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Clinical characteristics and haemodynamic state of patients undergoing interhospital transfer for postpartum haemorrhage: A study of a single-centre helicopter emergency medical service

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ABSTRACT

Objective: Uterine artery embolization is an attractive option for the management of postpartum haemorrhage, however it is not available in every hospital. We compared the clinical characteristics and haemodynamic state of patients with postpartum haemorrhage, before and after helicopter transfer to a tertiary hospital for possible uterine artery embolization. We also analysed whether the type of treatment could modify the outcome.

Study design: Between 1999 and 2019 in Switzerland, we retrospectively found 82 consecutive patients with postpartum haemorrhage who were transferred by a physician-staffed helicopter emergency medical service to the tertiary hospital for potential uterine artery embolization. The collected data included the type of delivery, estimated blood loss, shock index and blood lactate levels before transfer and at destination, uterine artery embolization rate and hospital mortality rate. Our primary outcome was to describe the clinical characteristics, outcomes and haemodynamic state of the patients with postpartum haemorrhage before and after helicopter transfer. Our secondary outcome was to report the treatments performed at the tertiary hospital. The collected data were analysed with Stata version 14 (Stata Corporation, College Station, TX, USA). Continuous data are compared by using the Student's *t*-test or the Mann-Whitney *U* test, as appropriate.

Results: We included 69 patients. Postpartum haemorrhage occurred after vaginal delivery in 38 cases (55%). Blood loss prior to transfer exceeded 2 L in 34% of cases. The median shock index was 1 (IQR 0.8–1.1) before transfer and 0.9 (IQR 0.8–1.1) after transfer (p = 0.41). The median lactate level was 2.9 mmol/L (IQR 2.1–6.8) before, and 2.1 mmol/L (IQR 1.55–3.5) after transfer (p = 0.90). Forty-four patients underwent uterine artery embolization (64%), with an overall success rate of 93%. One patient died (1.4%), from a haemorrhagic shock of abdominal origin.

Conclusions: Interhospital helicopter transfer of patients with postpartum haemorrhage to a tertiary hospital seems to be safe in our setting, despite a significant proportion of patients exhibiting signs of haemodynamic instability. Decision criteria would be helpful to better guide choices regarding the transfer of patients with postpartum haemorrhage.

Introduction

Postpartum haemorrhage (PPH) is defined as the loss of more than 500 ml of blood within 24 h after giving birth vaginally [1,2]. It is one of the main causes of maternal death worldwide [3] and is responsible for about 30% of maternal deaths in developing countries[4]. In developed countries, the maternal mortality rate is lower but rising (estimated at 2–10 per 100,000 births) [5].

Abbreviations: UAE, uterine artery embolization; HY, hysterectomy; HEMS, helicopter emergency medical service; PPH, postpartum haemorrhage; CHUV, university hospital of Lausanne; NACA, National advisory Committee on Aeronautics; ICU, intensive care unit; IQR, interquartile range; PRBC, packed red blood cells; SI, shock index.

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The management of PPH is standardized regardless of the aetiology of bleeding. It is based on pharmacological therapy (uterotonics) and surgical revision of the uterine cavity and genital tract (curettage, haemostatic suturing) with simultaneous treatment of haemorrhage and shock, including volemic resuscitation, administration of blood products, and prevention and treatment of coagulopathy [4,6,7]. In the case of failure of this initial management, further measures include mechanical tamponade with an intrauterine (Bakri) balloon, or uterine artery embolization (UAE) by interventional radiology, which is usually performed if available in haemodynamically stable patients [4,7,8]. Conservative surgical management (sutures or arterial ligatures) is another salvage solution. Emergent abdominal hysterectomy (HY) is usually considered a last-resort life-saving procedure for intractable PPH [6,7].

Because of its high success rate and low complication rate, its conservative approach, and its potential for avoiding HY and therefore preserving fertility in young women, UAE is an especially attractive option for the management of PPH [1,4,7,9–14]. However, this procedure is available only in hospitals with a high level of technical platform [7]. Interhospital transfer of patients is therefore required, which can be quite challenging because of the potential for haemodynamic instability [15].

We compared the clinical characteristics and haemodynamic state of patients with postpartum haemorrhage, before and after a helicopter transfer to a tertiary hospital for possible uterine artery embolization. We also analysed whether the type of treatment could modify the outcome.

