

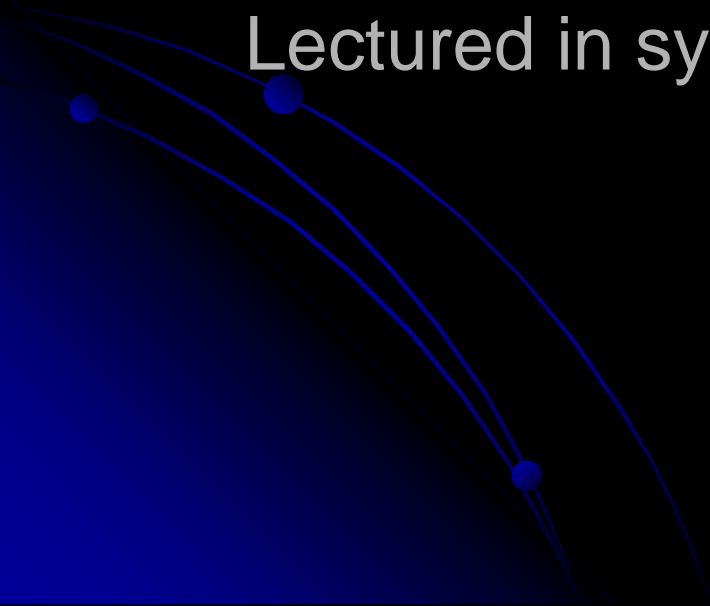
PPH – Lessons from Confidential Inquiries & Recent Advances

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Declaration of Interest

Academic/ Research & Teaching
Medical Advisory Panel – Clinical Innovations
Adhoc adviser to Inpress technology
Lectured in symposia sponsored by Ferring



Objectives

1. Lessons learnt from confidential inquiries & other fields of medicine
2. HAEMOSTASIS Algorithm
3. Medical Management
4. Surgery - Conservative techniques – no coagulaopathy or + correction
5. 5. Surgery – Invasive techniques
6. 6. Determinants of treatment - General condition/ blood loss & coagulopathy
7. 7. Recent advances

CONFIDENTIAL ENQUIRY INTO MATERNAL DEATHS

TOO LATE > TOO LITTLE

**Too Late (PG, resuscitation -
blood replacement, decision
for surgery + to get senior
surgeon & anaesthetist
involved)**

**Too Little (IV fluids, oxytocics,
BLOOD, Clotting factors)**

Confidential Enquiry into Maternal and Child Health



Saving Mothers' Lives:

Reviewing maternal deaths to make motherhood safer - 2003-2005



December 2007

The Seventh Report of the Confidential Enquiries
into Maternal Deaths in the United Kingdom

Obstetric haemorrhage: learning points

IMPORTANCE OF HAVING A NORMAL Hb%

Anaemia magnifies the effects of obstetric haemorrhage. Antenatal anaemia should be diagnosed and treated effectively: parenteral iron therapy should be considered antenatally for women with iron deficiency anaemia who do not respond to oral iron.

Moderate or excessive traction on the cord before placental separation is inappropriate. The appropriate initial management of uterine inversion is attempted replacement.

Saving Lives, Improving Mothers' Care
**Lessons learned to inform future maternity care
from the UK and Ireland Confidential Enquiries into
Maternal Deaths and Morbidity 2009-2012**

Table 4.2 Estimated blood volumes and proportionate losses according to body weight

Weight	Total blood volume*	15% blood volume loss	30% blood volume loss	40% blood volume loss
50kg	5000mls	750mls	1500mls	2000mls
55kg	5500mls	825mls	1650mls	2200mls
60kg	6000mls	900mls	1800mls	2400mls
65kg	6500mls	975mls	1950mls	2600mls
70kg	7000mls	1050mls	2100mls	2800mls

*Based on 100mls/kg blood volume in pregnancy (Royal College of Obstetricians and Gynaecologists 2011b) but may overestimate blood volume in obese women (Lemmens, Bernstein et al. 2006)



Royal College of Obstetricians and Gynaecologists

Green-top Guideline
No. 52
May 2009

Setting standards to improve women's health

PREVENTION AND MANAGEMENT OF POSTPARTUM HAEMORRHAGE

This is the first edition of this guideline.

1. Purpose and scope

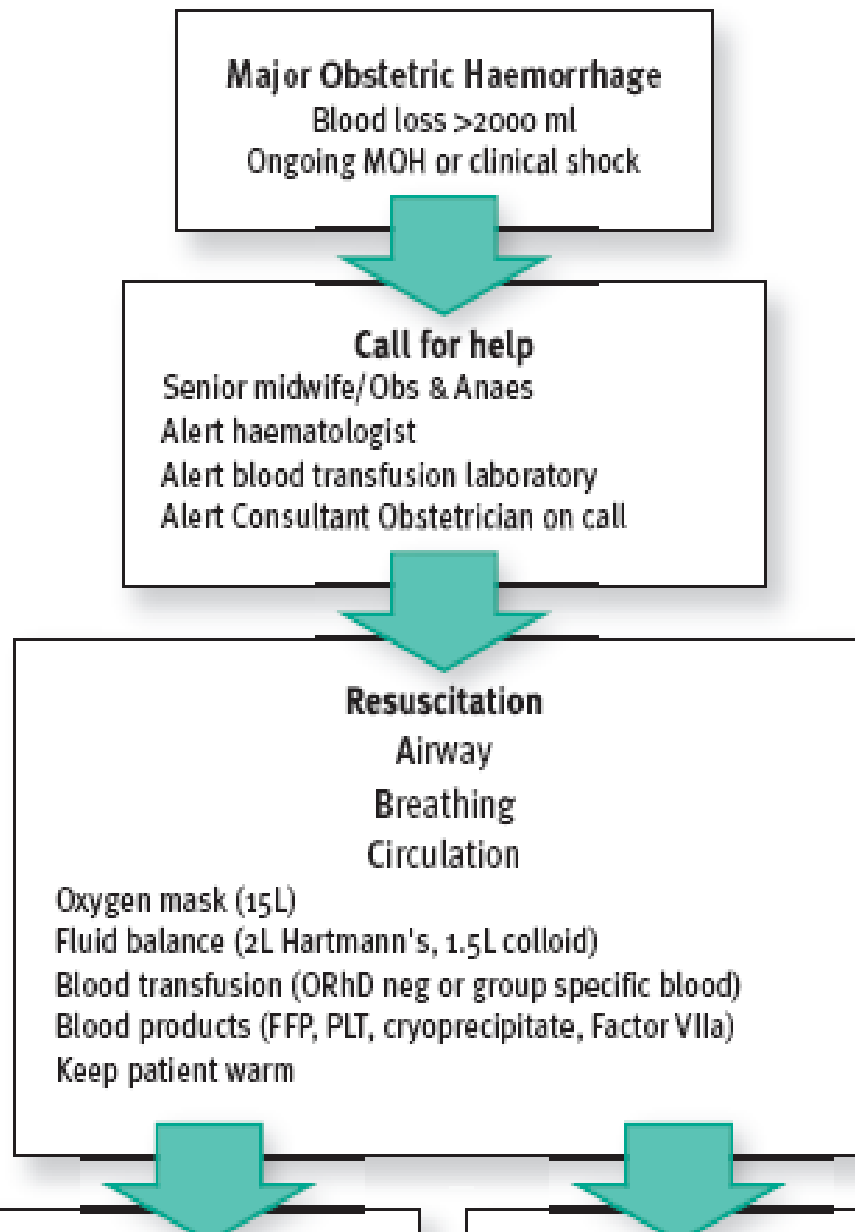
Primary postpartum haemorrhage (PPH) is the most common form of major obstetric haemorrhage. The traditional definition of primary PPH is the loss of 500 ml or more of blood from the genital tract within 24 hours of the birth of a baby.¹ PPH can be minor (500–1000 ml) or major (more than 1000 ml). Major could be divided to moderate (1000–2000 ml) or severe (more than 2000 ml). The recommendations in this guideline apply to women experiencing primary PPH of 500 ml or more. Secondary PPH is defined as abnormal or excessive bleeding from the birth canal between 24 hours and 12 weeks postnatally.² This guideline also includes recommendations specific to the management of major secondary PPH. Women with

This guideline was produced on behalf of the Guidelines and Audit Committee of the Royal College of Obstetricians and Gynaecologists by:

Professor S Arulkumaran FRCOG, London, Dr E Mavrides MRCOG, London and Dr GC Penney FRCOG, Aberdeen.

APPENDIX II : A flow chart of the different steps for the management of major postpartum haemorrhage.

Resuscitation, monitoring, investigation and treatment should occur simultaneously



Monitoring and investigations

14g cannulae x2
FBC, coagulation, U&Es, LFTs
X-Match (4U, FFP, PLT, cryoprecipitate)
ECG, oximeter
Foley catheter
Hb bedside testing
Blood products
Consider central and arterial lines
Commence record chart
Weigh all swabs and estimate blood loss

Medical treatment

Bimanual uterine compression
Empty bladder
Oxytocin 5iu x2
Ergometrine 500 µg
Oxytocin infusion (40 u in 500ml)
Carboprost 250 µg im every 15mins up to 8 times
Carboprost (intramyometrial) 0.5mg
Misoprostol 1000 µg rectally

Theatre

Is the uterus contracted?
Examination under anaesthetic
Has any clotting abnormality been corrected?

Intrauterine balloon tamponade
Brace suture
Consider interventional radiology

Surgery

Bilateral uterine artery ligation
Bilateral internal iliac ligation
Hysterectomy (second consultant)
Uterine Artery embolisation

Consider HDU (high dependency unit)
Or ITU

Algorithm for management of Atonic PPH

'HAEMOSTASIS'

- **H** - Ask for **Help**
- **A** - Assess **vital parameters & blood loss** and Resuscitate – (Rule of 30)
- **E** - Establish **Etiology + Eccholics** (syntometrine, ergometrine, bolus syntocinon) + Ensure availability of blood.
- **M** - **Massage** Uterus – **bimanual** compression
- **O** - Oxytocin infusion / prostaglandins (**PGs**) - intravenous / per rectal / intramuscular / intra-myometrial

Algorithm for management of Atonic PPH

'HAEMOSTASIS'

- **S** - **Stabilise Clotting**, anti Shock Garment & **Shift** to theatre – Aortic compression/ Bimanual compression
- **T** - (**4 T's**) Tissue/ Trauma/Tone/Thrombin > **Tamponade**
– Balloon / uterine packing (Fibrin concentrate)
- **A** - Apply **compression sutures** – B- Lynch / modified/
+/- Balloon
- **S** - Systematic Pelvic **devascularisation** – Uterine / Ovarian / Quadruple / internal iliac
- **I** - Interventional Radiology – If appropriate, Uterine artery **embolisation/ Internal iliac artery ligation**
- **S** - Subtotal / Total abdominal **hysterectomy**

Modified Early Warning Score (MEWS), Rule of 30, Shock Index

- 30% blood loss > moderate shock
- Pulse rate – increase > 30 bpm
- Respiratory rate > 30/min
- Systolic BP – drop by 30 mm Hg
- Urinary output < 30 ml/hour
- Haematocrit drop > 30% & to be kept at an absolute value of > 30
- **Shock Index = Pulse rate / Systolic BP – Change by 30%**
Normal = 0.5 to 0.7 : In pregnancy SI 0.7 to 0.9;
>0.9 indicates state of shock that needs urgent resuscitation

Use of the “obstetric shock index” as an adjunct in identifying significant blood loss in patients with massive postpartum hemorrhage

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ARTICLE INFO

Article history:

Received 14 June 2013

Received in revised form 18 August 2013

Accepted 25 November 2013

Keywords:

Blood transfusion

Estimated blood loss

Massive postpartum hemorrhage

Obstetric shock index

Visual estimation of blood loss

ABSTRACT

Objective: To establish the normal range for the “obstetric shock index” (OSI) after birth and to determine its usefulness as an aid to estimate blood loss in postpartum hemorrhage (PPH). **Methods:** A retrospective case-control analysis was conducted involving pregnant women admitted to St Georges Hospital for delivery: 50 with no PPH (control group) and 50 with massive PPH (> 30% loss of blood volume; case group). The OSI was calculated at 10 and 30 minutes from PPH onset. **Results:** Mean OSI in the control group at 10 and 30 minutes was 0.74 (range, 0.4–1.1) and 0.76 (range, 0.5–1.1), respectively. In the case group, mean OSI at 10 and 30 minutes was 0.91 (range, 0.4–1.5) and 0.90 (range, 0.5–1.4), respectively, with 64% requiring blood products. In the case group, 89% of women with an OSI of 1.1 or more at 10 minutes required transfusion; 75% with an OSI of 1.1 or more at 30 minutes required transfusion. **Conclusion:** We recommend that the normal OSI range should be 0.7–0.9. An OSI of more than 1 seems to be a useful adjunct in estimating blood loss in cases of massive PPH and in predicting the need for blood and blood products.

