PALERMO 5-7 Ottobre
XXVIII CONGRESSO NAZIONALE

European Society of Regional Anaesthesia & Pain Therapy
ESRA ITALIA

Early Coagulation Support nel paziente emorragico……
….in ostetricia

Ospedale Isola Tiberina
GEMELLI ISOLA

Maria Grazia Frigo

UO INTERDIPARTIMENTALE ANESTESIA E RIANIMAZIONE OSTETRICA GEMELLI ISOLA
PONSABILE SIAARTI SEZIONE CURE MATERNO INFANTILI
PONSABILE SCIENTIFICO DAJE

SIAARTI
PRO VITA CONTRA DOLOREM SEMPER

DAJE TEAM
Delivery Analgesia Jet Emergency

Doctor, the lady is bleeding……..

Call the anesthetist

Midwife

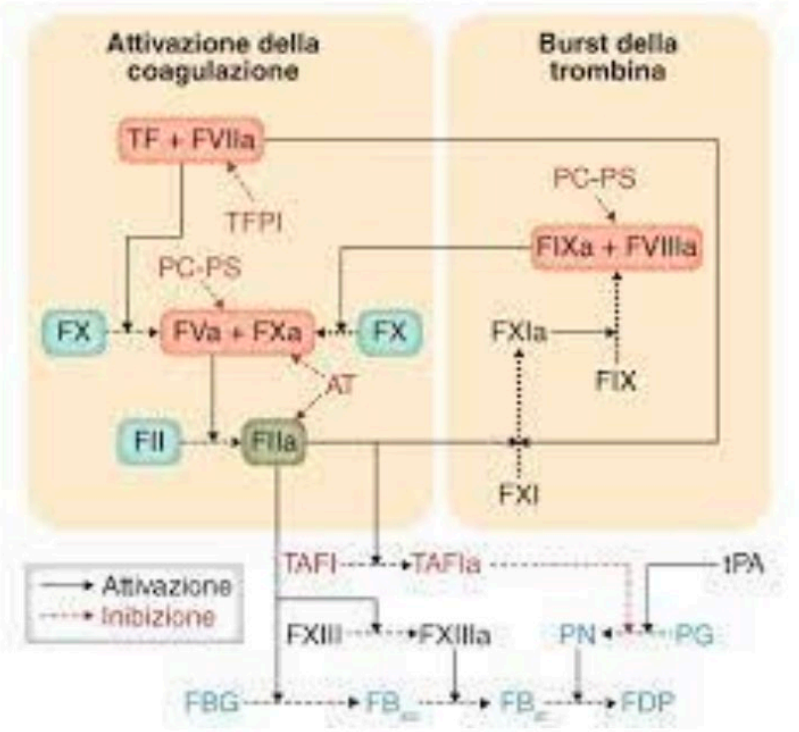
Gynecologist

anesthetist

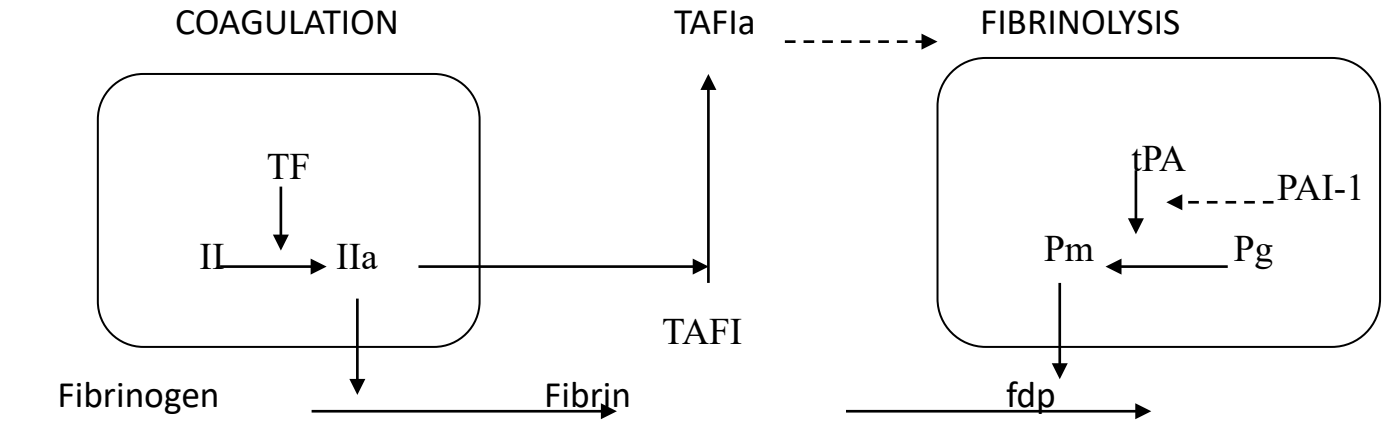
But do I have to decide???

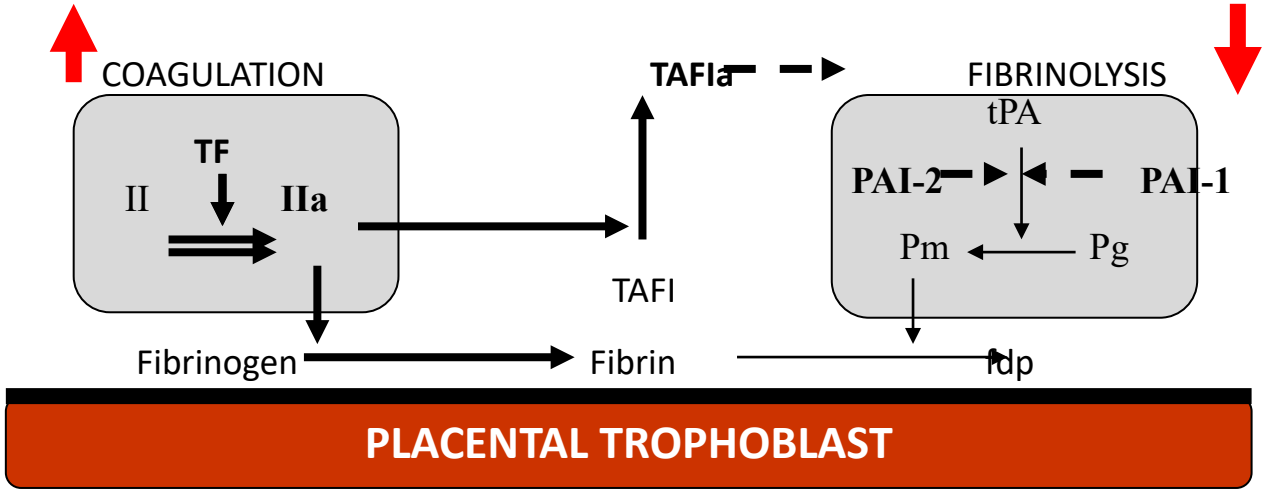
Coagulations factors in Pregnancy

	Pro-coagulanti	Anti-coagulanti
Aumentano durante la gravidanza	Fibrinogen, vWF, FVII, FX, FVIII, FXII, PAI-1, FIX, TAFI, TAT complex, Prothrombin fragment 1+2	D-dimer, Fibrinopeptide A
Variabile aumento/diminuzione o nessun cambiamento	FXI, FV, FXIII	Protein C, Antithrombin
Diminuiscono durante la gravidanza	Platelet count	Protein S, tPA



NORMAL ENDOTHELIUM





PLACENTAL TROPHOBLAST

HEMOSTATIC CHANGES IN PREGNANCY

Variables (mean ± SD)	First tri*	Second tri*	Third tri*	Normal range
Platelet ($\times 10^9$ 1^{-1})	275 ± 64	256 ± 49	244 ± 52	150–400
Fibrinogen (g/L)	3.7 ± 0.6	4.4 ± 1.2	5.4 ± 0.8	2.1–4.2
Prothrombin complex (%)	120 ± 27	140 ± 27	130 ± 27	70–30
Antithrombin (U/mL)	1.02 ± 0.10	1.07 ± 0.14	1.07 ± 0.11	0.85–1.25
Protein C (U/mL)	0.92 ± 0.13	1.06 ± 0.17	.94 ± 0.2	0.68–1.25
Protein S, total (U/mL)	0.83 ± 0.11	0.73 ± 0.11	0.77 ± 0.10	0.70–1.70
Protein S, free (U/mL)	0.26 ± 0.07	0.17 ± 0.04	0.14 ± 0.04	0.20–0.50
Soluble fibrin (nmol/L)	9.2 ± 8.6	11.8 ± 7.7	13.4 ± 5.2	<15
Thrombin–antithrombin (μg/L)	3.1 ± 1.4	5.9 ± 2.6	7.1 ± 2.4	<2.7
D-dimers (μg/L)	91 ± 24	128 ± 49	198 ± 59	<80
Plasminogen activator inhibitor-1 (AU/mL)	7.4 ± 4.9	14.9 ± 5.2	37.8 ± 19.4	<15
Plasminogen activator inhibitor-2 (μg/L)	31 ± 14	84 ± 16	160 ± 31	<5
Cardiolipin antibodies positive	2/25	2/25	3/23	0
Protein Z (μg mL^{-1})†	2.01 ± 0.76	1.47 ± 0.45	1.55 ± 0.48	
Protein S (%)†		34.4 ± 11.8	27.5 ± 8.4	

Blood Gas Analysis: pH, Hb, Lac, BE

Complete blood count, coagulation profile

ROTEM/TEG

Transfusion center: request 4 U leucodepleted red blood cells

DO NOT WAIT FOR THE LABORATORY RESULTS TO START THE TREATMENT

.....check the following parameters every 30-60 minutes

FATAL TRIAD: *ACIDOSIS HYPOTERMIA COAGULOPATHY*

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Eur J Anaesthesiol 2023; **40**:29–38