Methods

Study design and population

The study was conducted in a 3200 km^2 area in which we count six secondary hospitals with maternity wards and the University Hospital of Lausanne with a tertiary level of care in obstetrics-gynaecology. In the canton of Vaud, interhospital transfers of patients in critical condition are assumed by the Lausanne-based helicopter of Rega Swiss Air Ambulance, the major physician-staffed helicopter emergency medical service (HEMS) in Switzerland.

In this retrospective study, all HEMS admissions were screened from 01 January 1999 to 31 December 2019. We included 69 patients who, after vaginal or caesarean delivery, had a PPH and were transferred to the University Hospital of Lausanne (CHUV) for potential UAE. We excluded 13 patients who experienced haemorrhage secondary to miscarriage, or voluntary termination of pregnancy (Fig. 1).

Data collection

The following patient data were collected to define the situation before transfer: age, gravidity, parity, comorbidities (related to the specific situation, for example, disturbances in placental development, history of PPH, or abortion), characteristics of the birth (type of delivery, use of instruments), and quantity of blood loss. Data were also obtained on the medical, surgical, and mechanical treatments received by patients in the secondary hospital.

For the prehospital/transport phase, we collected the prehospital National Advisory Committee on Aeronautics (NACA) severity score [16], as well as the need for drug administration during the flight according to the patient's haemodynamic condition at the beginning of the mission and on arrival at the "Centre hospitalier universitaire Vaudois" (CHUV). We used the shock index (SI), defined as the ratio of heart rate to systolic blood pressure, to determine the severity of the patient's condition and level of haemodynamic instability before and after transfer [17–20].

Finally, we also analysed the tertiary hospital stay, paying attention to the choice of treatment (surgical revision, UAE) and the delay in its performance, the outcome (survival), the duration of the intensive care unit (ICU) stay, and the patient's condition at discharge.

Prehospital data were retrieved from the HEMS medical chart, which is completed by the emergency physician prospectively at the end of every mission. Hospital data from the secondary hospital were retrieved from the discharge medical report, and data from the tertiary hospital were extracted from the patients' medical charts.

Objectives of the study

Our **primary outcome** was to describe the clinical characteristics and haemodynamic state of the patients with PPH before and after the helicopter transfer (HEMS) to the tertiary hospital for possible UAE. Our secondary outcome was to report the treatments performed at the tertiary hospital (UAE, HY, conservative) and how they affected the outcome.

Statistical analysis

The collected data were analysed with Stata version 14 (Stata Corporation, College Station, TX, USA). Continuous data are expressed as means and standard deviations (SDs) or as medians and interquartile ranges (IQRs) according to the data distribution and compared with the Student's *t*-test (normal distribution of the data) or the Mann-Whitney *U* test (non-normal distribution of the data), as appropriate. The vital parameters and laboratory values of patients at the transferring and receiving hospitals were compared using the Wilcoxon matched-pairs signed rank test. Categorical data are expressed as numbers and percentages and compared by using Pearson's chi-squared test (expected counts ≥ 5) or Fisher's exact test (expected counts < 5). A bilateral P of < 0.05 was considered significant.

Ethical considerations

The study and data collection were approved by the Ethics Committee of the state of Vaud "CER-VD", Switzerland (project number 2020–01176).

Results

The mean age was 31 ± 5 years, and most patients had undergone their first (41%, n = 28) or second (37%, n = 25) pregnancy. Of the total sample, 55% of the PPH occurred after natural delivery, without the use of particular instruments. The total blood loss for the majority of the patients was more than 1500 ml (Table 1). Various pharmacological treatments and blood supplies had already been administered before transfer: almost the entire population received uterotonics drugs; 28 (41%) patients received fibrinogen, and 34% received tranexamic acid; the transfusion of packed red blood cells (PRBC) (51%) and fresh frozen plasma (FFP) (51%) was preferred over the use of vasoactive drugs and conservative surgery had been attempted for four patients (6%) (Table 2). The haemodynamic state showed that SI before transfer (available for 67 patient) was $\geq$1 in 27 (40%) and $\geq$1.4 in seven patients (10%). Lactate levels before transfer were available for eight patients it was $\geq$2 mmol/L in seven patients (88%, n = 7) and $\geq$ 4 mmol/L in three.