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Shock index: an effective predictor of outcome in postpartum haemorrhage?

HL Nathan,^a A El Ayadi,^b NL Hezelgrave,^a P Seed,^a E Butrick,^b S Miller,^b A Briley,^a S Bewley,^a AH Shennan^a

^a Women's Health Academic Centre, King's College London, London, UK ^b Safe Motherhood Programs, University of California, San

Objectives To compare the predictive value of the shock index (SI) with conventional vital signs in postpartum haemorrhage (PPH), and to establish 'alert' thresholds for use in low-resource settings.

Design Retrospective cohort study.

Setting UK tertiary centre.

Population Women with PPH ≥ 1500 ml ($n = 233$).

Methods Systolic blood pressure (BP), diastolic BP, mean arterial pressure, pulse pressure, heart rate (HR) and SI (HR/systolic BP) were measured within the first hour following PPH. Values measured at the time of highest SI were selected for analysis. The area under the receiver operating characteristic curve (AUROC) for each parameter, used to predict admission to an intensive care unit and other adverse outcomes, was calculated. Sensitivity, specificity and negative/positive predictive values determined thresholds of the best predictor.

Main outcome measures Intensive care unit (ICU) admission, blood transfusion ≥ 4 iu, haemoglobin level < 7 g/dl, and invasive surgical procedures.

Results Shock index has the highest AUROC to predict ICU admissions (0.75 for SI [95% CI 0.63–0.87] compared with 0.64 [95% CI 0.44–0.83] for systolic BP). SI compared favourably for other outcomes: SI ≥ 0.9 had 100% sensitivity (95% CI 73.5–100) and 43.4% specificity (95% CI 36.8–50.3), and SI ≥ 1.7 had 25.0% sensitivity (95% CI 5.5–57.2) and 97.7% specificity (CI 94.8–99.3) for predicting ICU admission.

Conclusions Shock index compared favourably with conventional vital signs in predicting ICU admission and other outcomes in PPH, even after adjusting for confounding; SI < 0.9 provides reassurance, whereas SI ≥ 1.7 indicates a need for urgent attention. In low-resource settings this simple parameter could improve outcomes. It was not possible to adjust for resuscitative measures administered following vital sign measurement that may have influenced the outcome.

Keywords Hypovolaemic shock, postpartum haemorrhage, shock index.

CRADLE/Microlife - Traffic Light Vital Sign Alert (VSA)

Range Syst Dias Traffic
Light

Severe Shock
flash

Red LED will

Arrow down

BP V. high >160 >110
arrow up

Red flash

constantly

Shock <160
Arrow

Yellow flash –
Flashes down

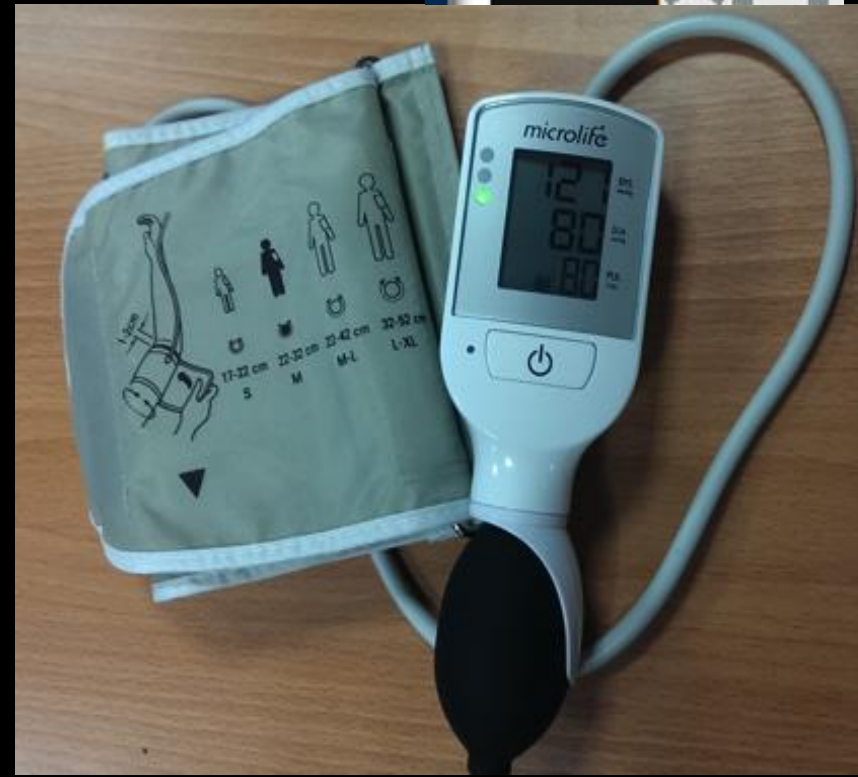
BP High >140 >90
<160 <110

Yellow flash
Arrow up -

const
Developed by King's College London,
Prof. Andrew Sheehan, Haman Nathan,
Natasha Melzgrave
& No shock

Green

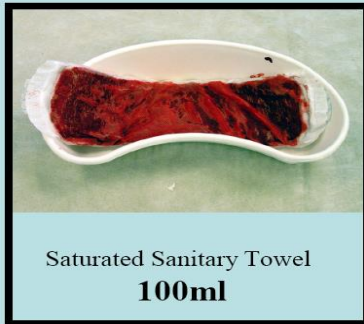
No arrow



A Pictorial Guide to Blood Loss at Obstetric Haemorrhage



Soiled Sanitary Towel
30ml



Saturated Sanitary Towel
100ml



Saturated Small Swab 10x10cm
60ml



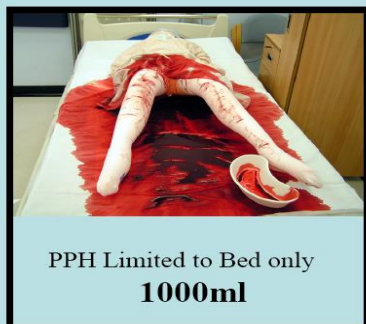
Incontinence Pad
250ml



Saturated Large Swab
45x45cm **350ml**



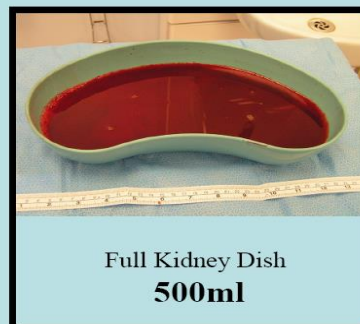
100cm Diameter Floor Spill
1500ml



PPH Limited to Bed only
1000ml



PPH Spilling onto Floor
2000ml



Full Kidney Dish
500ml

**UPTO 30% BLOOD
VOLUME LOSS
CRYSTALLOIDS**

**>30% - Consider
BLOOD AND
PLASMA**

Improving the Accuracy of Estimated Blood Loss at Obstetric Haemorrhage using Clinical Reconstructions. Bose P, Regan F, Paterson-Brown S. BJOG 2006; 113:919-924

For Further Information Please email patrick.bose@addenbrookes.nhs.uk

Emergency Trolley PPH, Eclampsia

Emergency protocols

Endotracheal tube
Laryngoscope

GENERAL MANAGEMENT

Increase inspired O₂

Essential drugs

Crystalloids, giving sets, haemacel



Large bore IV cannulas (gauge 14 x 2)


Increase perfusion of tissues

**Crystalloids – 2L Hartmann's
1.5 L colloids (upto 30% blood loss)**

>30% - Blood & Plasma

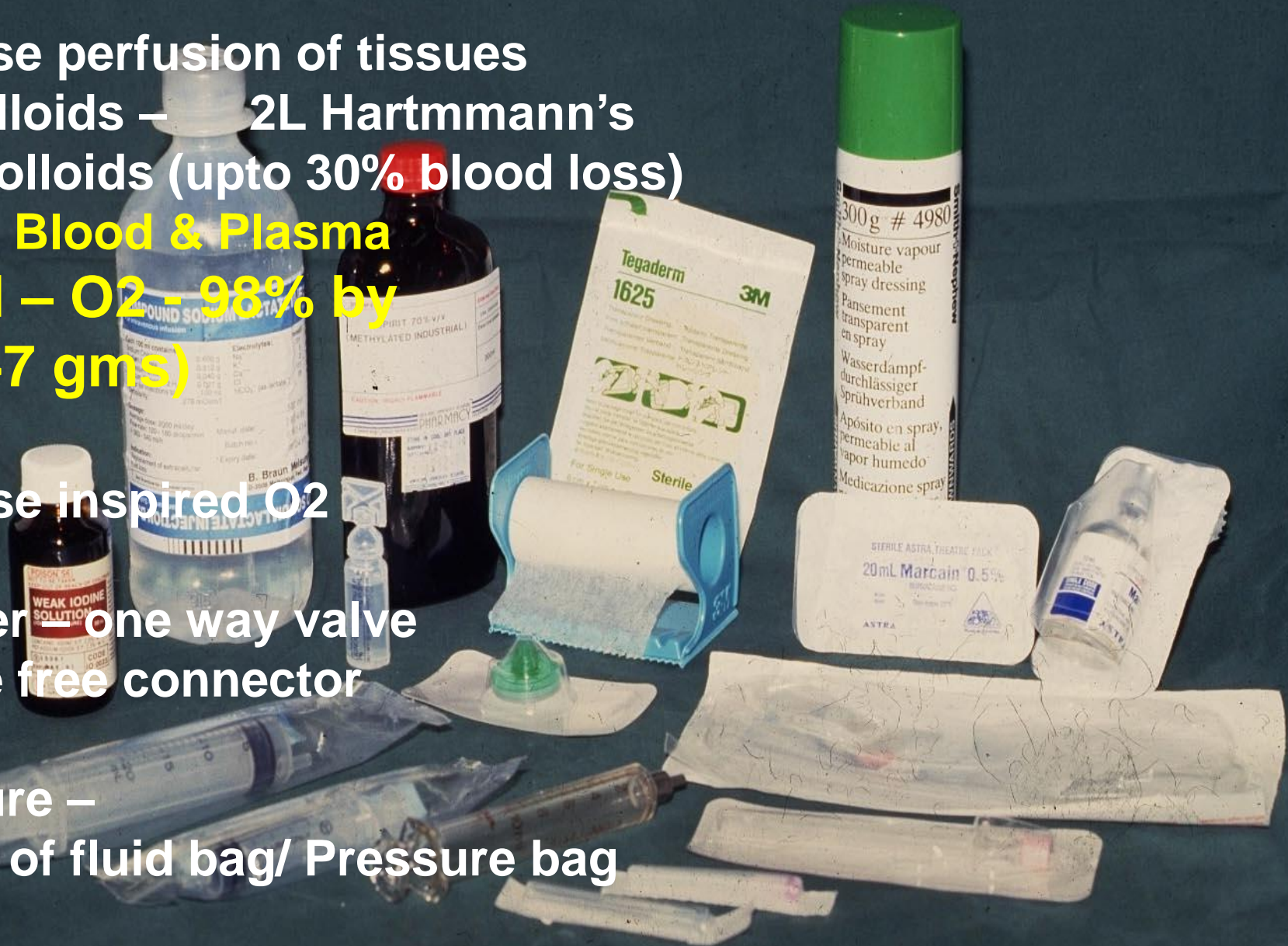
Blood – O₂ - 98% by Hb (>7 gms)