OPEN

REVIEW ARTICLE

Haemostatic support in postpartum haemorrhage

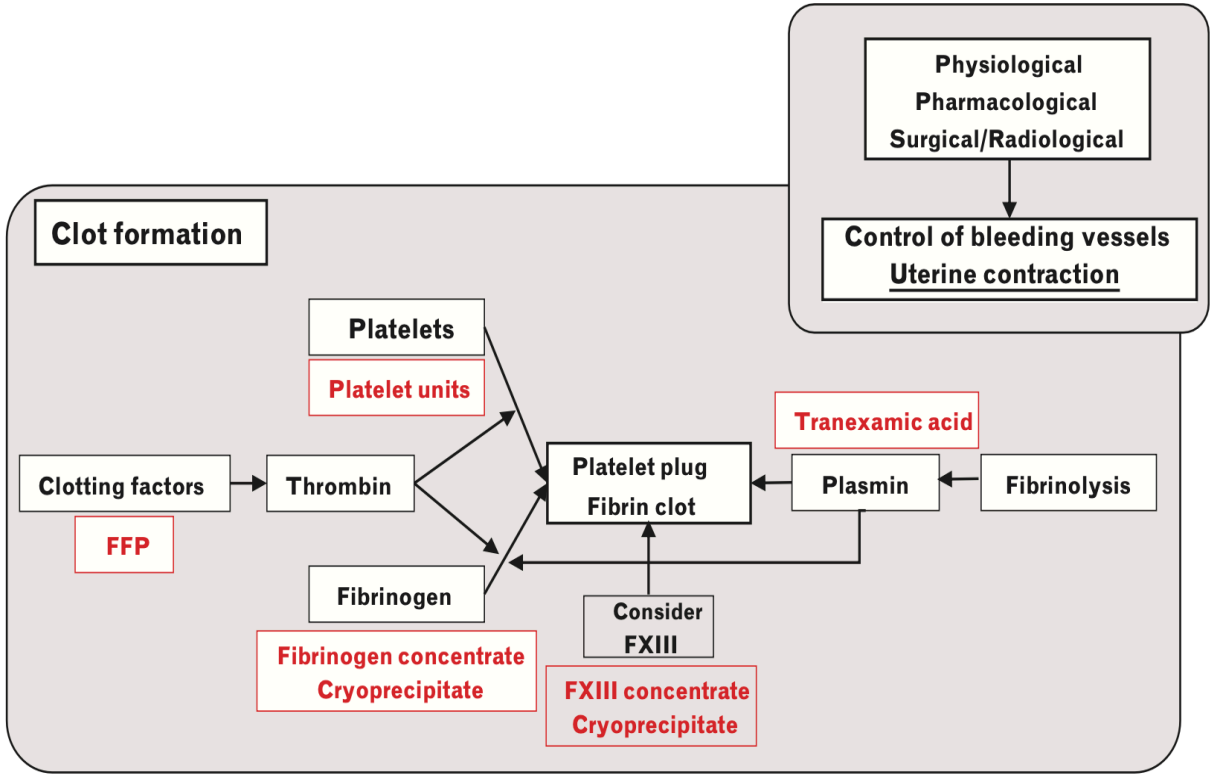
A review of the literature and expert opinion

Stefan Hofer, Jan Blaha, Peter W. Collins, Anne-Sophie Ducloy-Bouthors, Emilia Guasch, Francesco Labate, Filipa Lança, Lill Trine Nyfløt, Kostja Steiner and Marc Van de Velde

Treatment of coagulopathy should be considered early and simultaneously with the other strategies, especially in aetiologies with a higher risk of coagulopathy such as abruption or AFE.

The main goals of haemostatic management are to treat hyperfibrinoly- sis and to restore clot formation. In the case of PPH this includes the use of antifibrinolytics like tranexamic acid (TXA), and agents that act on the coagulation cascade, such as coagulation factor concentrates, fresh frozen plasma (FFP) and platelets

Fig. 3 Summary of haemostatic intervention strategies for obstetric bleeding.



Clot stability is affected by different factors (black text) and the main goals of haemostatic management (red text) are to treat hyperfibrinolysis and to restore clot formation. FFP, fresh frozen plasma; FXIII, factor XIII.

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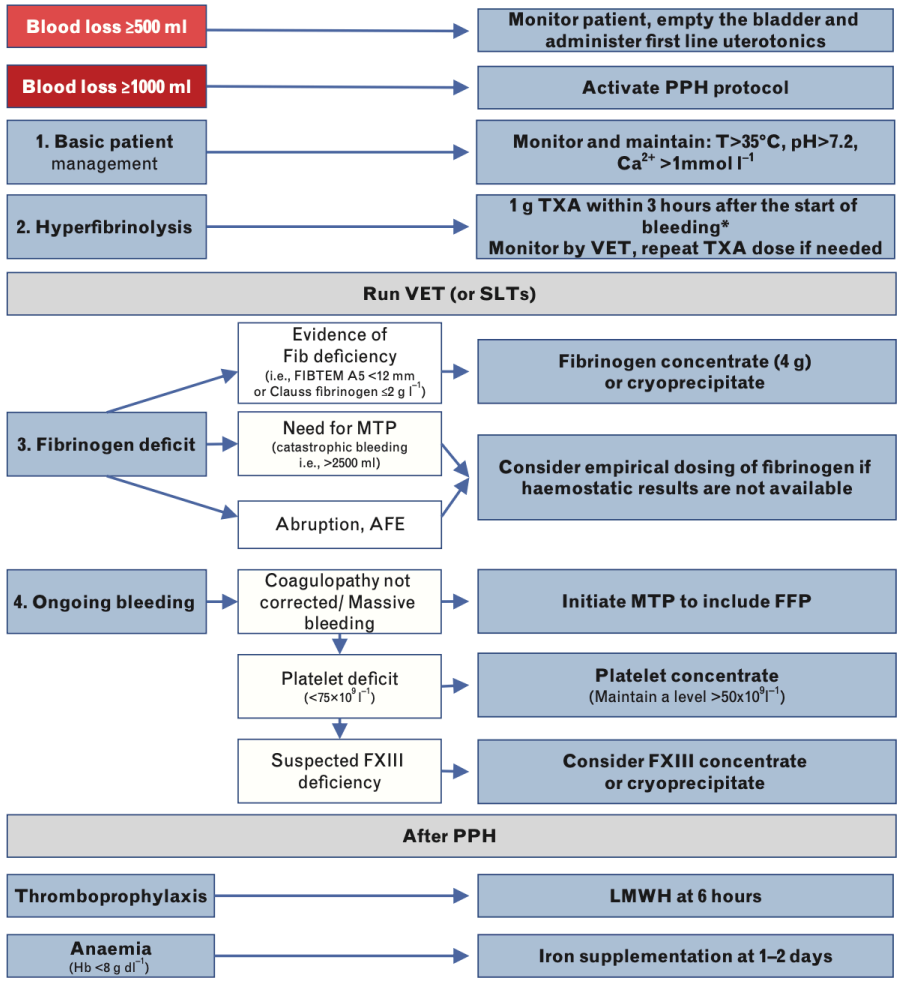
Initiation of haemostatic treatment is guided by the volume of blood loss.

Blood loss equal or greater than 500 ml should trigger infusion of TXA and close monitoring of the patient, including initial SLTs (Clauss fibrinogen) VET (ROTEM/TEG).

The algorithm starts with a reminder regarding basic patient management, including monitoring and maintaining body temperature, acid-base status and calcium levels.

Fig. 4 Suggested haemostatic treatment algorithm in PPH.



*Caution is needed in patients receiving more than 2 g day^{-1} due to potential renal and epileptogenic effects of TXA. AFE, amniotic fluid embolus; F, factor; FFP, fresh frozen plasma; FIBTEM, fibrinogen thromboelastometry; Fib, fibrinogen; Hb, haemoglobin; LMWH, low-molecular-weight heparin; MTP, massive transfusion protocol; PPH, postpartum haemorrhage; SLTs, standard laboratory tests; TXA, tranexamic acid; VET, viscoelastic testing.

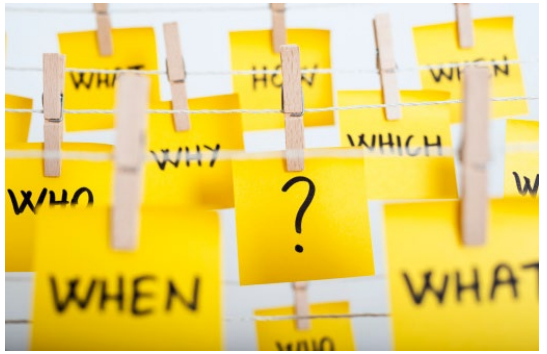
Objectives

- **Hb >8gr/dL**
- **PLT >50x10^9 /L**
- **PT ratio <1.5 in respect to normal**
- **aPTT <1.5 in respect to normal**
- **Concentration of Fibrinogen >2gr/L**

Maintain :

Ht > 21 - 24% *T >34 °C* *pH > 7,20.* *Ca++>1*

STRATEGIES FOR REANIMATION



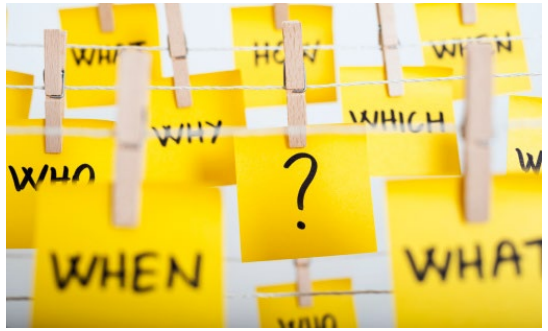
Restore circulating volume with cristalloid solutions while waiting for blood components….