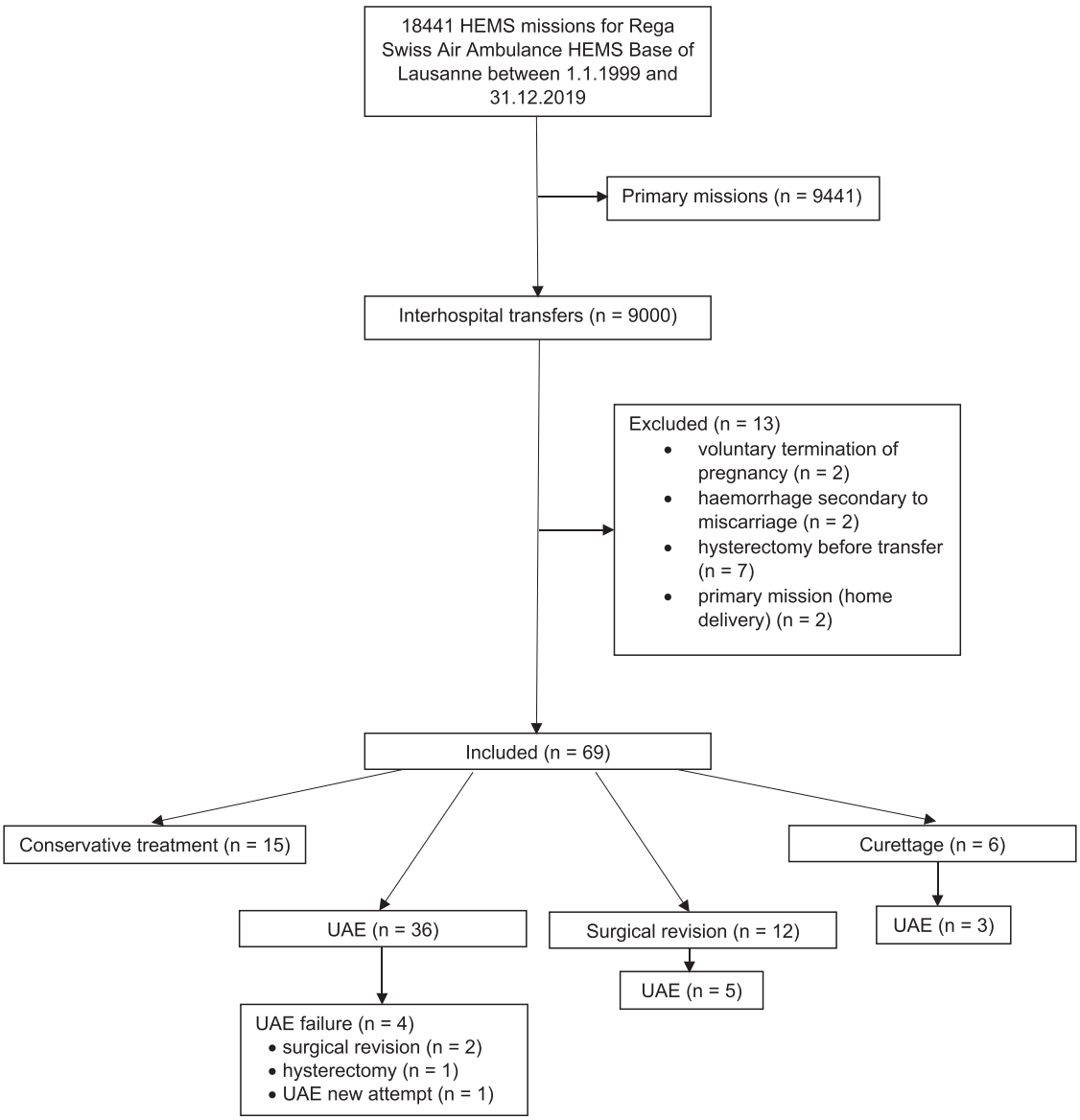

Fig. 1. Flowchart of study patients.

Most patients had a NACA score of ≥4 (66/69; 95%).Of the total sample, 91% (n = 60) were admitted to the shock room at the receiving hospital. The operational and medical characteristics of the HEMS interhospital transfer are shown in Table 3.

The evolution of the vital parameters and laboratory values of patients between the transferring and receiving hospitals is shown in Table 4.

UAE was the first-line treatment for 36 patients (Table 5) and was successful in 32 (success rate of 89%). One patient of 69 underwent HY (1.4%) after a failed UAE. UAE was also performed as the second-line treatment in eight patients, including once after a failed first UAE attempt. Overall, 44 patients underwent UAE (64%), of whom three experienced UAE failure (overall success rate of 93%).