Increase inspired O₂



No filter—one way valve
Needle free connector

Pressure –
Height of fluid bag/ Pressure bag

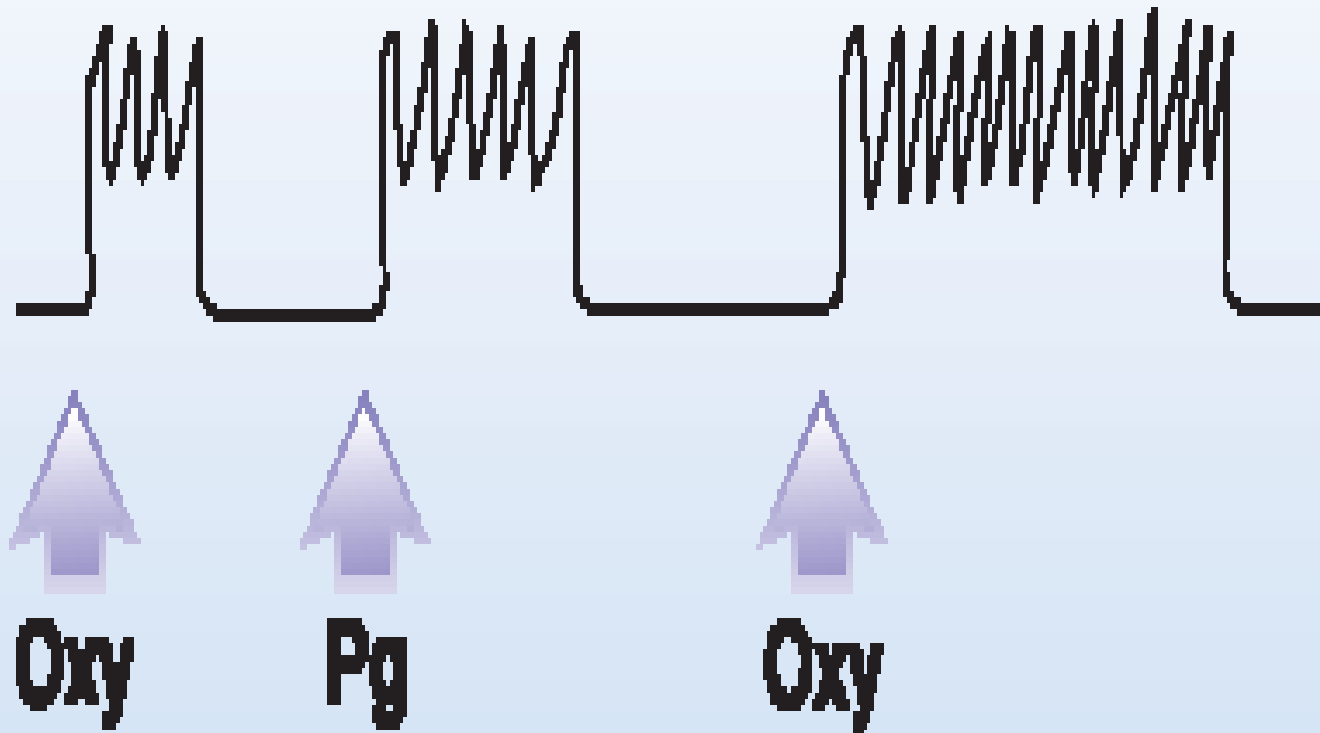


Cannula Characteristics

Gauge	Colour code	Catheter O.D. mm	Catheter length	Flow rate ml/min
14	Orange	2.10	45	240
16	Grey	1.74	45	180
17	White	1.4	45	125
18	Green	1.2	45	80
19 20	Pink	1.11	32	54
20 22	Blue	0.80	25	31
20 24	Yellow	0.60	19	13
21 26 22	Dark Blue	0.60	19	13

**Duration of contraction – syntocinon; ergometrine;
Duratocin; Syntocinon infusion; PG**

Myometrial response to oxytocin



Clinical RCT's Vs Prospective studies

Why Misoprostol

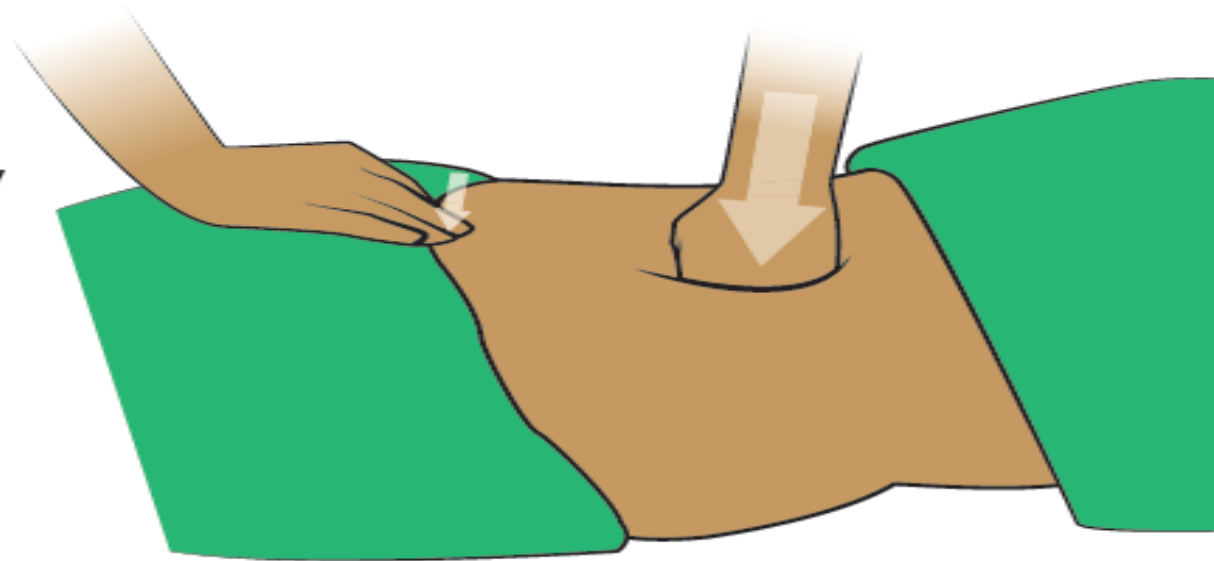
**Synthetic analog of prostaglandin E1
800 ug sublingually - FIGO**

- **Shelf life of several years if kept in their aluminum blister packets**
- **Low cost**
- **Sublingual route – for rapid absorption**
- **Being selective for the PGE1 receptors: no clinically significant effects on bronchi or blood vessels, hence fewer systemic side - effects → ‘has been used in patients with underlying diseases such as asthma or cardiovascular disorders’**

Aortic Compression

If bleeding is severe and if initial measures are not successful, then external aortic compression should be considered. Successful aortic compression, is achieved when the femoral pulse ceases and when blood pressure in the lower limit is unrecordable; it may be of benefit as a temporary measure in the management of postpartum hemorrhage whilst resuscitation and other management plans are made.

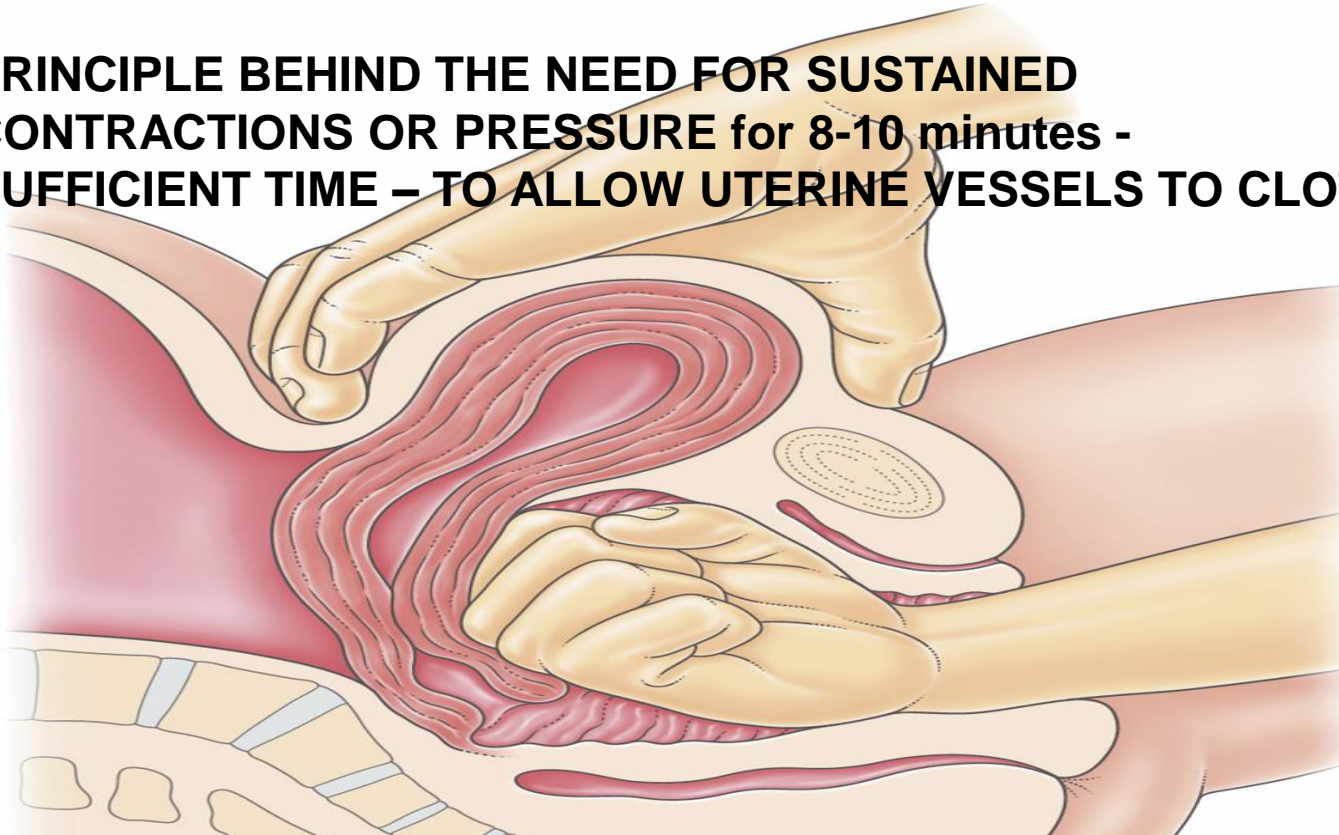
Internal aortic compression can also be used as a temporary measure to control severe postpartum hemorrhage due to placenta percreta during cesarean section.



NB. To view a video demonstrating how to apply aortic compression visit www.glowm.com

Bimanual Compression

PRINCIPLE BEHIND THE NEED FOR SUSTAINED CONTRACTIONS OR PRESSURE for 8-10 minutes - SUFFICIENT TIME – TO ALLOW UTERINE VESSELS TO CLOT*



**Balance between clotting and fibrinolysis
At times fibrinolysis is greater – stabilise clots**

© Copyright B-Lynch'05

Figure 1 Illustration showing bi-manual compression of the uterus.

