We performed a retrospective analysis regarding all requests for emergency surgical evaluation in hospitalized patients suspected of having massive hemorrhage ("hemorrhagic code"). The study was carried out in a private Brazilian hospital from April 1, 2017 to March 31, 2018. The Ethics Committee of Hospital Israelita Albert Einstein, under the protocol number 95674518.0.0000.0071, approved this study.

In order to reduce mortality and morbidity from hemorrhagic shock, since May 2016, our institution has a "quick response team" for suspected bleeding cases, coded as hemorrhagic shock.

The eligible criteria for the team consultation are:

- SBP <90mmHg after initial resuscitation with 500mL of crystalloid solutions;
- DBP <60mmHg after initial volemic resuscitation with 500mL of crystalloid solutions;
- HR >110bpm after the initial resuscitation with 500mL of crystalloid solution;
- Paleness together with the above vital signs;
- Radiological confirmation of active bleeding;
- Severe abnormal coagulation tests.

Data were collected from an electronic medical regarding the following information: sex, age, the reason for hospitalization, clinical and laboratory parameters, suspected bleeding site, cause of bleeding, treatment and outcomes (length of stay, blood-derived products and deaths).

Inclusion criteria for REBOA eligibility:

- Suspected abdominal and/or pelvic bleeding.
- Hemorrhagic shock (defined as systolic blood pressure below 90 mmHg, heart rate above 120 bpm or need for vasoactive drugs).
- Patients older than 18 years of age.

The exclusion criteria were:

- Patients older than 70 years of age.
- Pre-existing terminal illness or significant comorbidities.

A descriptive analysis of all variables obtained was performed. The quantitative variables were presented according to the central tendency (mean) and dispersion (standard error), and the qualitative variables as absolute frequency and percentage.

RESULTS

The hospital has approximately 580 beds, 40 ICU beds, 95 semi-ICU beds and 40 operating rooms. In 2018, it assisted 32,900 surgical patients, performed 4,200 deliveries and had more than 340,000 medical consultations in the emergency room¹⁵. Throughout the study period, there were 90 emergency assessments for suspected massive hemorrhage. 45.6% of these patients were male, and the average age of the sample was 56.4 years old.

The main reasons for hospital admissions were gynecological causes (32.2%), elective abdominal surgery (16.7%), gastrointestinal bleeding (11.1%), vascular diseases and trauma (8.9% each). All causes are listed in table 1.

Table 1. Hospital admission diagnosis.

Gynecology/obstetrics	29	32.2%
Elective abdominal procedures	15	16.7%
Gastrointestinal bleeding	10	11.1%
Vascular diseases	8	8.9%
Trauma	8	8.9%
Transplants	7	7.4%
Cardiac diseases	4	4.4%
Others	9	10%

The hemorrhagic sites were potentially located in the abdomen in 46 cases (51.1%), 23(25.6%) in the pelvis, 10 (11.1%) in the chest, five (5.6%) in the head, five (5.6%) in the limbs and one (1.1%) in the subcutaneous tissue.

The mean systolic BP, at the time of the emergency evaluation, was 103.2 mmHg and the

heart rate was 93.7 bpm, but only 33 (36.7%) patients were classified as having hemorrhagic shock.

Operation was performed in 30 cases (33.3%), upper or lower digestive endoscopy in 12 cases (13.3%), arteriography in seven patients (7.8%), curettage in six (6.7%), oxytocin infusion in five (5.6%) and anticoagulation reversal in two patients (2.2%).

According to the eligibility criteria, REBOA use could have been indicated in 14 (15.6%) occasions (Figure 1). These cases presented with gynecological/obstetric causes (11 - 78.6%) and elective cancer surgery (3 - 21.4%). Surgery was performed in seven (50%) cases, curettage in four (28.6%) and supportive care measures in the remaining three (21.4%).

The mean systolic BP was 82.8 mmHg and the HR was 96.4 bpm. The average length of stay (LOS) was 11.6 days, while the ICU - LOS was 4.7 days. On average, 2.3 units of red blood cells were used. There was one (7.1%) death (Table 2).

Table 2. Potential patients to undergo REBOA.

	Total 90 cases	Potential patients REBOA 14 cases (15.6%)
Sex		
Male	45.6% (41)	78.6% (11)
Female	54.4% (49)	21.4% (03)
Age (years), SE	56.4 (2.08)	42.6 (3.40)
Blood pressure (mmHg), SE	103.2 (3.14)	82.8 (6.38)
Heart rate (bpm), SE	93.7 (2.58)	96.4 (6.27)
Hemorrhagic shock	36.7% (33)	100% (14)
<i>Bleeding site</i>		
Abdomen	51.1% (46)	21.4% (03)
Pelvis	25.6% (23)	78.6% (11)
Thorax	11.1% (10)	
Head	5.6% (5)	
Limbs	5.6% (5)	
Subcutaneous	11.1% (1)	
Length of hospital stay (days), SE	17.6 (2.38)	11.6 (2.43)
ICU stay (days), SE	8.8 (1.81)	4.7 (1.60)
Packed red blood cells (units), SE	3.9 (1.39)	2.3 (0.71)
Mortality	17.8% (16)	7.1% (1)

SE: Standard error.

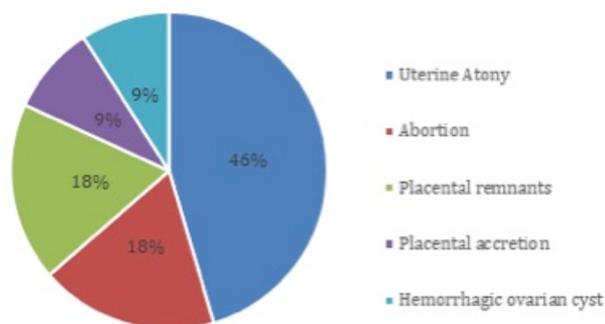


Figure 1. Causes of gynecological and obstetric hemorrhage that may be eligible for REBOA.