Of the total sample, 7% of the patients required ICU after the procedure and the majority had a 1 day stay or even less.

All but one patient survived the PPH (mortality rate of 1.4%). This patient presented in the regional hospital with acute abdominal pain and haemorrhagic shock. She underwent a caesarean delivery at the regional hospital because of foetal distress. Two episodes of cardiac arrest occurred during surgery, and retroperitoneal bleeding of unknown origin was identified. The patient was transferred to the tertiary centre (CHUV), where rupture of a splenic aneurysm was diagnosed and treated by arterial embolization. The course was complicated and the patient subsequently died in the ICU 71 days after admission.

Discussion

Our findings indicate that more than 50% of our total sample demonstrated signs of haemodynamic instability prior to helicopter transfer, as shown by elevations in SI and the lactate rate and low base excess levels. Forty-four (64%) different patients underwent UAE at the receiving hospital, which included three UAE failures (overall success rate of 93%). The cause of death for the only patient who died was non-obstetrical bleeding.

UAE as a first-line treatment of PPH

Worldwide the incidence of PPH is about 3 in 1000 and has increased in recent years [21–23]. This is also true in Switzerland, where PPH occurs in about 3% of all deliveries and is severe (requiring blood transfusion and/or emergent HY) in about 0.1%

Table 1
Maternal and obstetrical characteristics of patients with postpartum haemorrhage (n = 69).

Age, mean ± SD	31 ± 5
Age, range	19-43
Gravidity, n (%)	
1	28 (41)
2	25 (37)
3	10 (15)
≥4	5 (7)
Parity, n (%)	
0	7(10)
1	30 (44)
2	23 (34)
3	7 (10)
4	1 (1)
Delivery, n (%)	
Vaginal delivery	38 (55)
Caesarean delivery	29 (42)
Abortus	2 (3)
Type of delivery instruments, n (%)	
None	62 (90)
Other instruments[a]	4 (6)
Forceps	3 (4)
Maternal comorbidities, n (%)	
None	43 (64)
History of miscarriage	6 (9)
History of caesarean delivery	5 (7)
History of PPH	4 (6)
History of voluntary termination of pregnancy	4 (6)
History of psychiatric problems	2 (3)
Other problems[b]	2 (3)
History of placental problems	1 (1)
Blood loss in ml, n (%)	
<1000	11 (25)
1000–1499	12 (27)
1500–1999	6 (14)
2000–2999	9 (20)
3000-4000	6 (14)
Number of children, n (%)	
1	63 (97)
2	2 (3)
APGAR score, median (IQR)	
1 min	9 (6–9)
5 min	9 (7–10)
10 min	10 (9–10)

IQR = interquartile range; PPH = postpartum haemorrhage.
[a] Vacuum extractor, spoon, spatula.
[b] Prophylactic anticoagulation (n = 1), uterine fibroma ablation (n = 1), thalassemia minor (n = 1).

Table 2
Management of patients with postpartum haemorrhage at the transferring hospital (n = 69).

Uterine massage, n (%)		9 (13)
Surgery, n (%)		
	Curettage	35 (51)
	Surgery[a]	4 (6)
	Genital surgical revision	10 (14)
Blood products, n (%)		
	≥1 PRBC transfusion	35 (51)
	FFP transfusion	33 (48)
	>5 PRBC transfusions	11 (16)
	Platelets transfusion	6 (9)
Blood units, median (IQR)		2 (0–4)
Blood units, range		0–12
Coagulation/haemostatic factors		
	Fibrinogen	28 (41)
	Tranexamic acid	23 (34)
	Coagulation factors[b]	7 (10)
Intravascular infusion, n (%)		
	Crystalloids	30 (43)
	Colloids	29 (42)
Uterotonics[c], n (%)		60 (88)
Mechanical haemostasis[d], n (%)		21 (30)
Vasoactive drugs[e], n (%)		4 (6)

IQR = interquartile range; FFP = fresh frozen plasma; PRBC = packed red blood cells.
[a] Surgical uterine artery ligature (n = 3), laparotomy (n = 1).
[b] Haemostasis factors II, VII, IX, X (Prothrombine Proconvertine Stuart B (PPSB) and protein C and S.
[c] Oxytocin (n = 51), sulprostone (n = 36), methylergonovine (n = 34), misoprostol (n = 40), intracavitary prostaglandins (n = 12).
[d] Bakri balloon (n = 15), B-Lynch (n = 3), intrauterine packing (n = 2), Bakri balloon and B-Lynch (1).
[e] Norepinephrine (2), ephedrine (1), epinephrine (1).