Tranexaemic Acid

?Imbalance between clot formation & lysis or rapid flow of blood that dislodges the clots

Used extensively in Scandinavian Countries

1- 2 gm IV just prior to any surgery
+ post open heart surgery

Stabilise the formed clot but
does not promote clotting



Trials – prophylactic use in EI CS
– RCTs show reduced blood loss

Tranexamic Acid

ANTIFIBRINOLYTIC AGENT

Antifibrinolytic agent that prevents clot breakdown by blocking lysine sites on plasminogen molecules

Can be used when there is a RISK of hemorrhage

Inhibits fibrinolysis with no effect on clotting parameters

- Use in trauma patients within 1 hour reduces risk of death by 1/3 rd (RR 0.68 95% CI 0.57-0.82)**

Lancet 377 (9771):1096 PMID 21439633

Tranexamic Acid

LSTMH - double-blinded RCT with 20,000 women to determine effect on death and hysterectomy + other morbidities

No clear direction as to whether it should be used widely until trial results are available

Shakur et al Trials 2010;11:40

- Administer Tranexamic acid early to injured patient at risk of substantial bleeding

Plasma and clotting factors will treat clotting but not clot lysis

One gm IV in 100 ml in 10 mins followed by 1 gm over 8 hrs

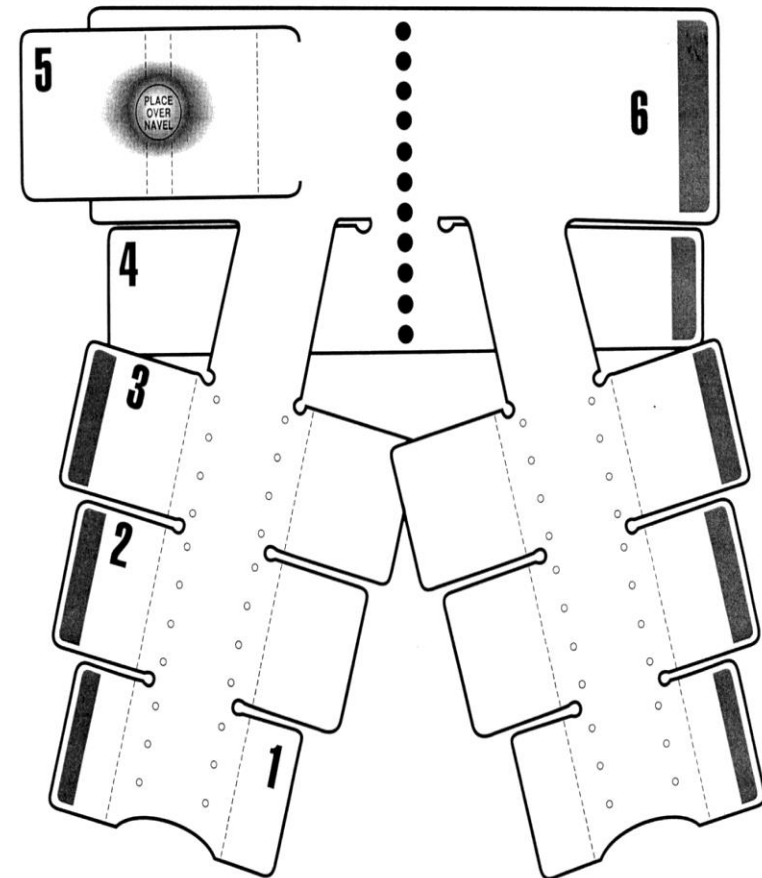
Gruen RL, Reade MC = **BMJ 24'th Nov 2012** p-46-47

Non-Inflatable Anti-Shock Garment



ANTI-SHOCK GARMENT

‘Squeezes more blood from periphery + Pressure on uterus’

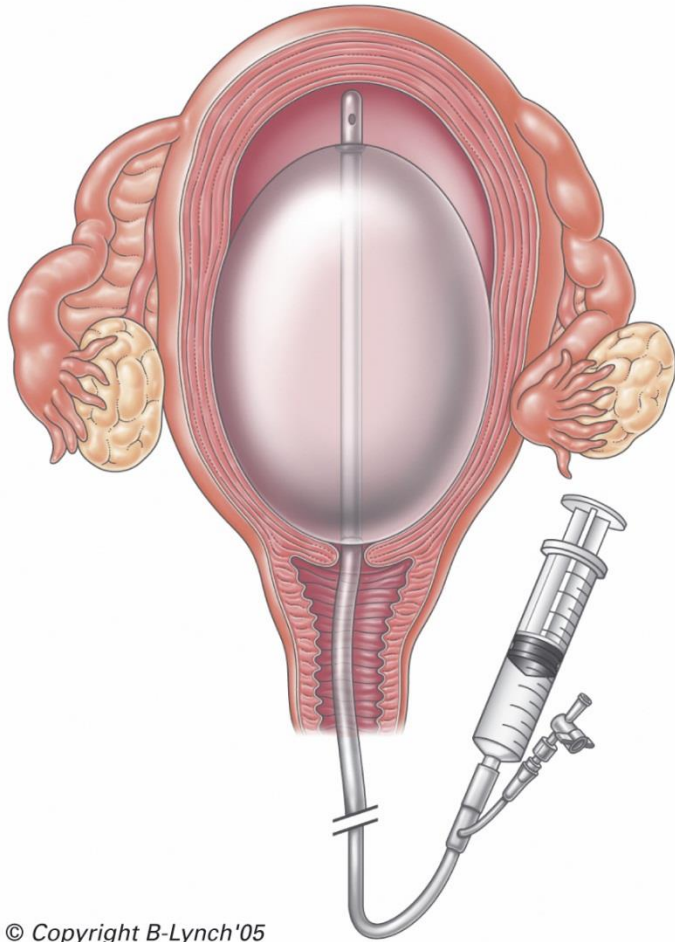


Blood pressure becomes recordable and veins become visible & palpable to establish IV lines

Courtesy - Suellen Miller

Figure 1 Schematic diagram of the non-pneumatic anti-shock garment

Internal Uterine Tamponade



© Copyright B-Lynch'05

Figure 1 Inflated Bakri Balloon max capacity 500mls.

**Need to place it before
coagulopathy sets in**

Takes 5 to 10 minutes

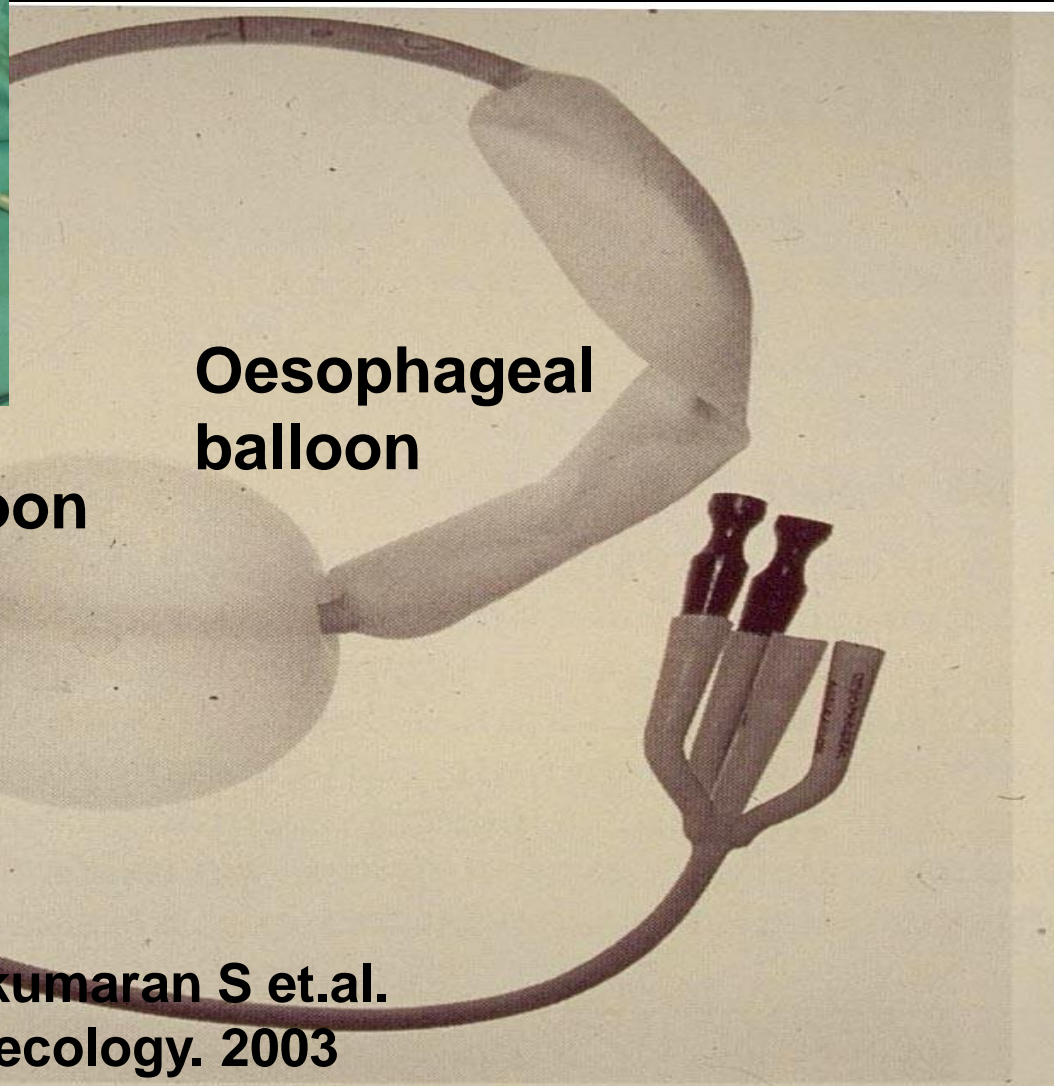
**Junior staff or midwife
can perform the procedure**

Results known immediately

**Tamponade Test – prognostic
& Therapeutic**

TAMPONADE TEST

Therapeutic & Prognostic
with severe PPH

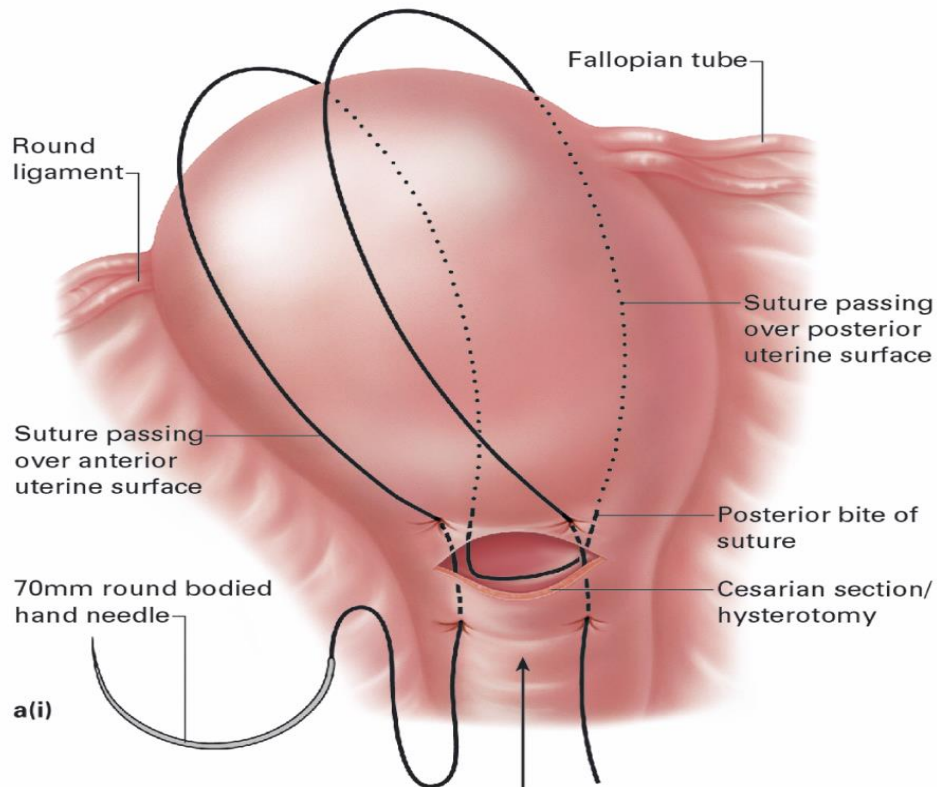


Sengstaken,
Rusch,
Cookes/ Bakri,
Condom
Rubber glove
EBB baloon

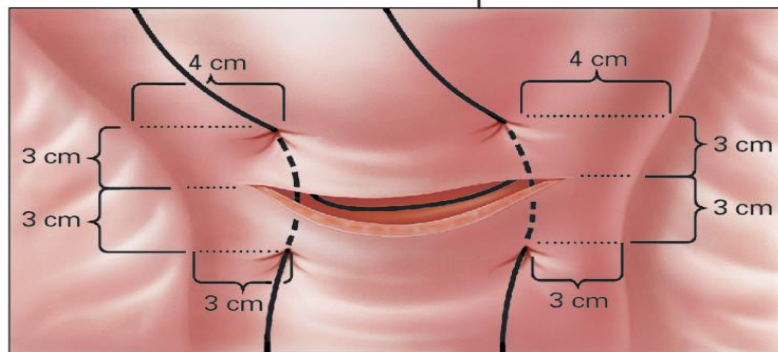
Volume varies
Pressure not an
issue –
mechanism of
Action?