In the subgroup of hemorrhagic shock due to gynecological/obstetric causes (11 cases), the causes of bleeding were: uterine atony in five cases (57.1%), abortion and placental remnants in two cases each (18.8%) and placental increase and ruptured ovarian cyst in one case each (9.1%). In this specific subgroup, surgery was performed in five cases (45.5%), curettage in four cases (36.4%) and supportive care in the remaining two cases (18.2%).

DISCUSSION

Our retrospective analysis aimed to assess patients treated by a “quick bleeding response team”, known as a “hemorrhagic code team”, in hospitalized patients in a private Brazilian hospital. 15.5% of the hospitalized patients, who requested an emergency surgical evaluation for suspected massive hemorrhage, would be eligible to undergo the use of the intra-aortic balloon.

Other authors^{13,14} have already reported similar results. Barnard et al.¹³ demonstrated that 5.4% of adult trauma patients in England and Wales, could benefit from the use of REBOA. Thabouillot et al.¹⁴ indicated that in the prehospital scenario, 3.2% of patients who suffered severe trauma could have benefited from the use of the intra-aortic device.

In the current study, more than 70% of the cases, in which REBOA could have been used, were gynecological/obstetric patients. Of these cases, five patients had uterine atony (57.1%), with four requiring surgical treatment, including two hysterectomies. Trauma centers in Brazil are, in most cases, public hospitals. The vast majority of severe traumas, in the city of São Paulo, are sent to these referral hospitals by firefighters rescue teams, by using helicopters or ambulances belonging to the public health system. In this regard, the number of severe trauma patients who are treated in private hospitals, in Brazil, is considerably low.

In a retrospective study, Stensaeth et al.¹⁶ evaluated the use of REBOA in 36 patients with postpartum hemorrhage (PPH), and they demonstrated an increase in systolic pressure (32 ± 22 mmHg), allowing time for a better evaluation and different treatment possibilities, such as uterine artery embolization. Uterine atony is responsible for 80% of all cases of PPH. Placenta accreta and its variants (increta and percreta) are other major causes of obstetric hemorrhagic shock, especially during child delivery¹⁷. Up to 90% of these patients require blood transfusion and approximately 40% require massive transfusion protocols¹⁸. These data indicate a benefit of REBOA use in the hospital setting, especially for obstetric cases.

In a small series of patients, Ordoñez et al.¹⁹ used REBOA as a prophylactic measure in 12 pregnant women diagnosed with placenta accreta, before elective cesarean section. This protocol tends to reduce the bleeding volume and decreases the demand for blood transfusions. Stensaeth et al.¹⁶ evaluated the use of REBOA in 36 patients with postpartum hemorrhage.

No patient died due to REBOA, but 16.7% (n = 6) had complications: arterial or femoral thrombosis in five cases and one inadvertent injury to the aorta that was treated surgically. In our study, one of the eligible cases was diagnosed with PPH secondary to placental accretism.

In addition to the obstetric cases, this study demonstrated that the intra-aortic balloon could have been used in three patients undergoing elective oncological surgery. However, in one case, the bleeding occurred during the operation, being controlled at that moment. For the other two cases, the hemorrhage was secondary to arterial bleeding, diagnosed right after the surgical procedures, and they were controlled by emergency reoperations. The use of REBOA in the immediate perioperative period cases is still uncertain, but the dissemination of the method and prompt accessibility make it an option in the treatment of such situations.

The present study has some limitations. It evaluated a very heterogeneous population regarding size and characteristics. Many of the patients could have used REBOA, but despite its non-use, most of them had bleeding effectively controlled, with the reversion of the hemorrhagic shock. Thus, future controlled studies will be needed to determine the real benefit of using REBOA in patients with established indications.

CONCLUSIONS

Massive bleeding in a hospital environment is a cause of morbidity and mortality for hospitalized trauma, gynecological and obstetric patients. The REBOA is seldom used in Brazil, but it can be a potential tool to be used, and perhaps the last resource in severe patients until definitive, surgical, endovascular or endoscopic treatment is carried out.

R E S U M O

Objetivo: Este estudo objetivou analisar o uso potencial Balão de Oclusão Endovascular da Aorta para Ressuscitação (REBOA) em um hospital brasileiro. **Métodos:** Foi realizada uma revisão da literatura e uma análise retrospectiva de todas as avaliações cirúrgicas de emergência para pacientes com suspeita de hemorragia maciça internados em um hospital brasileiro, de 1 de abril de 2017 a 31 de março de 2018. Os critérios de elegibilidade do REBOA foram: origem abdominal e/ou pélvica, choque hemorrágico e acima de 18 anos de idade. Os critérios de exclusão foram: acima de 70 anos e doença terminal pré-existente ou comorbidades significativas. **Resultados:** No período, foram solicitadas 90 avaliações. Em 14 ocasiões (15,6%) havia indicação para o uso do REBOA. Os casos em que isso foi possível foram devidos a causas ginecológicas/obstétricas em 11 casos (78,6%) e cirurgia oncológica eletiva em três casos (21,4%). **Conclusões:** O REBOA é ainda pouco utilizado em nosso país, mas pode ser uma ferramenta de extrema importância, e talvez o último recurso em pacientes extremamente graves, até que o tratamento definitivo, cirúrgico, endovascular ou endoscópico seja efetuado.

Descritores: Serviços Médicos de Emergência. Choque Hemorrágico. Ressuscitação. Oclusão com Balão. Procedimentos Endovasculares.

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