Table 3
Operational and medical characteristics of the interhospital transfer (HEMS) of patients with postpartum haemorrhage (n = 69).

Nocturnal interventions, n (%)		15 (22)
Departure time (min), median (IQR)		
	Overall	7 (5–10)
	Daytime	5 (4–9)
	Night-time [a]	12 (9–13)
Time on site (min), median (IQR)		27 (22–32)
Time to destination (min), median (IQR)		11 (9–12)
Total prehospital time (min), median (IQR)		58 (50–65)
Patient already intubated before transfer		23 (32)
Treatments administrated during the flight, n (%)		
	Vascular filling	64 (96)
	Oxytocin IV	22 (32)
	Oxygen	39 (56)
	PRBC	21 (30)
	Vasoactive drugs [b]	12 (14)
	Fentanyl [c]	9 (13)
	FFP	8 (12)
	Tranexamic acid	6 (9)

FFP = fresh frozen plasma; HEMS = helicopter emergency medical service; IQR = interquartile range; PRBC = packed red blood cells; IV = intravenous.
[a] P < 0.001 between day and night.
[b] Ephedrine (n = 3), neosynephrine (n = 7), epinephrine (n = 2).
[c] Median dose (IQR) of 100 μg (IQR 100–200).

[24]. Emergency postpartum HY is a last-resort option in the management of PPH and generally proposed for patients in severe shock [22,24]. Although HY unavailability in some rural settings may be the reason to transfer a patient with PPH to a higher level centre [15], interhospital transfer for PPH is mostly indicated to avoid HY by offering patients conservative treatments, including UAE, at a proportion as high as 91% in some centres [24–30]. The rationale for transfer for PPH is the fertility-sparing potential of UAE, which is mostly important [7,8,24,29] for primiparous women [7,27], as well as to avoid the psychological impact of HY when it can be avoided [22,24].

The proportion of first-line treatment performed before transfer in our study was similar to that described in a previous study [31]. The global UAE success rate was 93% in our study, which is in the range of 79% to 100% reported by other teams [8,25–28,30]. Only one patient underwent re-embolization and one underwent HY after a failed UAE (1.4%), which is also similar to that reported in other studies [27–29,32]. Although it is not possible to determine if HY would have been necessary for every patient who underwent UAE in our study, we believe that a substantial proportion of HYs were prevented, considering the high proportion (61%) of patients who benefited from UAE in our cohort. This may have allowed for the preservation potential for subsequent pregnancies [8]. The success rate of UAE is lower for unstable patients and a transfer for UAE should therefore ideally be considered in patients without signs of haemodynamic instability [7,29].

Pharmacological treatments and blood supplies

In our study, most treatments initiated at the transferring hospital were continued, and many treatments were initiated or repeated during HEMS transfer, including uterotonics, blood components, and tranexamic acid. Similar to the case for trauma, it is advised that medical treatment, including blood transfusion,

Table 4
Evolution of the vital parameters and laboratory values of patients with postpartum haemorrhage between the transferring and receiving hospitals (n = 69).

	Before transfer	At hospital	p value
Vital parameters			
CRT > 2 s, n (%)	14 (22)	–	–
GCS, median (IQR)	15 (3–15)	15 (3–15)	–
$EtCO_2$ (mmHg), median (IQR) (p = 0.6)[a]	37 (35–39.5)	36 (34–39)	0.81
SpO_2, median (IQR)	99 (97–100)	99 (97–100)	0.24
HR (min^{-1}), median (IQR)	105 (94–124)	104 (92–123)	0.54
RR (min^{-1}), median (IQR)	16 (14–20)	16 (14–19)	0.05
SBP (mmHg), median (IQR)	113 (95–128)	111 (100–125)	0.60
Shock index, median (IQR)	1 (0.8–1.1)	0.9 (0.8–1.1)	0.41
Temperature (°C), median (IQR)[b]	36.5 (36–36.7)	–	–
VAS[c]	0 (0–3)	0 (0–1)	0.02
Laboratory values			
Base excess (mEq/L)[d], median (IQR)	−7.45 (−11.2 to −5.9)	−4.9 (−7.1 to −2.9)	0.20
Hb (g/L), median (IQR)[e]	79 (68–94)	89.5 (75.9–101.5)	0.14
Lactate > 2 mmol/L, n (%)	7 (88)	31 (55)	–
Lactate (mmol/L), median (IQR)	2.9 (2.1–6.8)	2.1 (1.55–3.5)	0.90