Condous G, Arulkumaran S et.al.
Obstetrics & Gynecology. 2003

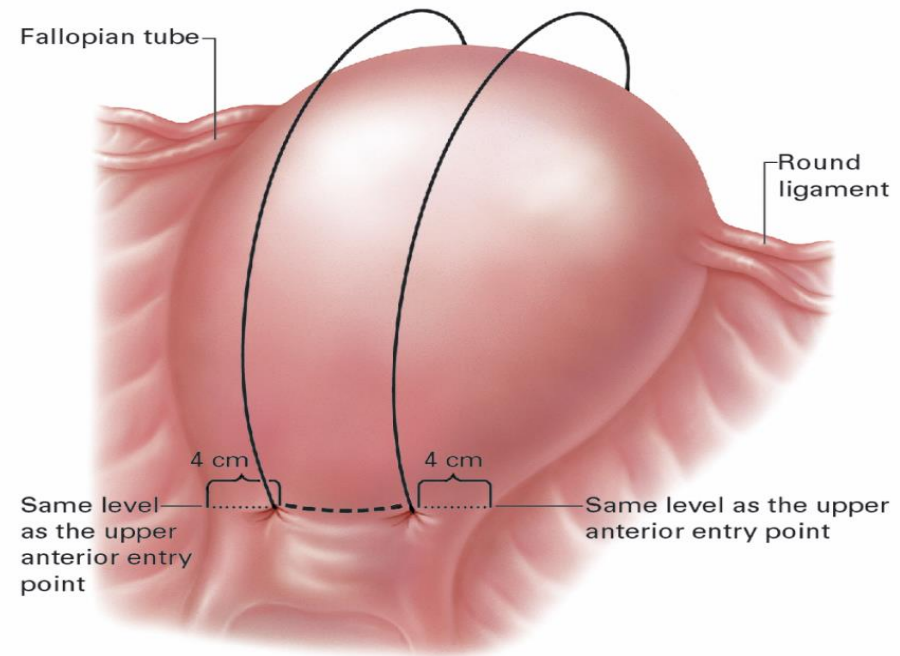
Sengstaken-Blakemore tube (stomach balloon inflated).



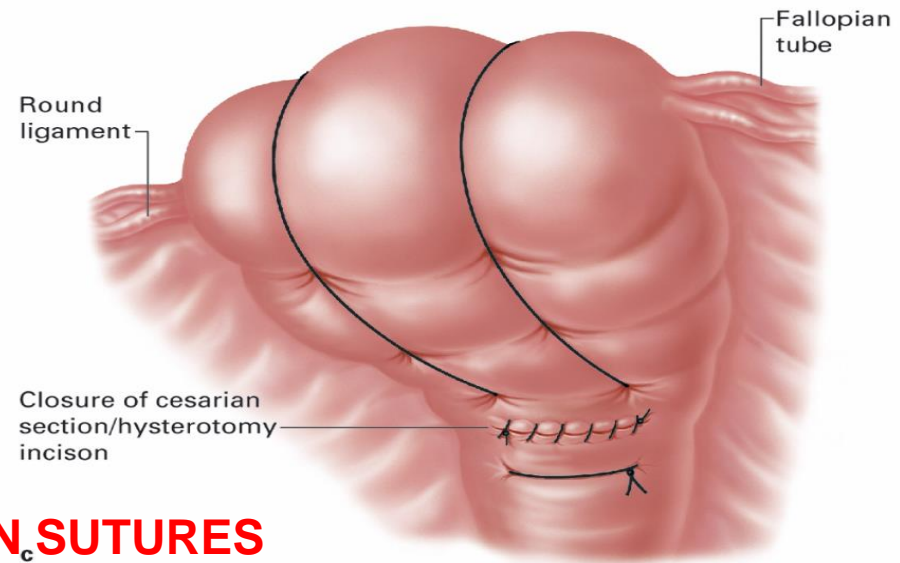
a(i)



a(ii)



b



Closure of cesarean section/hysterotomy incision

B- LYNCH COMPRESSION SUTURES

© Copyright B-Lynch '05

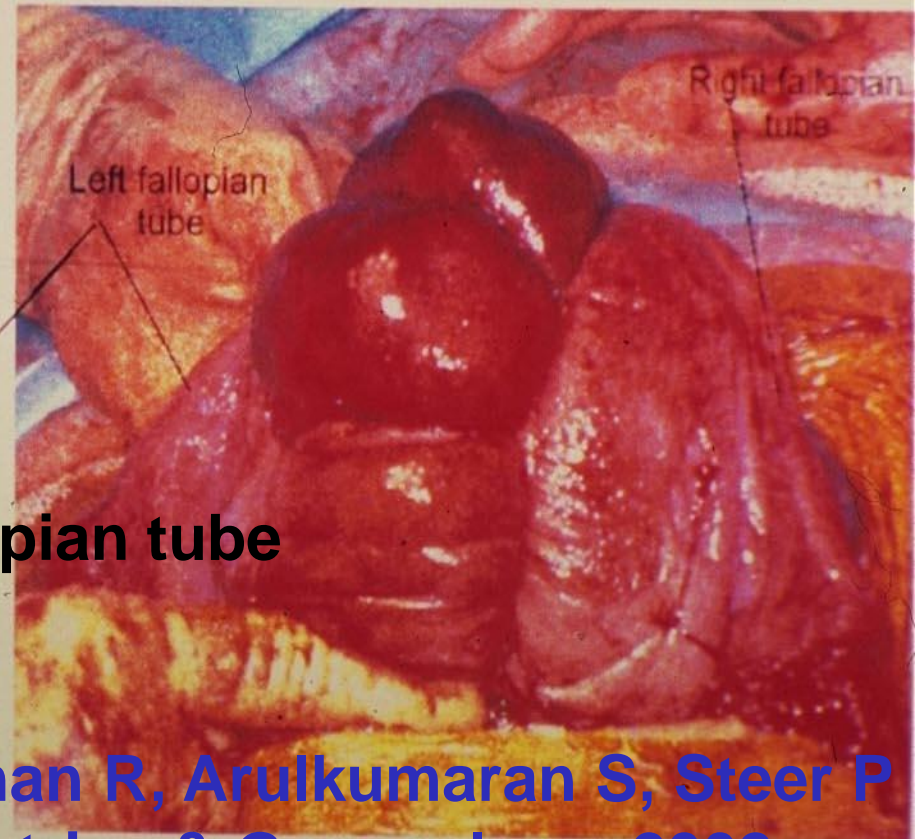
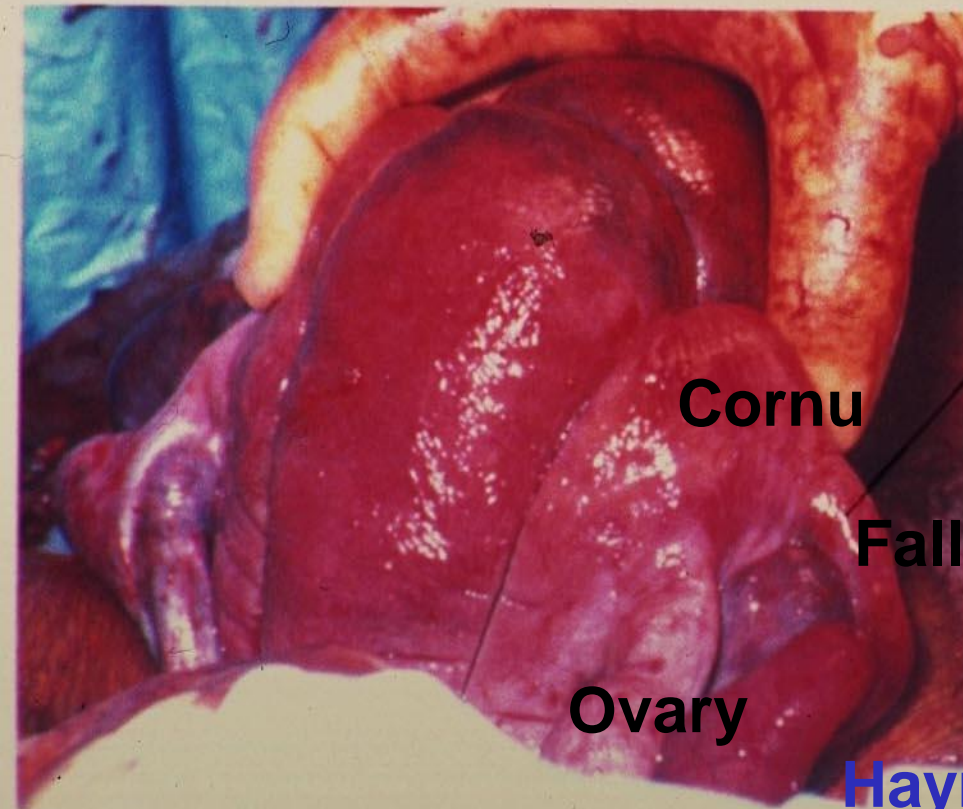
Figure 2a(i+ii), b, c Summary of the B-Lynch procedure application.