…to sustain volemia and warrant adequate tissue perfusion

- **Boluses of 500ml**
- **Balanced crystalloid solutions to reduce risk of Hyperchloremic acidosis**
- **After the administration of each bolus, physicians must assess the clinical status of patients**

FIGO, 2022

STRATEGIES FOR REANIMATION



TARGET

MAP 50-60 mmHg

PAS 80-90 mmHg

Until major bleeding has been controlled

(RECCOMENDATION 1C)

The concept of hypotensive resuscitation is because administering small crystalloid volumes reduces the risk of diluitional coagulopathy

FIGO, 2022

Rossaint et al. Critical Care (2016) 20:100
DOI 10.1186/s13054-016-1265-x

Critical Care

RESEARCH Open Access

The European guideline on management of major bleeding and coagulopathy following trauma: fourth edition

Rolf Rossaint[1], Bertil Bouillon[2], Vladimir Cerny[3,4,5,6], Timothy J. Coats[7], Jacques Duranteau[8], Enrique Fernández-Mondéjar[9], Daniela Filipescu[10], Beverley J. Hunt[11], Radko Komadina[12], Giuseppe Nardi[13], Edmund A. M. Neugebauer[14], Yves Ozier[15], Louis Riddez[16], Arthur Schultz[17], Jean-Louis Vincent[18] and Donat R. Spahn[19*]

…early and aggressive fluid administration to restore blood volume. This approach may, however, **increase the hydrostatic pressure on the wound**, **cause dislodgement of blood clots,** a **dilution of coagulation factors** and **undesirable cooling of the patient.**

The concept of low volume fluid resuscitation, so-called "**PERMISSIVE HYPOTENSION**", avoids the adverse effects of early aggressive resuscitation while maintaining a level of tissue perfusion that, although lower than normal, is adequate for short periods…

Crystalloid balanced vs NaCl 0.9%

Na = 135-145 mEq/l
Cl = 98-110 mEq/l
K = 3.5-5.3 mEq/l

cristalloidi bilanciati **cristalloidi bilanciati**

	Nonbuffered			
	Isotonic saline	↓ Lactated Ringer's		↓↓ Ringer's acetate
Osmolality	308	277		276
Na^+	154	131		130
Cl^-	154	112		112
K^+	—	5.4		5.4
Ca^{++}	—	1.8		0.9
Mg^{++}	—	—		1.0
Lactate	—	28		—
Acetate	—	—		27
Malate	—	—		—
Gluconate	—	—		—
Bicarbonate	—	—		—
Citrate	—	—		—

	Plasma
Osmolarità (mOsm/l)	285
Sodio	140
Potassio	5
Calcio	2,2
Magnesio	1
Cloruro	100
Acetato	
Lattato	1
Bicarbonato	24
Citrato	

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FIGO recommendations on the management of postpartum hemorrhage 2022

HYPOTENSIVE RESUSCITATION

11.2.1 | Hypotensive resuscitation

The concept of hypotensive resuscitation is because administering small crystalloid volumes reduces the risk of dilutional coagulopathy

11.2.4 | Aggressive approach and adverse outcomes

During hemorrhagic shock the endothelial glycocalyx becomes thinner and administration of large amounts of crystalloids exacerbates this state, leading to fluid extravasation that may cause cerebral, cardiac, and pulmonary edema.[7,10,11] Third spacing may also lead to cardiac dysfunction, worsen hemodynamics, and decrease kidney perfusion. Decreased kidney perfusion occurs because of an increase in intra-abdominal pressure, which can additionally result in abdominal compartment syndrome.[7,11]

Aggressive Approach

11.2.2 | Intravenous fluids

Among the initial strategies for reanimation, the administration of crystalloids in small boluses of 500 ml is recommended.[10] Scientific evidence recommends the use of balanced crystalloid solutions such as Ringer's lactate owing to the risk of hyperchloremic acidosis and the worsening of kidney function with chlorine-rich fluids (saline solution).[7] This is particularly important for LMICs, where saline-based solutions are in abundance. After the administration of each bolus, physicians must assess the clinical status of patients, looking for an improvement in signs and symptoms of shock resulting from blood loss.[10]

11.2.3 | Targeted blood pressure

The difference between aggressive and hypotensive resuscitation lies within targeted blood pressure management.[4] Mean arterial pressure (MAP) represents the perfusion of the majority of organs, therefore providing the target for clinicians to guide fluid administration.[11] Hemorrhagic shock animal models have demonstrated a positive benefit in survival with MAP between 55–60 mm Hg during active bleeding.[10] The European guideline on management of major bleeding and coagulopathy following trauma recommends permissive hypotension with a systolic blood pressure target of 80–90 mm Hg (MAP 50–60 mm Hg) until major bleeding has been controlled (Recommendation Grade 1C).[12]

The decision to initiate red cell transfusion is CLINICAL

Red cell transfusion: homogrup/ Zero Rh neg

1U increases Hb of 1gr/dL and Hct of 2-3%

Trigger transfusion platelet is $75x10^9$ ·

Woman RhD neg receives Platelet RhD pos

prophylaxis anti-D is necessary

Fresh frozen plasma, when bleeding persists even after administration of red cells. Dosage: 15-20ml/kg.

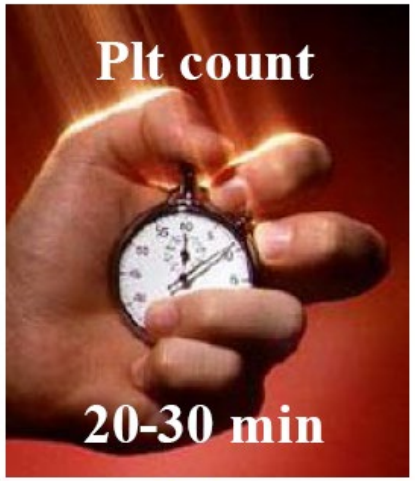
Risk TACO/TRALI

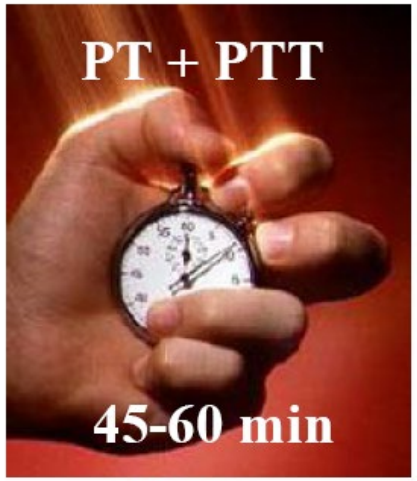
Point-of-care versus central laboratory coagulation testing during haemorrhagic surgery

A multicenter study

Pierre Toulon[1,2]; Yves Ozier[3]; Annick Ankri[4]; Marie-Hélène Fléron[5]; Geneviève Leroux[6]; Charles Marc Samama[7]

Thromb Haemost 2009; 101: 394–401





Test results were obtained in **less than 5'** when performed using **POC device** versus a **median turnaround time of 88' (range: 29-235')** when blood collection tubes were sent to the **central laboratory**.

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DOI: 10.1111/tme.12755

TRANSFUSION PRACTICE

TRANSFUSION MEDICINE WILEY

Practical approach to transfusion management of post-partum haemorrhage

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Abstract

Objectives: To describe transfusion management during post-partum haemorrhage (PPH) and the usefulness of standard or point-of-care (POC) laboratory tests for guiding haemostatic management.

Background: PPH is the leading cause of maternal mortality and severe maternal morbidity worldwide. Despite the efforts made in recent years, PPH is often burdened by preventable death. Recent data from the active Italian Obstetric Surveillance System (ItOSS) highlighted the following main critical issues: inadequate communication between healthcare professionals, inability to correctly and promptly assess the severity of haemorrhage, delays in diagnosis and treatment, failure to request blood promptly and inappropriate monitoring post-partum.

Materials and Methods: Data in the literature have been compared with the rotational thromboelastometry (ROTEM)- and the thromboelastography (TEG)-guided algorithms applied in the authors' departments.

Results: PPH transfusion therapy may have an empirical approach based on the standard use of blood products or a targeted approach based on coagulation monitoring by laboratory or POC tests. Here, the authors describe how they manage PPH in their departments, according to the Italian guidelines, along with the addition of a ROTEM- and a TEG-guided algorithms developed by themselves.

Conclusion: Although the proposed algorithms have not been validated by trials or observational studies conducted in our departments, we believe that these indications could be useful for supporting clinical practice. Furthermore, we deem it appropriate to emphasise the importance of a multidisciplinary approach and the need for standardised and shared protocols to support the decisions of healthcare professionals.

KEYWORDS
blind transfusion therapy, coagulation, postpartum haemorrhage, pregnancy, rotational thromboelastometry-guided algorithm, thromboelastography-guided algorithm

Early administration of tranexamic acid (1 g intravenously), in addition to the standard treatment with uterotonics.
If bleeding persists beyond 30 minutes, or if it resumes within 24 hours of the first administration, a second dose of tranexamic acid is recommended

While waiting for the laboratory results
4 bags of packed red blood cells: 4 units of plasma from a single donor or industrial type
or 4 bags of packed red blood cells: 2 units of apheresis plasma platelet concentrate, 1 unit of apheresis or buffy coat per 8 bags of packed red blood cells

If aPTT or INR is > 1.5
Transfuse packed red blood cells and plasma (initial dose 20 mL/kg, up to 30 mL/kg for persistent or worsening coagulopathy).