CRT = capillary refill time; $EtCO_2$ = end-tidal carbon dioxide; GCS = Glasgow Coma Scale; Hb = haemoglobin; HR = heart rate; IQR = interquartile range; RR = respiratory rate; SBP = systolic blood pressure; SpO_2 = blood oxygen saturation; VAS = visual analogue scale.
[a] n = 16.
[b] n = 6 observations.
[c] Visual analogue scale to determine pain with a score of 1–10/10.
[d] n = 9 observations.
[e] Hb levels at hospital were lower than before transfer in 22 (40%) patients for whom this information was available. The highest decline in Hb levels were 43, 37 (n = 2), 30, 29, and 16 g/L.

Table 5
Hospital treatments of patients transferred for postpartum haemorrhage (n = 69).

Hospital main 1st treatment, n(%)		Hospital 2nd treatment, n(%)	
UAE	36 (52)	UAE [c]	8 (12)
None	15 (22)	None	58 (84)
Curettage	6 (9)	Surgical revision	2(3)
Surgical revision (without HY)	12 (17)	Hysterectomy [d]	1(1)
Time to 1st hospital main treatment (minutes), median (IQR)	35 (27–44)	Time to 2nd hospital main treatment (minutes), median (IQR)	360 (142–695)
Other hospital treatment, n (%)			
Uterotonic drugs [a]		30 (60)	
PRBC		21 (30)	
Vasoactive drugs		15 (22)	
Hypnotic drugs [b]		12 (20)	
Opiates		9 (15)	
FFP		8 (12)	
Tranexamic acid		6 (10)	
Maternal outcome			
48-h outcome			
Alive, intermediate care unit hospitalization		31(45)	
Alive, ward hospitalization		21 (30)	
Alive, transferred to another hospital		11(16)	
Alive, ICU hospitalization		5 (7)	
Alive, discharged		1(1)	
ICU stay duration (days), n (%)			
<24 h		46(68)	
1 day		17(25)	
2 days		3(4)	
4 days		1(1)	
5 days		1(1)	
71 days		1(1)	
ICU length of stay (days), median (IQR)		0 (0–1)	
Intermediate care length of stay (days), median (IQR)		1 (1–2)	
Hospital length of stay (days), median (IQR)		4 (2–6)	
Maternal mortality		1 (1.4)	
Neonatal mortality		3 (6)	

FFP: fresh frozen plasma; HY: hysterectomy; ICU: intensive care unit; IQR: interquartile range; PRBC: packed red blood cells; UAE: uterine artery embolization.
[a] Sulprostone (n = 21), intracavitary prostaglandin (n = 8), oxytocin (n = 1).
[b] Propofol (n = 7), Midazolam (n = 2).
[c] After failure of surgical revision (n = 5), curettage (n = 2), and first embolization (n = 1).
[d] After failure of embolization.

should be initiated in the transferring facility [33,34]. This is especially important for patients with PPH who are being transferred for UAE, as disseminated intravascular coagulation is linked to UAE failure and worse outcomes [25,26,28,33]. Notably, if given soon after bleeding onset, tranexamic acid is known to reduce the risk of death from blood loss in women with PPH [2,17,35,36].

Although the utility of tranexamic acid is widely known, in our study we found a very low proportion of women who received it; 34% is the overall percentage without taking into consideration the frequency for each individual year. The most important study demonstrating the effectiveness of tranexamic acid in patients with post-partum haemorrhage was published in 2007 [2]. If we split our population into two parts (before and after 2007), the administration rate of tranexamic acid was 17% for the first part of the study period and more than 40% for the second part. The administration rate was in either case under 50% and the reason was found to be, especially in the years after 2007, in the lack of knowledge of the drug, especially in a secondary hospital. After 2007 only five patients received tranexamic acid during the flight, one of them as a first dose.

Interestingly, uterine massage may be considered in our setting and is recommended by some guidelines [4,7], but it was not reported in our case series, although it may have been performed by an accompanying midwife.

Blood transfusion is a supportive treatment for haemodynamic instability. We found a tendency to under-transfuse, as less than half of the population received at least one transfusion of PRBC and only 16% received more than five despite the critical conditions. This can be explained both by the concept of under-triage, as explained earlier, and by the fact that transferring hospitals often have limited blood bank capabilities.