MODIFIED VERTICAL COMPRESSION SUTURES

Figure 3

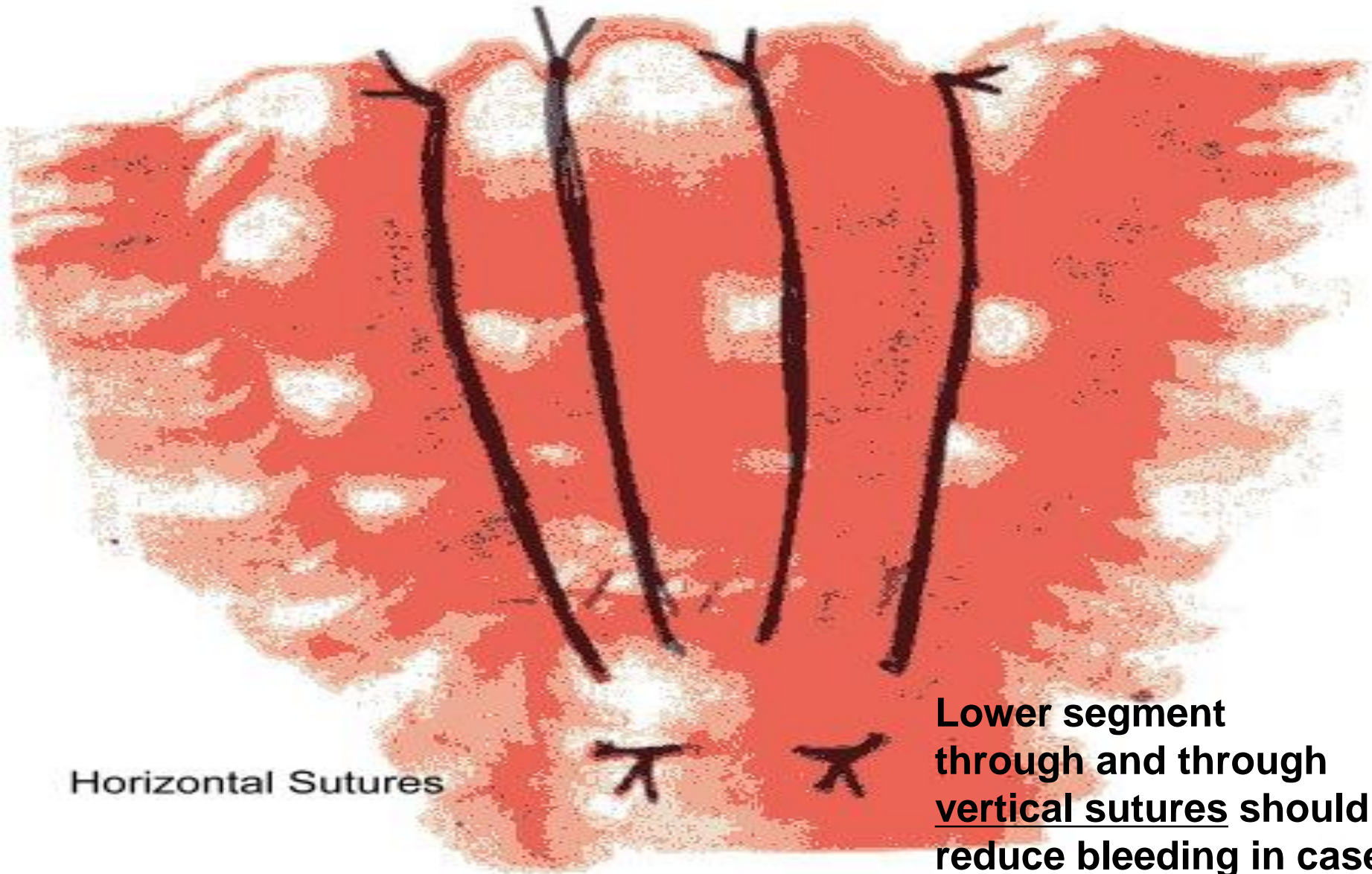
Anterior view

Posterior view



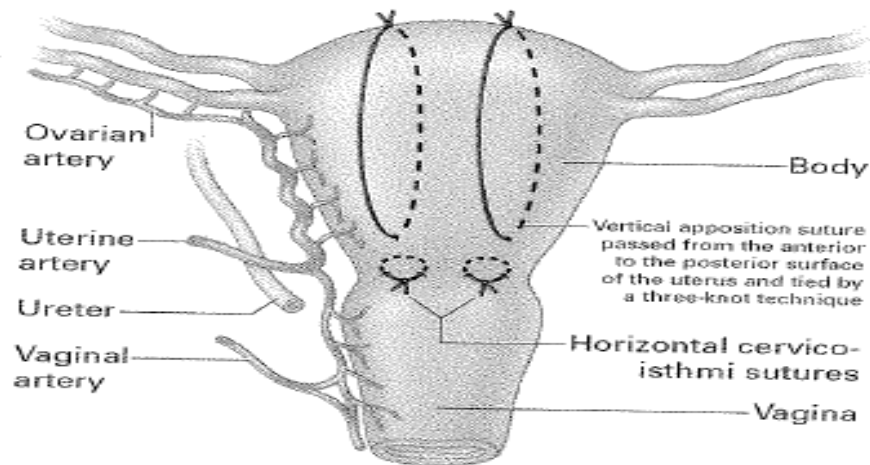
Hayman R, Arulkumaran S, Steer P
Obstetrics & Gynecology. 2002

Multiple vertical compression sutures



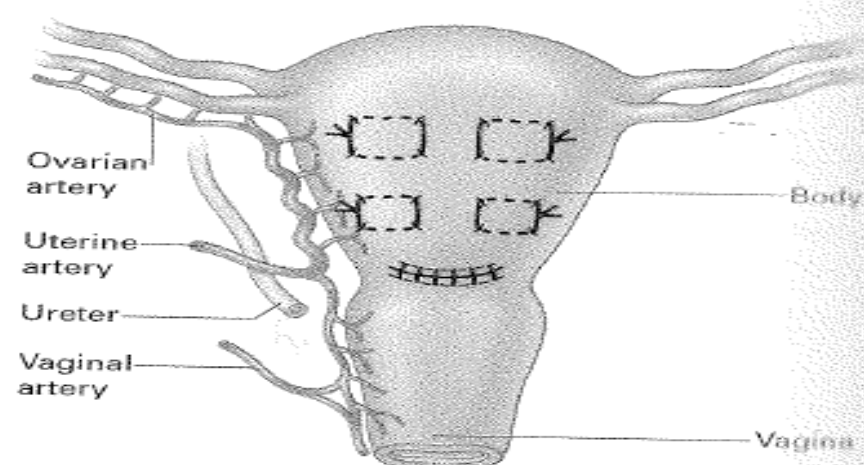
Horizontal Sutures

**Lower segment
through and through
vertical sutures should
reduce bleeding in cases
of placenta praevia**



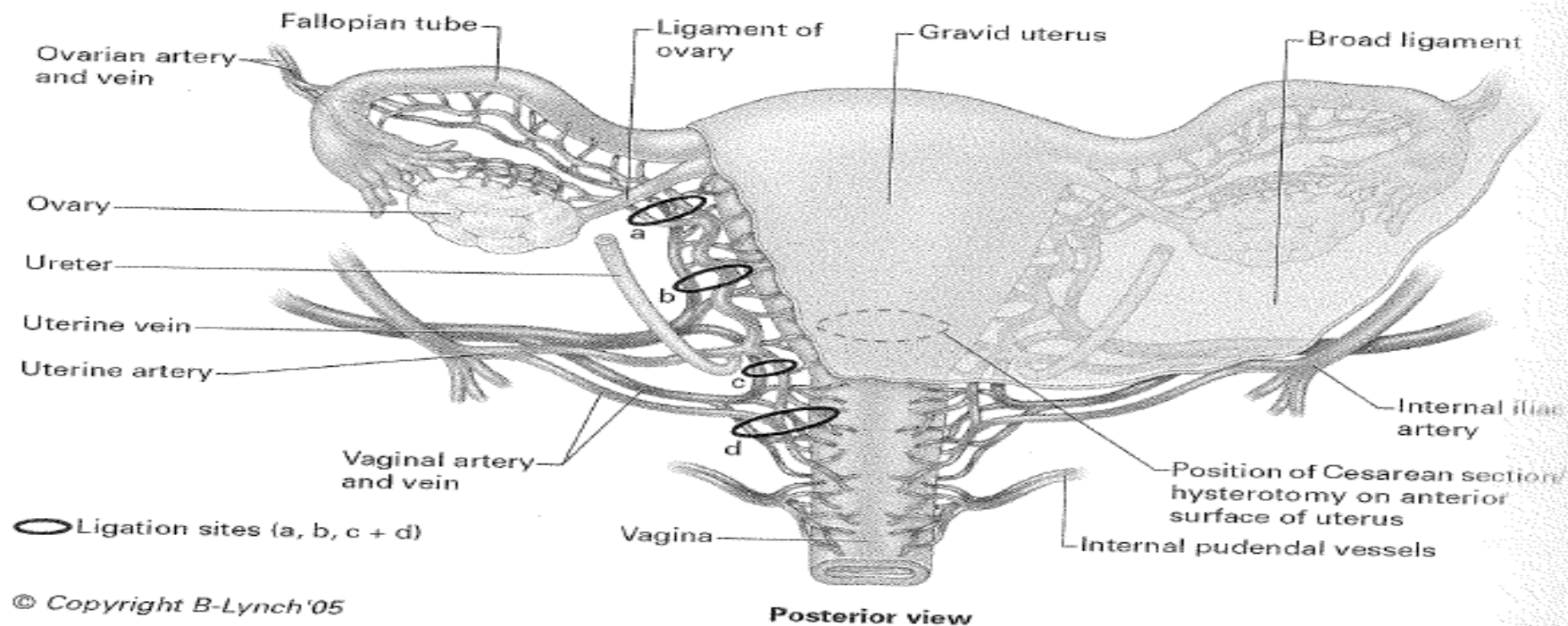
© Copyright B-Lynch'05

Figure 5 The Hayman uterine compression suture without opening the uterine cavity¹¹



© Copyright B-Lynch'05

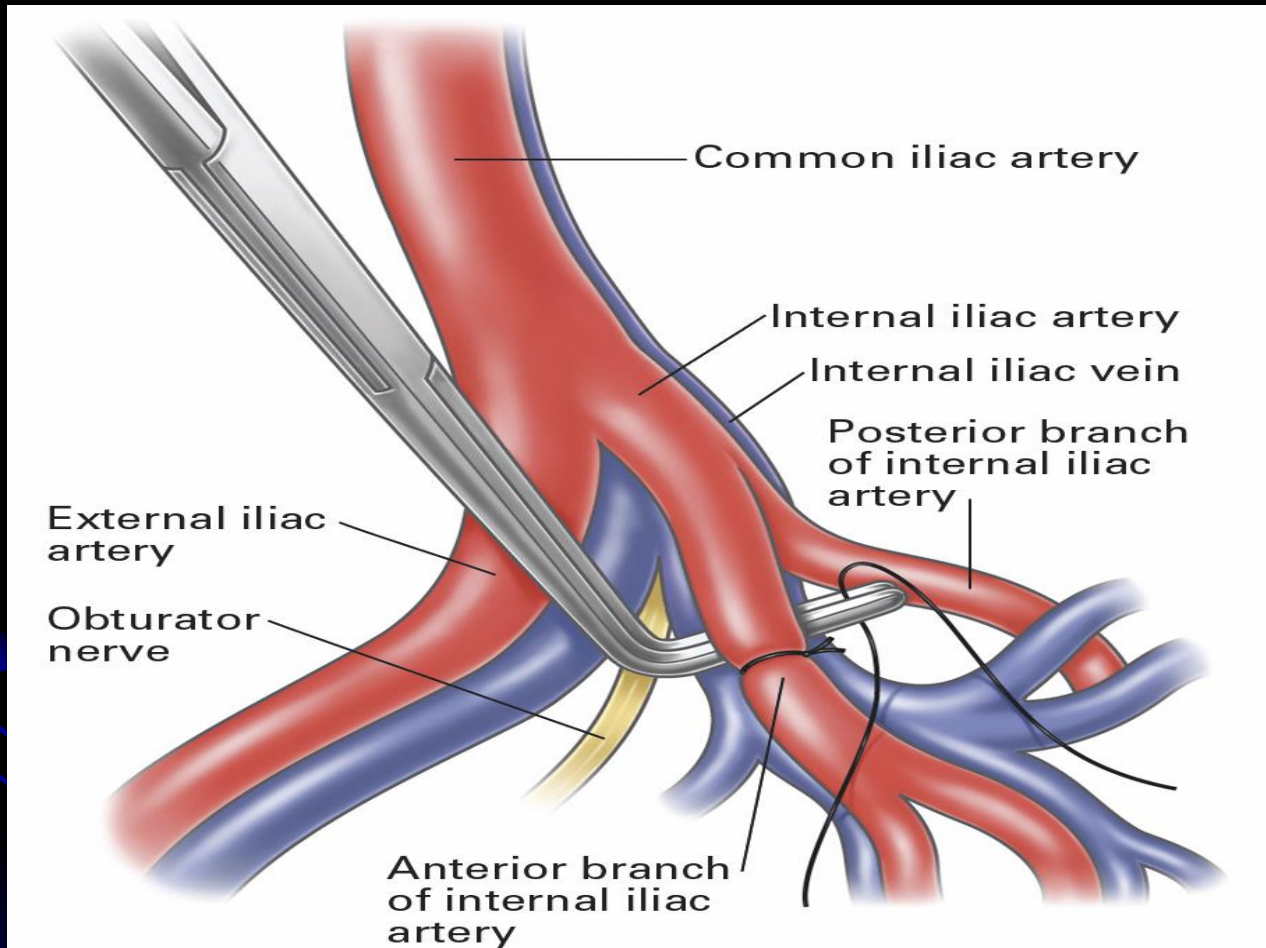
Figure 6 The Cho multiple square sutures compressing anterior to posterior uterine walls¹²



© Copyright B-Lynch'05

Figure 7 Placement of ligatures in the process of stepwise devascularization, including ligation of the descending uterine and vaginal arteries

Hypogastric Artery Ligation



© Copyright B-Lynch'05

Figure 1 Demonstrates ligation of the anterior branch of the internal iliac artery with its associated vein, in a vulnerable position.