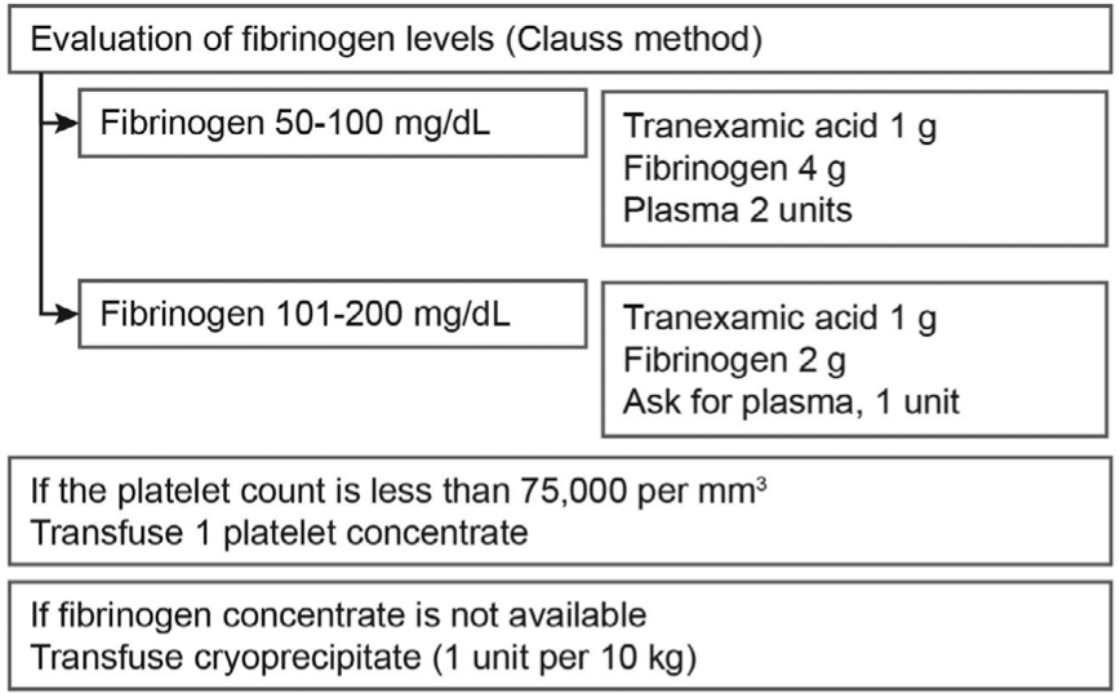


FIGURE 1 Blind transfusion therapy.[9] aPTT, activated partial thromboplastin time; INR, international normalised ratio

BLIND TRANSFUSION THERAPY

TEG / ROTEM

…each morphology has its own meaning

Normal
R;K;MA;Angle = Normal

Anticoagulants/hemophilia
Factor Deficiency
R;K = Prolonged;
MA;Angle = Decreased

Platelet Blockers
Thrombocytopenia/
Thrombocytopathy
R ~ Normal; K = Prolonged;
MA = Decreased

Fibrinolysis (UK, SK, or t-PA)
Presence of t-PA
R ~ Normal;
MA = Continuous decrease
LY30 > 7.5%; WBCLI30 < 97.5%;
Ly60 > 15.0%; WBCLI60 < 85%

Hypercoagulation
R;K = Decreased;
MA;Angle = Increased

D.I.C
Stage 1
Hypercoagulable state with
secondary fibrinolysis

Stage 2
Hypocoagulable state

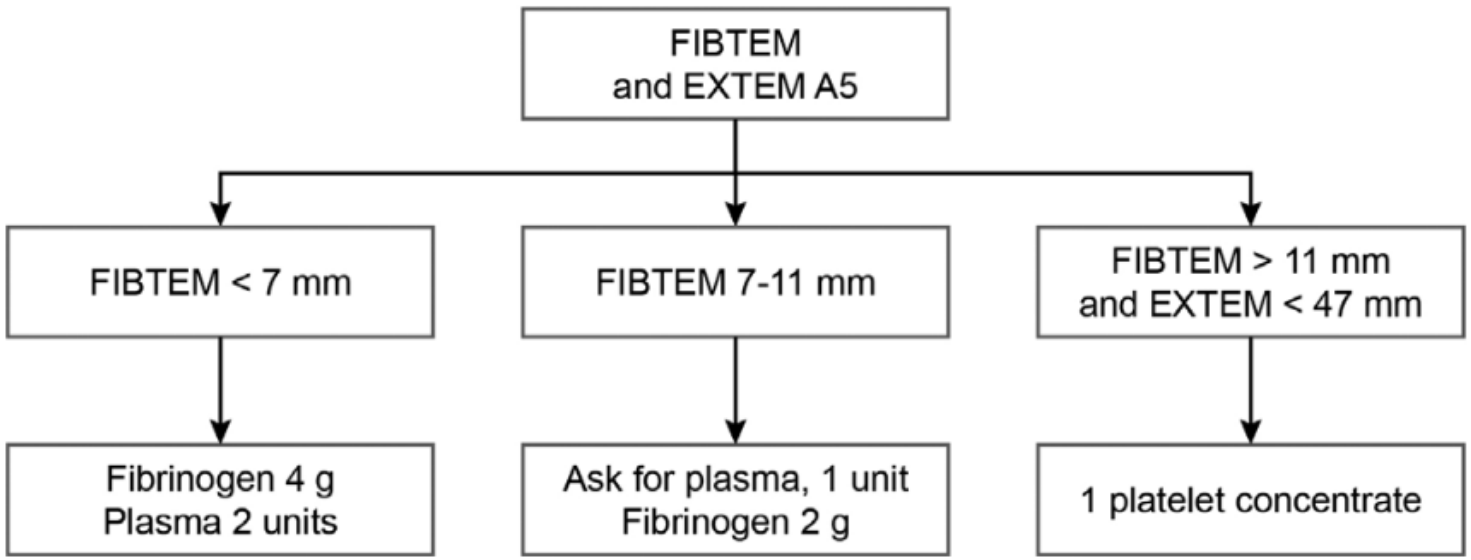
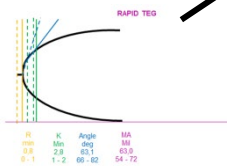
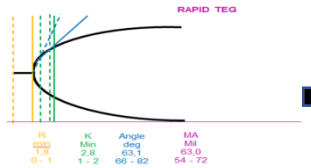


FIGURE 2 ROTEM-guided transfusion therapy



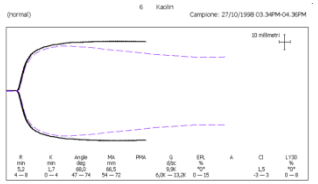
R

R: > 1



Carenza di Fattori della coagulazione → Plasma / Crioprecipitati

R: > 0 < 1



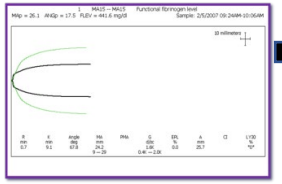
Sanguinamento chirurgico → Chirurgo esperto

MA: > 54 < 72

MA

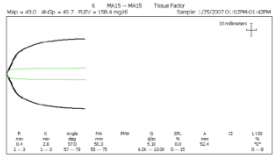
MA: < 54 → Fibrinogeno funzionale → MA

MA: > 9 < 29



Carenza di Piastrine → Piastrine

MA: < 9



Carenza di Fibrinogeno → Fibtinogeno

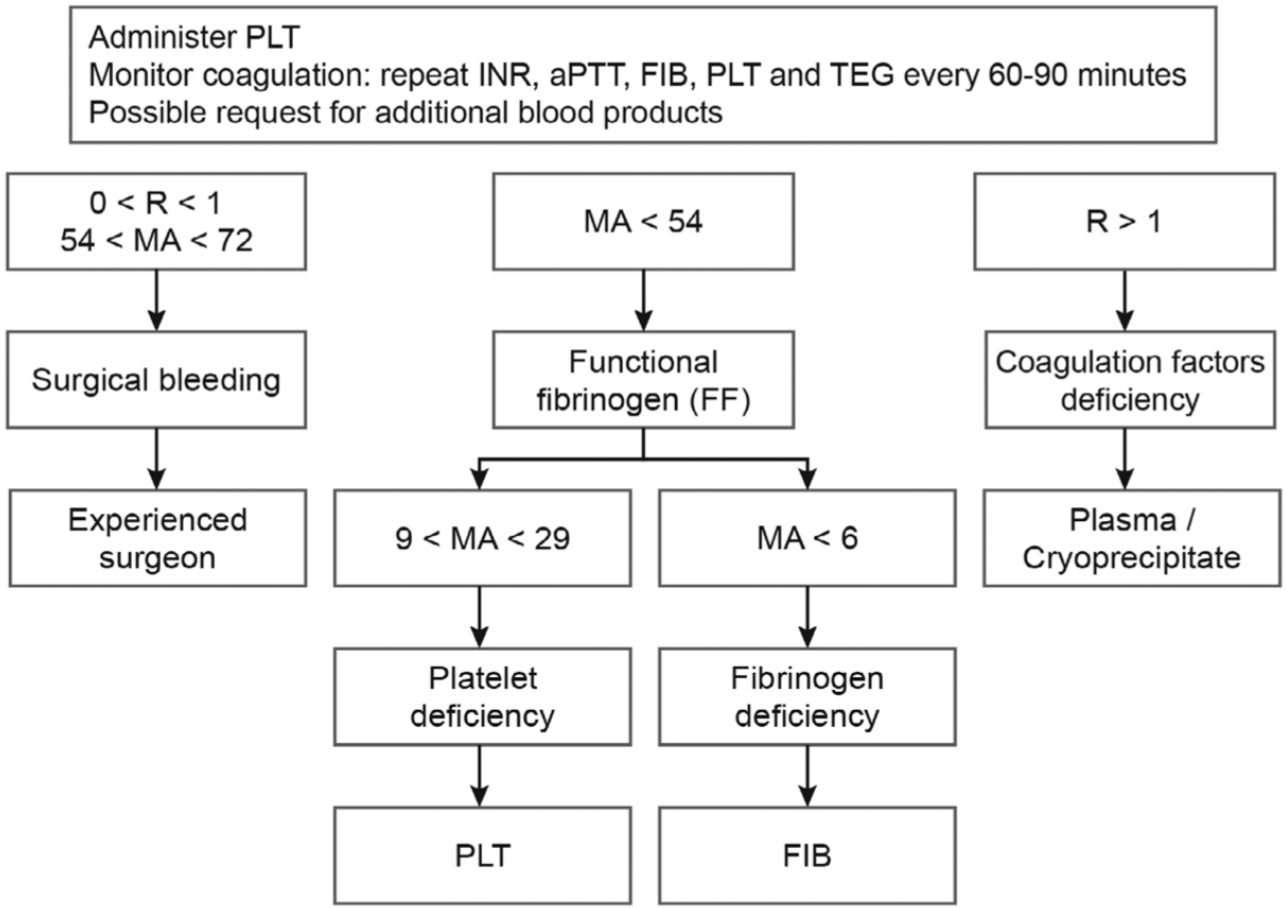
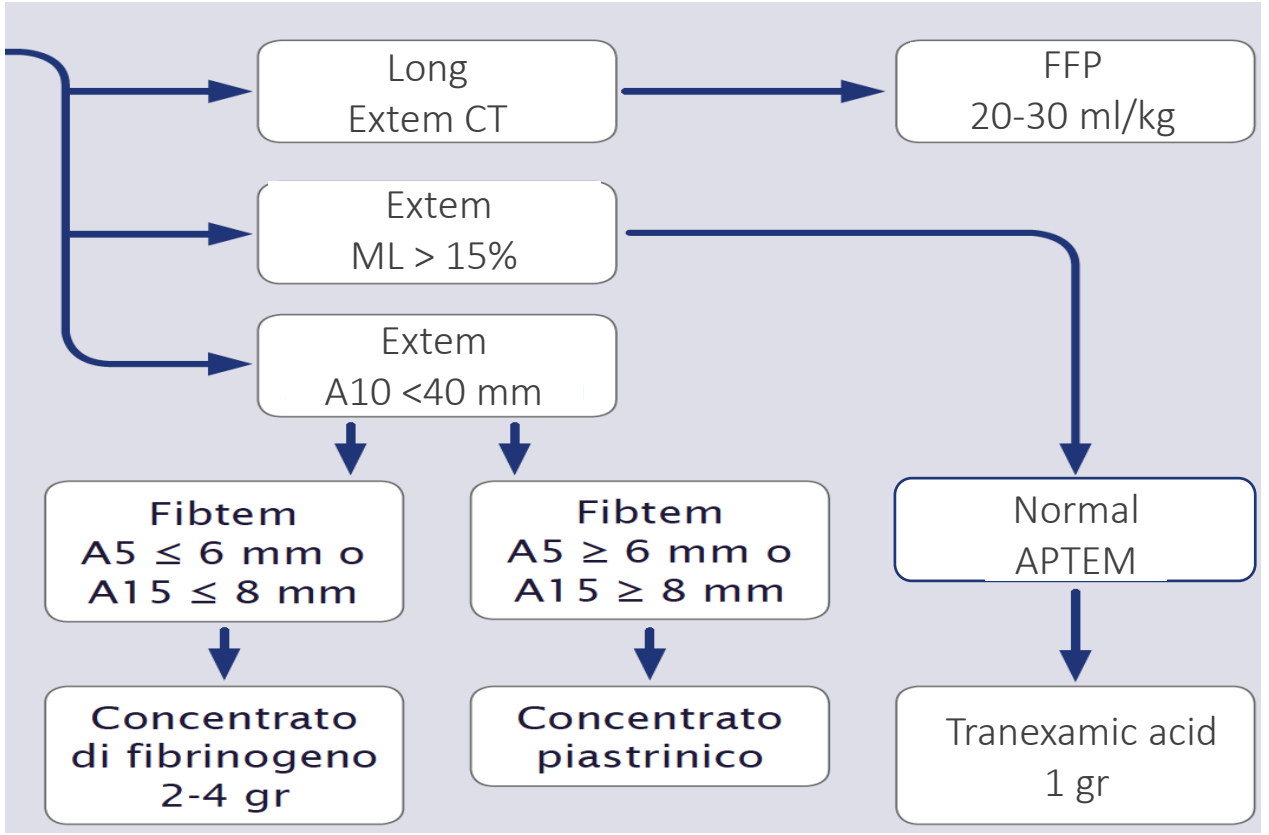