Transfer of unstable patients: pros and cons

The assessment of haemodynamic stability in PPH is, however, not straightforward. Blood loss estimation is probably an insufficient parameter; as visual estimation of blood loss has been shown to be inaccurate in PPH [7]. Our results nonetheless show that a substantial proportion of our patients transferred for UAE had the criteria for haemodynamic instability based on the SI. This parameter, suggested to assess the degree of hypovolemic shock [20], was notably $\geq$1 for 52% of patients [17,18,21]. Vasopressors, which are also an indicator of haemodynamic instability, were administered in 14% of our patients. In our setting, interhospital transfer of patients with PPH is an option, but it is also performed in situations of haemodynamically unstable patients. Other studies also report transferring patients with PPH with haemodynamic instability [15,25,26,31], the proportion of these unstable patients being 22% [15] or 18%, [16] and thus half of the percentage shown in our study. The parameters of shock or hypoperfusion (SI, lactate levels, base excess levels) and haemoglobin levels were not significantly worse at hospital arrival compared with values before transfer. The patients' general conditions remained unchanged despite the seriousness of the situation, which may partially be explained by the relatively short transfer time, as well as the treatments administered during transfer. The safety of our practice seems further supported by the good outcome of our patients, as well as the absence of serious complications occurring during HEMS transfer. Although our conclusions may be hindered by the relatively low number of cases, our results suggest that there was no under-triage [37]. Under-triage would be represented by patients being transferred for PPH who had serious complications during transfer or at hospital arrival. The only patient who died after transfer was found to have abdominal bleeding rather than a gynaecological source of haemorrhage. On the other hand, our data may also suggest that some unstable patients may have undergone rescue peripartum HY in the secondary hospital, which could have been avoided by transferring the patient for UAE. The existence and extent of such over-triage [37], however, cannot be determined from our data.

The transfer of a haemodynamically unstable patient is usually contraindicated unless a medical necessity exists (unavailable surgery in the transferring hospital) [33]. Many hospitals have maternal and obstetric services available to offer definitive surgical treatment (HY), but do not have the capacity for UAE [7]. Although in some other medical conditions, bringing the treatment to the patient either in the hospital [32] or in the community [34] may be an option, this is not the case for UAE. Such interhospital transfer needs to carefully balance the risk to the mother's life with the benefit of preserving fertility, which may be an extremely difficult and complex decision.

Guidelines have also been advocated for the selection and transfer of patients with PPH to higher level centres [7,38,39].

A comprehensive system regarding interhospital transfer does not yet exist, but could be developed with the input of tertiary hospitals. Finally, the existing guidelines should also support the transfer of selected patients with PPH for UAE, despite instability criteria.

Limitations

The main limitation of our study pertains to its retrospective nature, which may have affected the quality and exhaustiveness of the data. This impact is probably limited, however, because of our access not only to the HEMS medical chart, but also to those from the transferring and receiving hospitals. Other limitations include the long duration of the study, as well as the relatively low number of cases. Conclusions about outcomes or major complications therefore need to be interpreted with caution. These limitations are characteristic of numerous infrequent medical conditions, including PPH, and are a major reason that most published studies on this topic are retrospective. Finally, we had no access to the cases with PPH that were not transferred, including those for whom HY may have been performed in the secondary hospital. Better knowledge of these cases would be necessary to comprehensively assess the PPH management process in the regional network.

Conclusions

Interhospital helicopter transfer of patients with PPH to a tertiary hospital in order to undergo UAE seems to be safe, despite a significant proportion of patients having signs of haemodynamic instability. Our practice, as well as those of many other clinicians, contrasts with the guidelines that usually reserve transfer for those patients with PPH who are haemodynamically stable. Decision criteria still need to be developed. In deciding to transfer a patient with PPH to a tertiary hospital in order to receive UAE, the team needs to take into account not only the benefit of avoiding HY as a means to preserve future chances of pregnancy, but also the potential adverse maternal outcome secondary to haemorrhagic shock. This decision should be a multidisciplinary one that is shared with the transferring team in the context of a regional network that includes pre-established procedures and guidelines.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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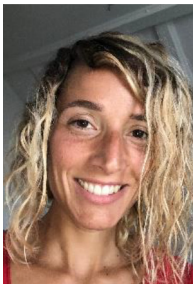

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