24-JAN-2002
15:41:00

RADIOLOGICAL INTERVENTION – EMBOLISATION

RT

LT

Point of ILA
ligature

90 L
1 CAU
1 RAO
2/ 4

0 1 2 3 4 5 6 7 8 9 10 11 12

24-JAN-2002
15:41:00

RT

LT

0 1 2 3 4 5 6 7 8 9 10 11 12

90 L
1 CAU
1 RAO
2/ 4

24-JAN-2002
15:41:00

RT

LT

90 L

1 CAU

1 RAO

2/ 4

0 1 2 3 4 5 6 7 8 9 10 11 12

24-JAN-2002
15:41:00

RT

LT

90 L
1 CAU
1 RAO
2/ 4

0 1 2 3 4 5 6 7 8 9 10 11 12

Conservative Surgical Treatment for PPH

Effectiveness – No coagulopathy

Method	No of Cases	Success rates
B-Lynch + other Compression sutures	94	90.4%
Arterial embolization	218	91%
Arterial ligation	264	83.7%
Uterine balloon tamponade	135	83.7%

Massive PPH - Surgical Techniques

Near Miss Enquiries - Scotland

- Use of Balloon techniques – 6 in '03; 42 in '06
- Compression sutures – 10 in '03; 24 in '06.
- Over 4 years; 106 balloon techniques - 95% success rate; 76 brace sutures – 83% success rate
- Peripartum hysterectomy – 15% in 2003; 8% in 2006
- Avoidable delay in diagnosis & management – 8%
- Failure to follow protocol/plan – 6%

THE GOLDEN HOUR

- As more time elapses between the point of severe shock and the start of resuscitation, the percentage of surviving patient decreases (**metabolic acidosis**)
- The “Golden Hour” is the time in which resuscitation must begin to achieve maximum survival – with **arrest of bleeding**

THE GOLDEN HOUR

Probability of survival



Survival is related to severity and duration

PPH Coagulation disorders

'Wash Out Phenomenon'

- **DIVC**- FDP inhibits clotting
- "Washout phenomenon" (**Consumptive**) - the coagulation factors are consumed and washed out at the site of bleeding
- The 'Consumptive' is the major phenomenon that prevents arrest of haemorrhage cf DIVC
- Laboratory tests/ Use of thrombo-elastograph -TEG

Reason for Excessive Uncontrolled Bleeding

- **Consumptive** coagulopathy
- Excessive **fibrinolysis**
- **Dilutional** coagulopathy - haemodilution
- **Hypothermia** – slow enzymatic process of clott. cascade + impaired platelet function
- **Multi-transfusion** syndrome – Depleted platelets and clotting factors
- Metabolic changes – **acidosis + citrate**

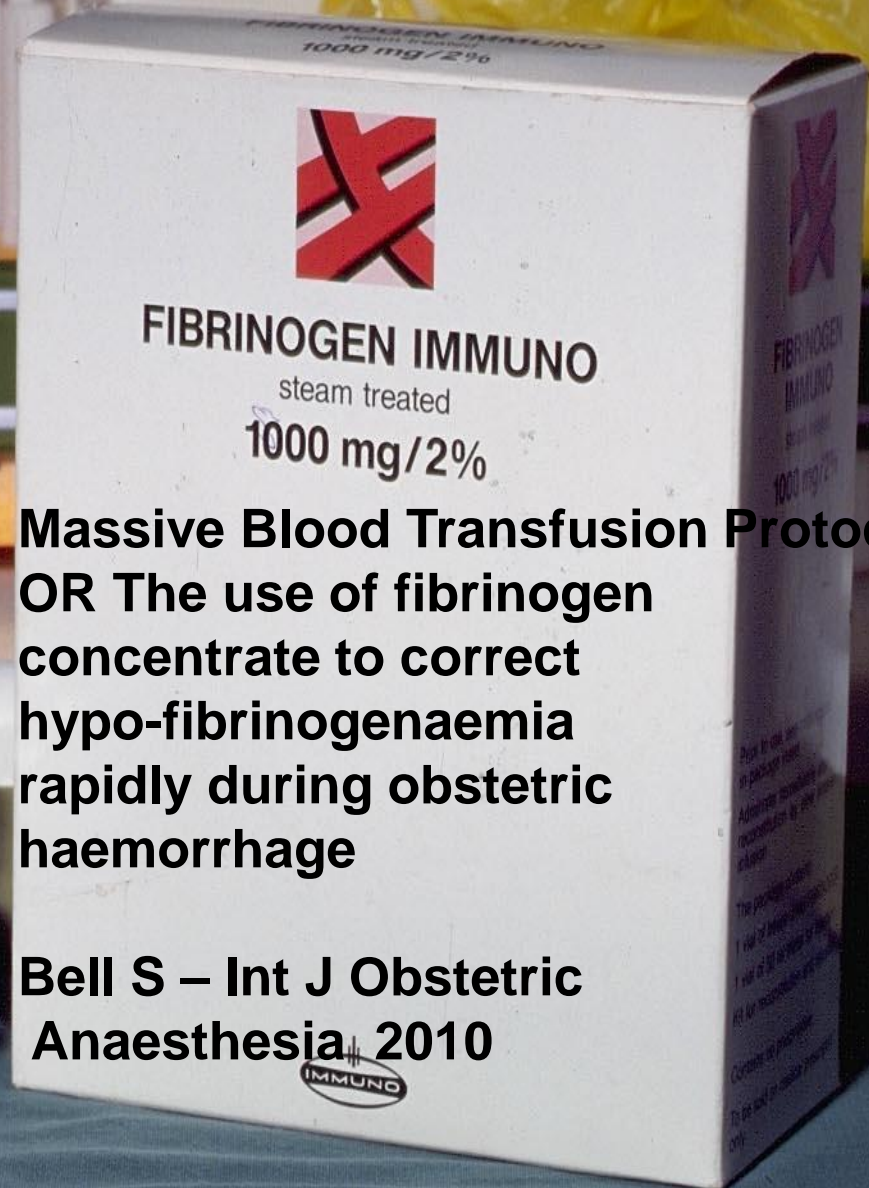
Does Military Experience Translate to Civilian (Trauma Center) Life

1. Mortality declined from **65% to 20%** in **casualties** receiving > 10 units PRBC in 24 hours IF **FFP to PRBC ratio 1:1 vs 1:4**

2. Of 2746 **surgery patients**, 135 (4.9%) received > 10 units PRBC + FFP

- When FFP:PRBC ratio **1:1, mortality 26%**; if ratio **1:4, mortality 87.5%** ($P=0.0001$)
- RR **mortality significantly greater** for those receiving ratio **1:4 vs 1:1**

Duchesne et al J Trauma 2009; 65:272-6



**Massive Blood Transfusion Protocol
OR The use of fibrinogen
concentrate to correct
hypo-fibrinogenaemia
rapidly during obstetric
haemorrhage**

**Bell S – Int J Obstetric
Anaesthesia 2010**

Not licensed for use in the UK

Therapy with rfVIIa

Initial dose 40–60 mcg IV

If bleeding continues >30min repeat

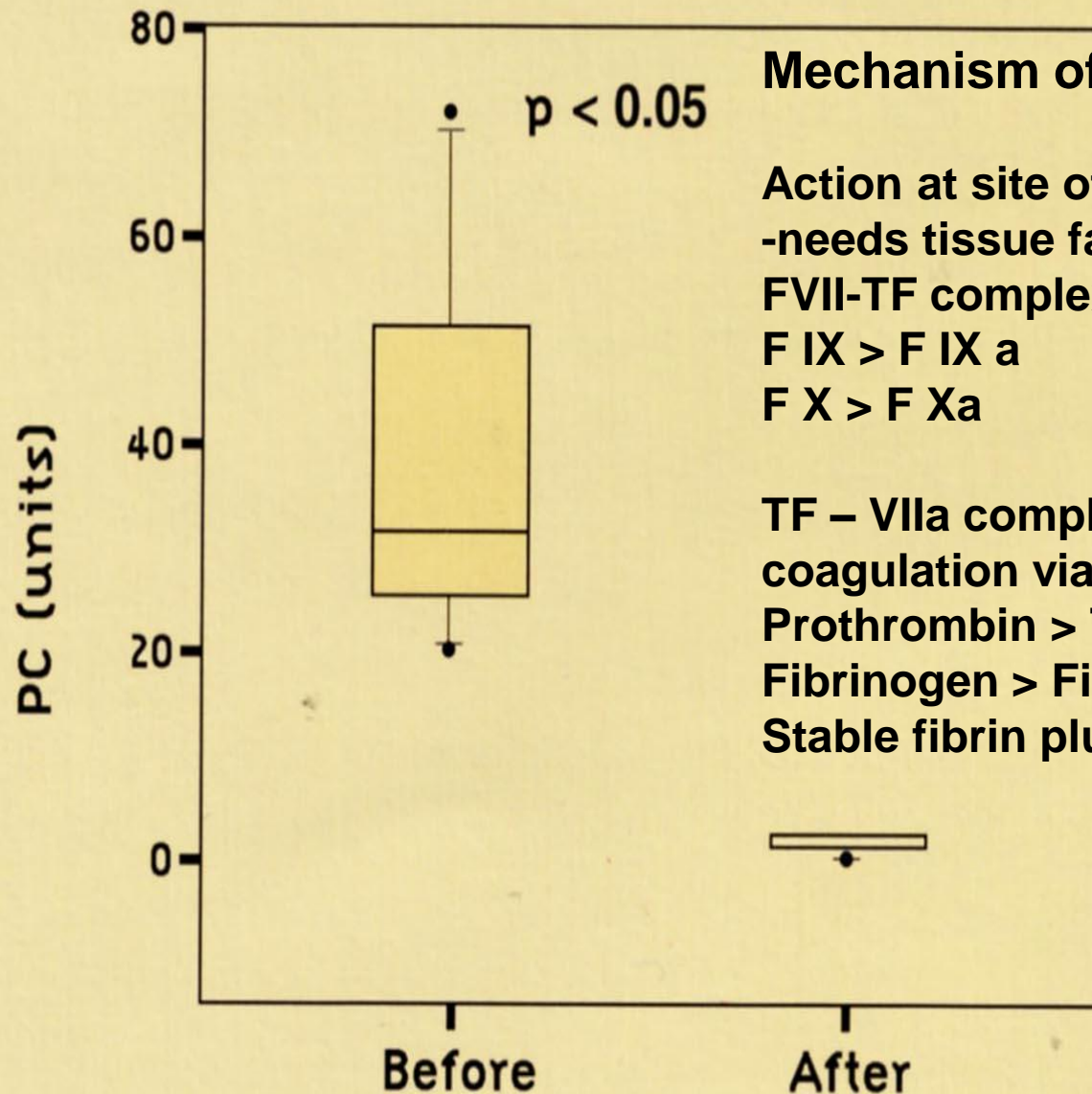
Can repeat 3-4 times more at 15-50 min intervals

**If response inadequate after 200 mcg
recheck preconditions for
administration**

*These recommendations based on complete review of use of this
drug in PPH by*

S. Sobieszczyk and GH. Breborowicz, 2006

Blood requirements before and after administration of rFVIIa



Mechanism of Action

Action at site of vascular injury

-needs tissue factor>

FVII-TF complex directly activated

F IX > F IX a

F X > F Xa

TF – VIIa complex initiates

coagulation via F V

Prothrombin > Thrombin

Fibrinogen > Fibrin

Stable fibrin plug

Figure 2

The shortening effect of rFVIIa on prothrombin time and partial thromboplastin time