FIGURE 3 TEG-guided transfusion therapy.[9] aPTT, activated partial thromboplastin time; FIB, fibrinogen; INR, international normalised ratio; PLT, platelets

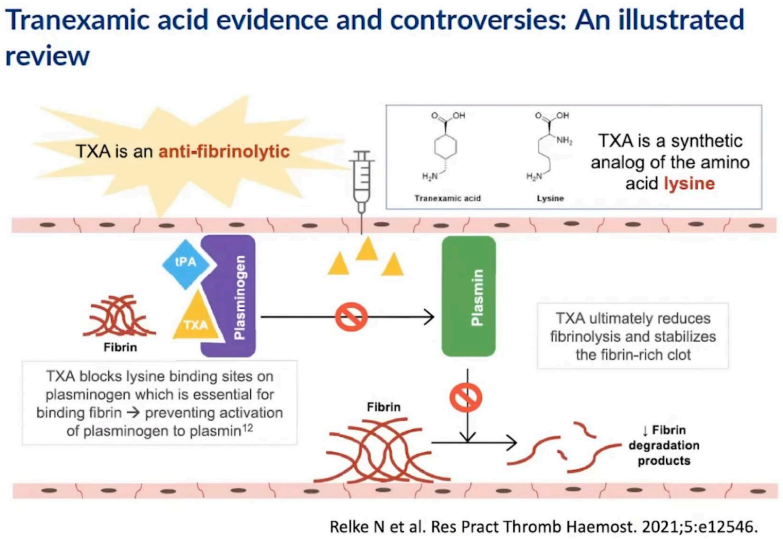
The daily-practiced post-partum hemorrhage management: an Italian multidisciplinary attended protocol

G. Affronti[1], V. Agostini[2], A. Brizzi[3], L. Bucci[4], E. De Blasio[5], M.G. Frigo[6], C. Giorgini[7], M. Messina[8], A. Ragusa[9], F. Sirimarco[10], A. Svelato[9]

Clin Ter 2017; 168 (5):e307-316



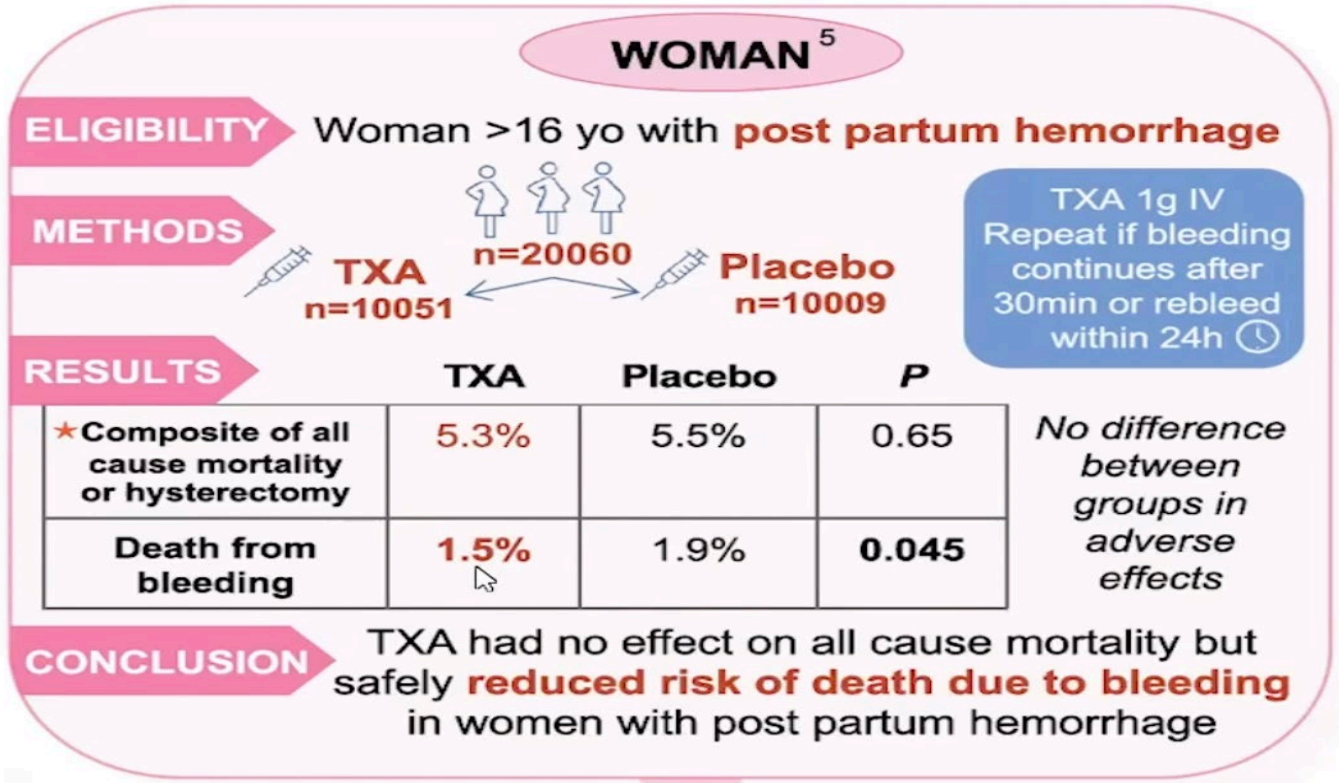
TRANEXAMIC ACID



WHO and ISS recommendation suggest early **antifibrinolytic** administration,within 3 hours of delivery of **1gr in 10minutes** in women with PPH after vaginal or c section birth, in addition to standard treatment with uterotonics, repeatable after 30 minutes or within 24 hours of the first dose, in case of recurrence of hemorrhage

WOMAN Trial Collaborators. Lancet 2017; 389: 2105–16.
WHO recommendation on tranexamic acid for the treatment of postpartum haemorrhage. Geneva: World Health Organization; 2017

Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial



Increases during pregnancy: 4-6gr/L nel III trim.

Level <2g/L : TARGET replacement

Accurate Biomarker of moderate to severe PPH progression

1° factor that is reduced during PPH

	FIBRINOGENO CONCENTRATO	CRIOPRECIPITATO
Efficacia	Buona	Buona
Tempo di preparazione	Breve	Lungo (scongelamento)
Costo	Elevato	Basso
Rischio infettivo	Basso (pastorizzazione)	Moderato (NO pastorizzaz)
Rischio Reazioni Trasfusion	Basso (anafilassi)	Elevato (reaz allergiche)
Fattori coagulazione	I (1gr)	I (200-300mg) VIII (80-120U) XIII (40-60U) vWF (80U)
Gruppo sanguigno ABO	Non necessario	ABO noto
Conservazione	Temperatura ambiente	Congelato (max 1 anno)

FIBRINOGEN

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Current perspective on fibrinogen concentrate in critical bleeding

Santiago R. Leal-Noval[a], Jose Fernández Pacheco[b], Manuel Casado Méndez[c], Diego Cuenca-Apolo[c] and Manuel Múñoz-Gómez[d]

ABSTRACT

Introduction: . Massive hemorrhage continues to be a treatable cause of death. Its management varies from prefixed ratio-driven administration of blood components to goal-directed therapy based on point-of-care testing and administration of coagulation factor concentrates.

Areas covered: . We review the current role of fibrinogen concentrate (FC) for the management of massive hemorrhage, either administered without coagulation testing in life-threatening hemorrhage, or within an algorithm based on viscoelastic hemostatic assays and plasma fibrinogen level. We identified relevant guidelines, meta-analyzes, randomized controlled trials, and observational studies that included indications, dosage, and adverse effects of FC, especially thromboembolic events.

Expert opinion: . Moderate- to high-grade evidence supports the use of FC for the treatment of severe hemorrhage in trauma and cardiac surgery; a lower grade of evidence is available for its use in postpartum hemorrhage and end-stage liver disease. Pre-emptive FC administration in non-bleeding patients is not recommended. FC should be administered early, in a goal-directed manner, guided by early amplitude of clot firmness parameters (A5- or A10-FIBTEM) or hypofibrinogenemia. Further investigation is required into the early use of FC, as well as its potential advantages over cryoprecipitate, and whether or not its administration at high doses leads to a greater risk of adverse events.

OBSTETRIC ANAESTHESIA

Association between ionised calcium and severity of postpartum haemorrhage: a retrospective cohort study

Danny Epstein[1,*], Neta Solomon[2,3], Alexander Korytny[4,5], Erez Marcusohn[6], Yaacov Freund[5], Ron Avrahami[7], Ami Neuberger[1,5,8], Aeyal Raz[5,9] and Asaf Miller[10]

Calcio

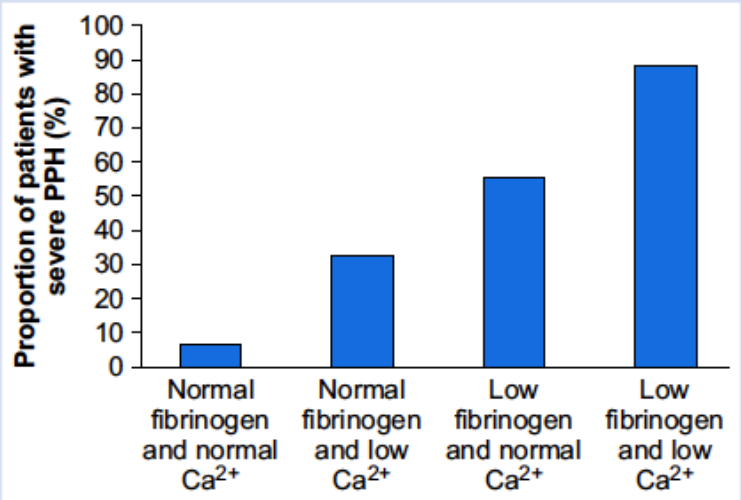

Fig 2. The relationships between fibrinogen, ionised calcium, and clinical outcome. Low fibrinogen was defined as fibrinogen <200 mg dl^{-1} and low Ca^{2+} was defined as Ca^{2+} <1.16 mmol L^{-1}. Ca^{2+}, ionised calcium; PPH, postpartum haemorrhage.

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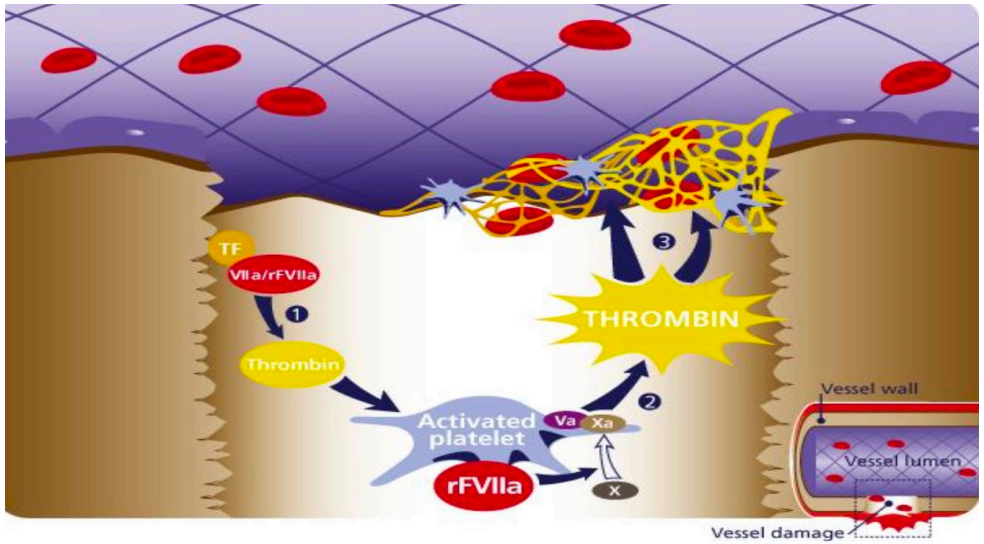
rFVIIa

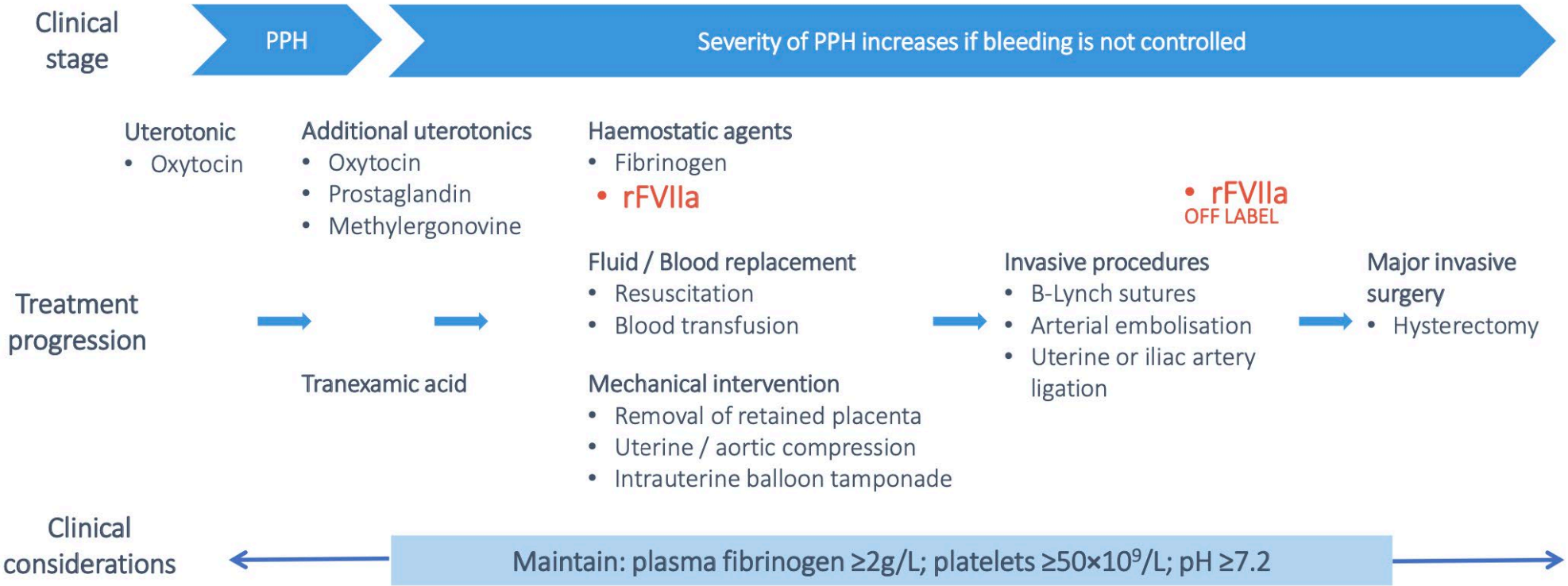


…update, May 2022

il rFVIIa is indicated for treatment sPPH,
when uterotonics are not sufficient
to achieve hemostasis

Dosage: 60-90 µg/Kg bolus ev.
Peak 10 minutes
If the response is insufficient,
repeat a second dose after 30 minutes

Recombinant human FVIIa for reducing the need for invasive second-line therapies in severe refractory postpartum hemorrhage: a multicenter, randomized, open controlled trial G. LAVIGNE 2015 International Society on Thrombosis and Haemostasis



rFVIIa in the management of sPPH after the new indication

Journal of Thrombosis and Haemostasis, **13**: 520–529 DOI: 10.1111/jth.12844

ORIGINAL ARTICLE

Recombinant human FVIIa for reducing the need for invasive second-line therapies in severe refractory postpartum hemorrhage: a multicenter, randomized, open controlled trial

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RCT France-Swisse
April 2007 - November 2010

- The study aimend to evaluate the efficacy and safety of a single dose of FVIIa in women with ongoing sPPH after failure with sulprostone
- Randomizzate 84 women with sPPH: 42 used rFVIIa after failure with Sulprostone

42 woman managed with the «standard of care» of the home centre

Deaths

	Randomised controlled trial (FAS)*		Observational studies										
			Bern University (FAS)		PPH Consortium						UniSeven**		ANZHR (FAS)
					Denmark (FAS)		Netherlands (FAS)		UK (FAS)		All exposed	FAS	
	rFVIIa N=51	Ref N=33	rFVIIa N=52	No rFVIIa N=113	rFVIIa N=40	No rFVIIa N=199	rFVIIa N=37	No rFVIIa N=1223	rFVIIa N=13	No rFVIIa N=149	rFVIIa N=111	rFVIIa N=87	rFVIIa N=166
Maternal deaths	0	0	0	0	0	2 (1.0)	2 (5.4)	5 (0.4)	0	2 (1.3)	1 (0.9)	0	13 (7.8)

NOTE: All deaths in ANZHR were assessed as unlikely related to rFVIIa by a physician from Monash University (Study site). Most patients died due to uncontrolled bleeding (despite large transfusion volumes) and possibly remoteness from speciality care.

- rFVIIa:resource among the options available in PPHs management
- No increase tromboembolic risk

«The use of rFVIIa in addition to current standard care may improve outcomes without further increasing the risks associated with sPPH»

Prothrombin Complex Concentrate: Anticoagulation Reversal and Beyond

O. Grottke and H. Schöchl

included in point-of-care guided algorithms designed to facilitate the treatment of bleeding trauma patients. In one such algorithm developed by Schöchl et al., PCCs are administered as a second-line treatment in patients with ongoing bleeding and an EXTEM clotting time (CT) > 80 s after restoration of fibrinogen levels (Fig. 1; [20]). In line with this algorithm, the European trauma guidelines recommend that PCC be administered in bleeding trauma patients with normal fibrinogen levels, based on evidence of delayed coagulation initiation from viscoelastic monitoring [8].

Several studies of PCC treatment of trauma-related bleeding in patients who are not receiving anticoagulants have involved the implementation of coagulation factor

PROTHROMBIN COMPLEX CONCENTRATE

Prothrombin complex concentrate

Prothrombin complex concentrates (PCCs) contain a concentrate of coagulation factors II, VII, IX, X and proteins S and C (and some heparin), and are recommended for urgent reversal of the effect of vitamin K antagonists[119-121]. Successful use of PCC was described in a case report of massive PPH[122]. In an ongoing trial, PCC and fibrinogen are being compared to plasma in PPH (trial identifier: NCT01910675). At the moment, there is no evidence to support the use of PCCs in the management of PPH, and their use should be limited to clinical trials in order to gather evidence on their efficacy and, in particular, on their safety.

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FIGO recommendations on the management of postpartum hemorrhage 2022

Decision for Damage Control Resuscitation

11 | ASSESSMENT AND RESUSCITATION

11.1 | Damage control resuscitation in PPH

Hemorrhagic shock is the most frequent type of shock in obstetric patients.[1] Blood loss exceeding 40% of total blood volume leads to global hypoxia and metabolic acidosis.[2] These metabolic complications, accompanied by organ hypoperfusion, trigger an irreversible state of coagulopathy, bolstering hemorrhage and inducing multiple organ dysfunction and death.[3] The concept of damage control resuscitation (DCR) was first reported by trauma surgeons and its applicability has spread in traumatic and nontraumatic scenarios in general surgery, orthopedics, and obstetrics.[4] DCR consists of a series of strategies to minimize hemorrhage, prevent the deadly triad (coagulopathy, acidosis, and hypothermia), and maximize tissue oxygenation. This is achieved by a staged surgical approach that minimizes operative time, counteracting life-threatening conditions and deferring the definitive surgical procedures until normal physiology is restored at the intensive care unit (ICU).[5–7]

TABLE 9 Alternative indications for damage control surgery secondary to postpartum hemorrhage[a]

Indication
Systolic blood pressure <70 mm Hg
Body temperature <34°C
Maternal blood pH <7.1
Venous bleeding not suitable for surgical control
Persistent bleeding despite several transfusions of blood products (>10 units of PRBC)
Massive transfusion: 6 units of Red Blood Cells (during the first 4 h)
Increasing and continuous need for fluids due to active nonarterial bleeding
Hemodynamic instability, requiring persistent vasopressor support or that results in the development of ventricular arrhythmias
Coagulopathy resulting from a combination of hypothermia (temperature <35°C), acidosis (pH <7.3), and loss of coagulation factors
Duration of surgery >90 min

[a]Source: Carvajal et al. [4] and Pacheco et al. [7]. Adapted with permission.

- Massive blood transfusion protocols
- Limited use of crystalloids
- Bleeding control :
  - DCS (Damage Control Surgery) and
  - DCRI (Damage Control Interventional Radiology)

Three parameters have been described in the literature as significant clinical indicators for early implementation of DCR and DCS :

- acidosis (base deficit >8)
- blood loss >1500 ml
- hypothermia (temperature 10 units by others4)

Continuous vital sign monitoring and serial monitoring with blood gas analysis and body temperature are recommended.

Operative time and number of blood units transfused are also crucial for DCR decision-making

for negative pressure.[2,12] Currently, there is neither consensus nor sufficient evidence regarding the use of prophylactic antibiotics in patients undergoing DCS with abdominal packing.[4] Several surgical guidelines recommend the administration of a single preoperative dose of broad-spectrum antibiotics, which theoretically should provide sufficient coverage for aerobic and anaerobic microorganisms.[4,13,14] Other experts suggest administration of prophylactic broad-spectrum antibiotics every 6–8 h until the abdominal packing is removed. Nevertheless, further studies are necessary to provide evidence-based recommendations in the obstetric population.[7]

Resuscitation – ICU

At this stage, the patient must be transferred to the ICU to address the physiologic derangements of the hemorrhagic patient: coagulation disorders and metabolic abnormalities.[6] Interdisciplinary care involving the obstetrician and critical care specialist is key for these patients as complications could arise at any time.[4] It is crucial to accurately quantify the accumulation of blood in the abdominal cavity. The optimal device to do so, after partial abdominal closure, is the vacuum pack, which allows a more precise quantification of bleeding during the postoperative period. In patients without coagulopathy, the drainage of >400 ml/h of blood through the vacuum pack represents an early indication for laparotomy.[4]

11.1.4 | Final objectives in resuscitation

DCR should be maintained as long as there are signs of bleeding and coagulopathy. A continuous assessment of the hemodynamic and physiological status of the patient is required. Monitoring several resuscitation parameters is essential until tissue hypoxia reverts. These parameters include pH, base deficit, lactate, hematocrit, and coagulation—ideally evaluated with conventional laboratory tests and point-of-care testing (POCT) of viscoelastic coagulation such as thromboelastography (TEG) and rotational thromboelastometry (ROTEM). In patients with a clinical trend toward improvement, the decision to perform definitive surgery is appropriate.[4]

BOX 14 FIGO recommends that damage control resuscitation (DCR) should be implemented in the management algorithms for major obstetric hemorrhage.

All countries should establish one or more referral hospital(s) and develop expert teams that are familiar with this strategy, the technique, and indications to be able to offer DCR.

Trasfer to ICU:

- Coagulation abnormalities
- Metabolic abnormalities
- Hemodynamics

FIGO recommendations on the management of postpartum hemorrhage 2022

DIFFERENTIAL DIAGNOSIS

CONSUMPTION COAGULOPATHY

CONSEQUENT TO THE LOST OF COAGULATION FACTORS DUE TO A MASSIVE BLOOD LOSS, WITHOUT THE ACTIVATION OF COAGULATION CASCADE

It doesn't determine uterine atony

DIC

THE CONSUMPTION OF COAGULATION FACTORS IS DETERMINED BY A PRIMARY INTRAVASCULAR ACTIVATION OF COAGULATION CASCADE. TRIGGERED BY A PRIMARY PATHOLOGY (PREECLAMPSIA, SEPSIS, PLACENTAL ABRUPTION, AMNIOTIC EMBOLISM, PROLONGED RETENTION OF DEAD FETUS)

Circulants fibrin degradation products (fdp) can cause uterine atony

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REVIEW

DIC in Pregnancy – Pathophysiology, Clinical Characteristics, Diagnostic Scores, and Treatments

The different types of DIC

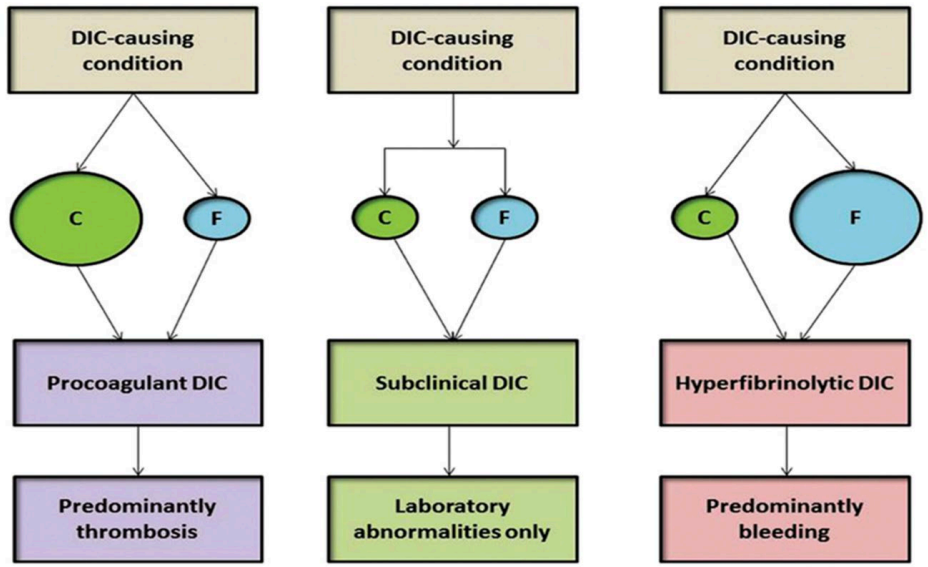
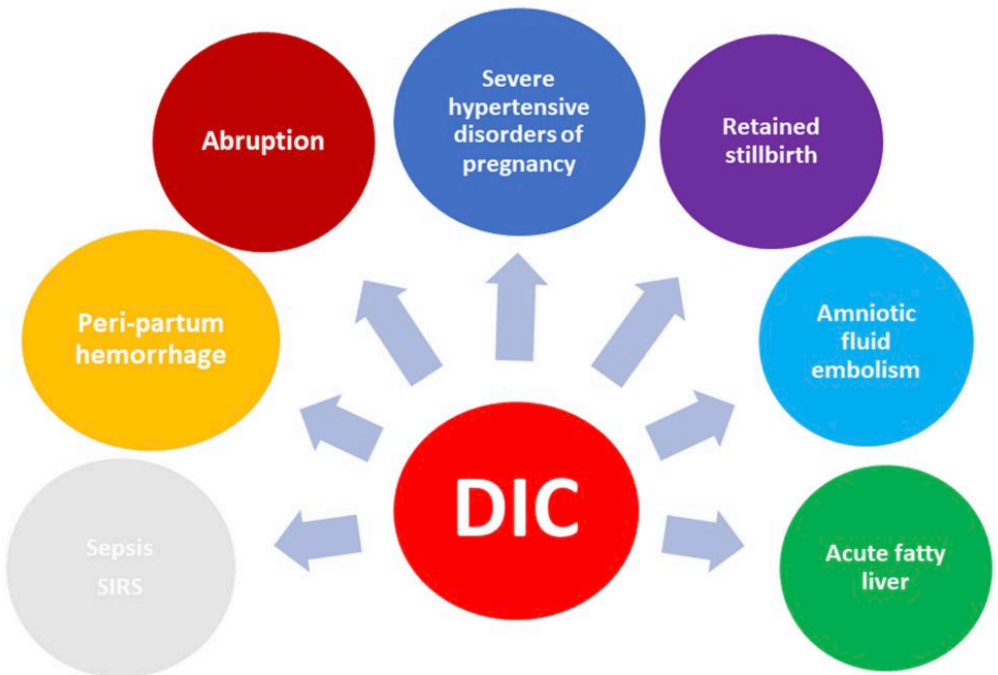


Figure 1 The different types of DIC and their clinical presentation. If there is predominance of coagulation pathway activation (denoted as C), in comparison with the fibrinolytic pathways (denoted as F), procoagulant DIC is the result. While the reverse leads to hyperfibrinolytic DIC.
Notes: Reprinted from: Thachil J. The Elusive Diagnosis of Disseminated Intravascular Coagulation: does a Diagnosis of DIC Exist Anymore? *Semin Thromb Hemost.* 2019;45:100–107.[24] With permission. Copyright © Georg Thieme Verlag KG.

Obstetrical complications associated with DIC



Schematic representation of pathogenic pathways in DIC

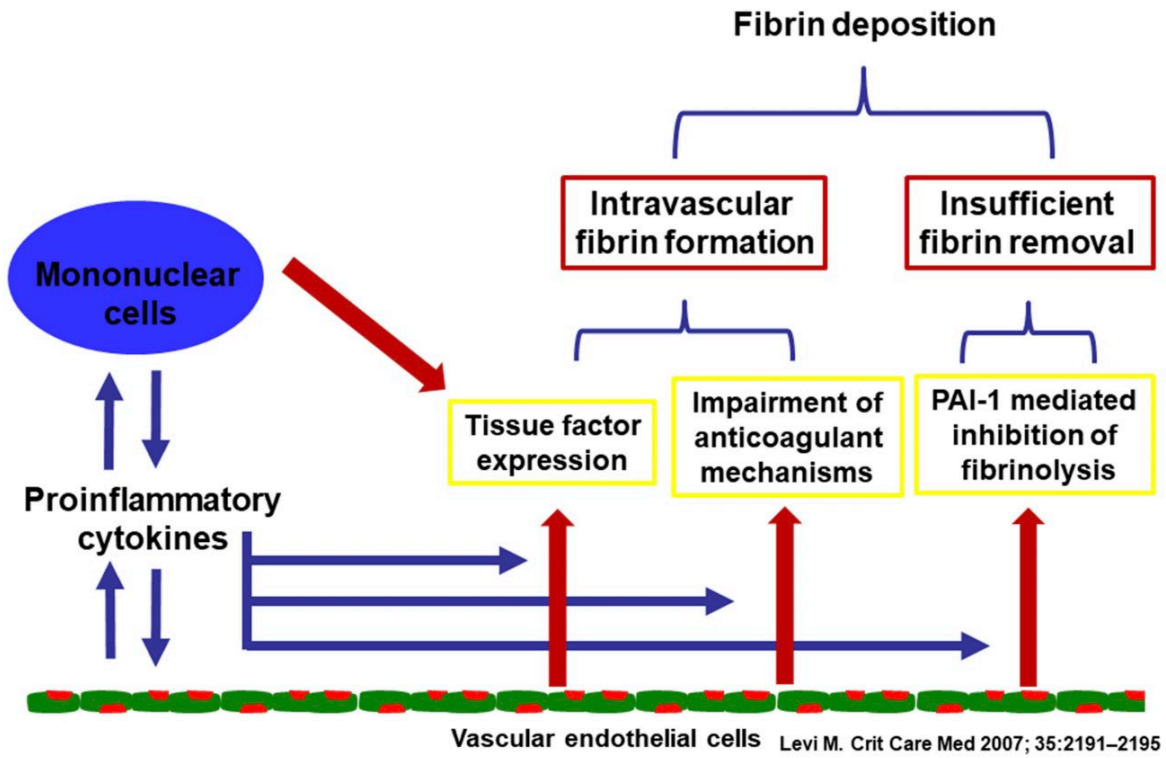


Figure 4 Schematic representation of pathogenic pathways in DIC.
Notes: Adapted from: Levi M. Disseminated intravascular coagulation. *Crit Care Med*. https://journals.lww.com/ccmjournal/pages/default.aspx. 2007;35(9):2191–2195.[49] With permission. © 2007 by the Society of Critical Care Medicine and Lippincott Williams & Wilkins.

DIC has a complex pathophysiology, the understanding of the normal haemostasis and the highly orchestrated balance involving the various pathways including procoagulant/anticoagulant, fibrinolytic/antifibrinolytic and platelet/von Willebrand factor axis during pregnancy, is essential for the characterisation of the haemostatic abnormalities observed during DIC.

Normal pregnancy is associated with activation of maternal leukocytes into a state akin to sepsis.
Nevertheless, placental trophoblast maintain a balanced systemic maternal inflammation during gestation by inactivation of maternal leukocytes.
However, infectious agents, septic abortion, and amniotic fluid embolism leading to sepsis perturbed this balance and can lead to the development of maternal DIC

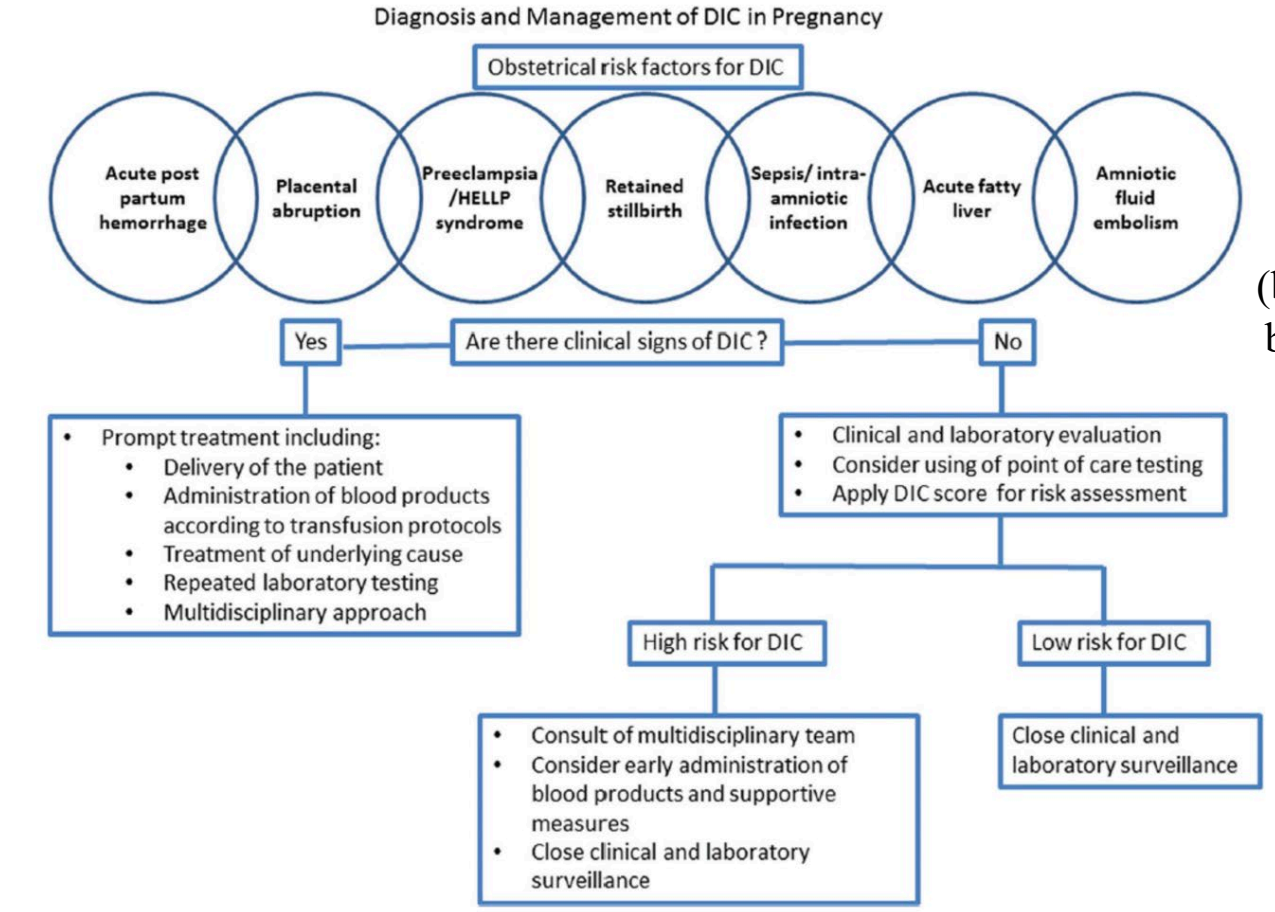


Figure 8 Principles of Diagnosis and management of DIC in pregnancy.
Notes: Reproduced from: Erez O. Disseminated intravascular coagulation in pregnancy - Clinical phenotypes and diagnostic scores. *Thromb Res.* 2017;151203 1:S56-S60.[200] With permission. Copyright © 2017 Elsevier Ltd. All rights reserved.

The basic principles for treating obstetrical DIC include:

1) treatment and resolution of the underlying condition leading to DIC;
2) fast and prompt delivery or termination of pregnancy (before the threshold of viability). The delivery options should be discussed by a multidisciplinary team and consider the safest mode of delivery to the mother, how fast she is expected to deliver, what are the resources of blood products and other supportive mechanisms available, and can she sustain a surgery;
3) supportive treatment with blood product transfusion, surgical care and related measures;
4) rigorous clinical and laboratory patients surveillance;
5) prompt involvement of needed consultant such as hematologists, gynecological surgeons, anesthesiologists and others;
6) in small to medium size health care facilities it is important to estimate whether their blood bank can support a massive blood transfusion and, if necessary, contact regional or larger hospitals for assistance or for transferring the patient.


Thanks