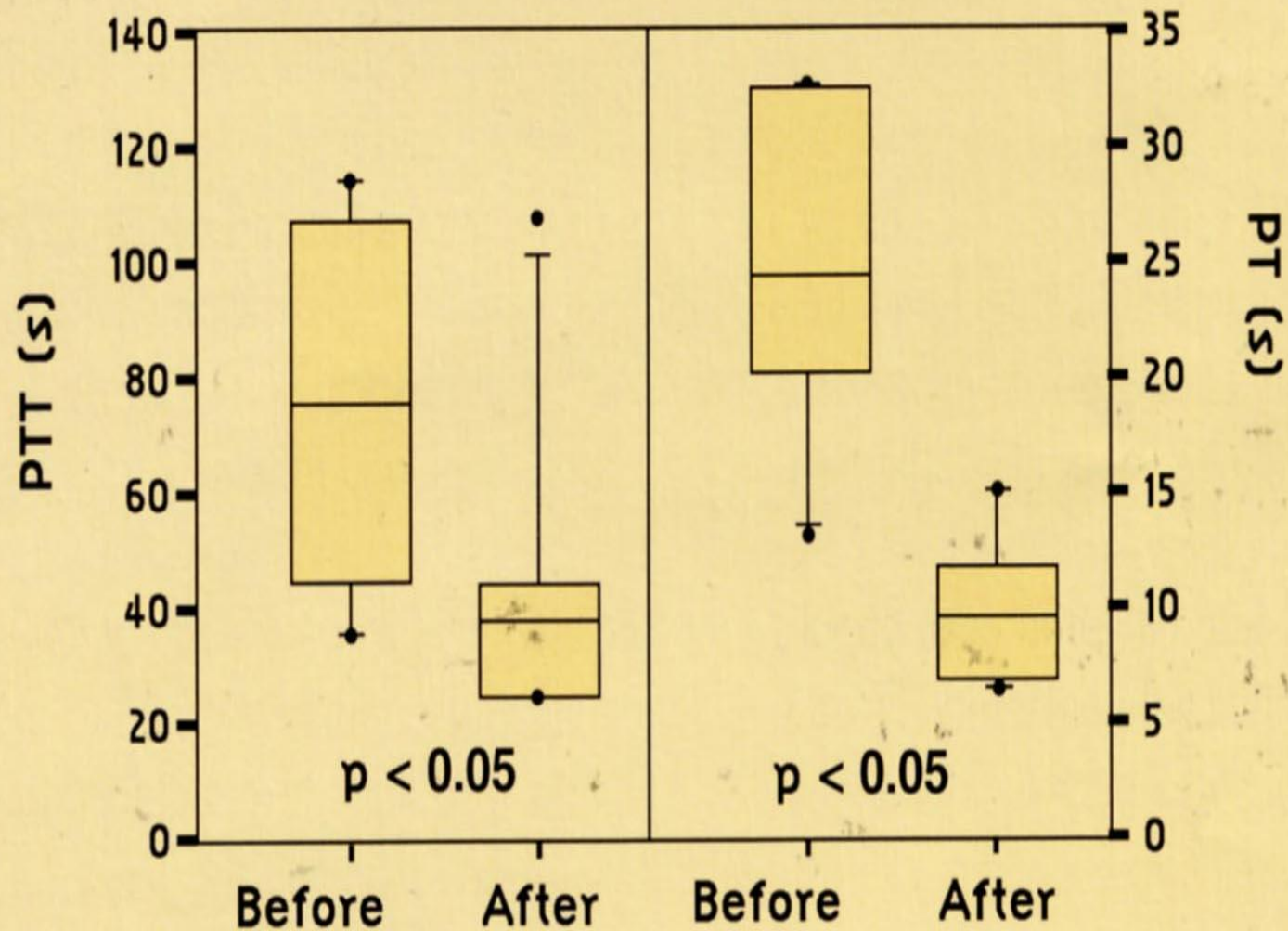


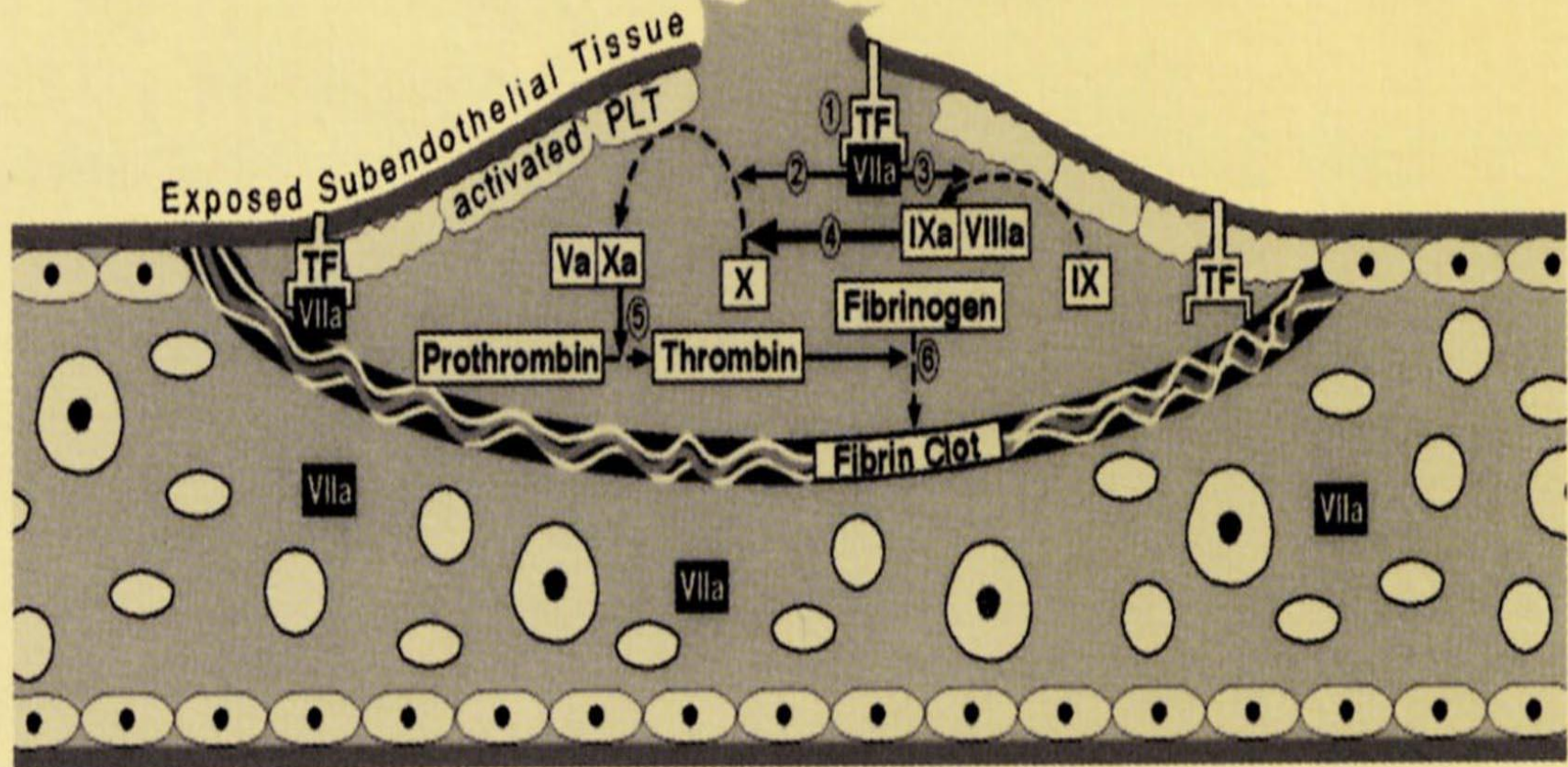
Figure 3

The mechanism of action of rFVIIa

North European Registry 2000-2001
Obs Gynae 2007; 110; 1270-78
4 TE, 1 MI, 1 SR

rVII a in Obstetric haemorrhage –
NZ & Australia Registry
Phillips et.al. Anaesth Analg 2009
1 PE & 1 DVT – no mortality

Site of Vascular Injury



Subendothelial Tissue

500

OBHC

500 ml

Haemacel[®]

Active ingredient: Polygeline

3.5% Colloidal Infusion Solution for Plasma Volume Expansion
for intravenous administration

- Sterile and pyrogen-free -

Composition

1000 ml of Haemacel contain: Degradable polypeptides cross-linked via urea bridges (3%)
(equivalent to 6.3 g nitrogen)

Cations: Na⁺ 145 mmol, K⁺ 5.1 mmol, Ca²⁺ 13 mmol

8.4.93
7.4.98
61878

Int J Gynaecol Obstet. 2011 May;113(2):152-4.

Outcome of the management of massive postpartum hemorrhage using the algorithm "HEMOSTASIS"

Varatharajan L, Chandraharan E, Sutton J, Lowe V, Arulkumaran S. St George's University, London, UK.

OBJECTIVE:

To evaluate whether the algorithm "HEMOSTASIS" was of value in the systematic management of postpartum hemorrhage (PPH).

METHODS:

A retrospective analysis was performed of all women who experienced massive primary PPH (blood loss >1500mL) in 2008 (5.400 deliveries) at St George's Hospital, London, UK.

RESULTS:

114 cases of massive primary PPH (2.1%)

Hemostasis was achieved in 63 (66.3%) women via use of additional oxytocics ("O");

19 (20.0%) via suture of tears and

10 (10.5%) via tamponade ("T");

1 (1.1%) via application of compression suture ("A");

1 (1.1%) via systematic devascularization ("S"); and

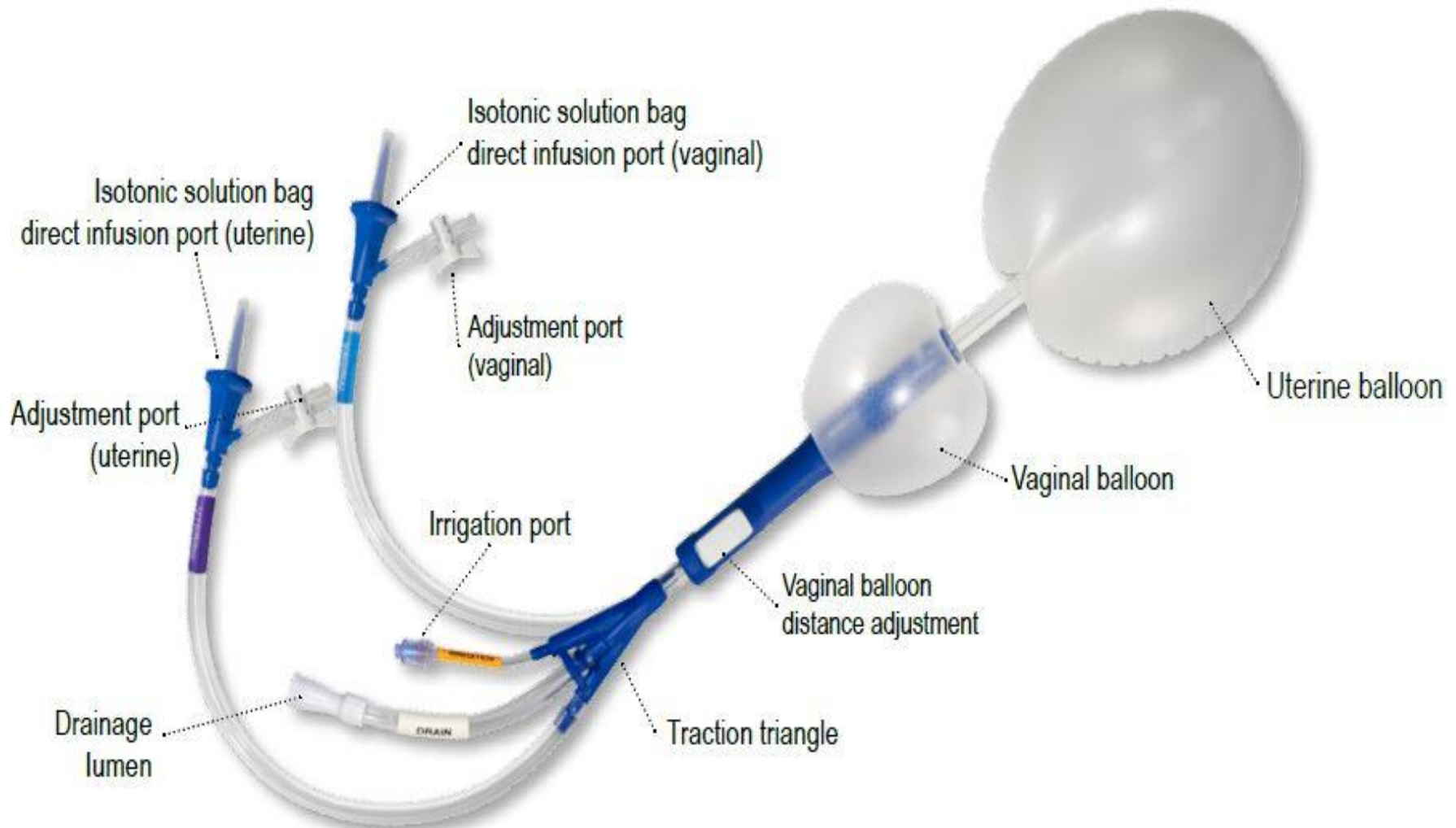
1 (1.1%) via subtotal/total hysterectomy ("S").

There were no maternal deaths.

CONCLUSION:

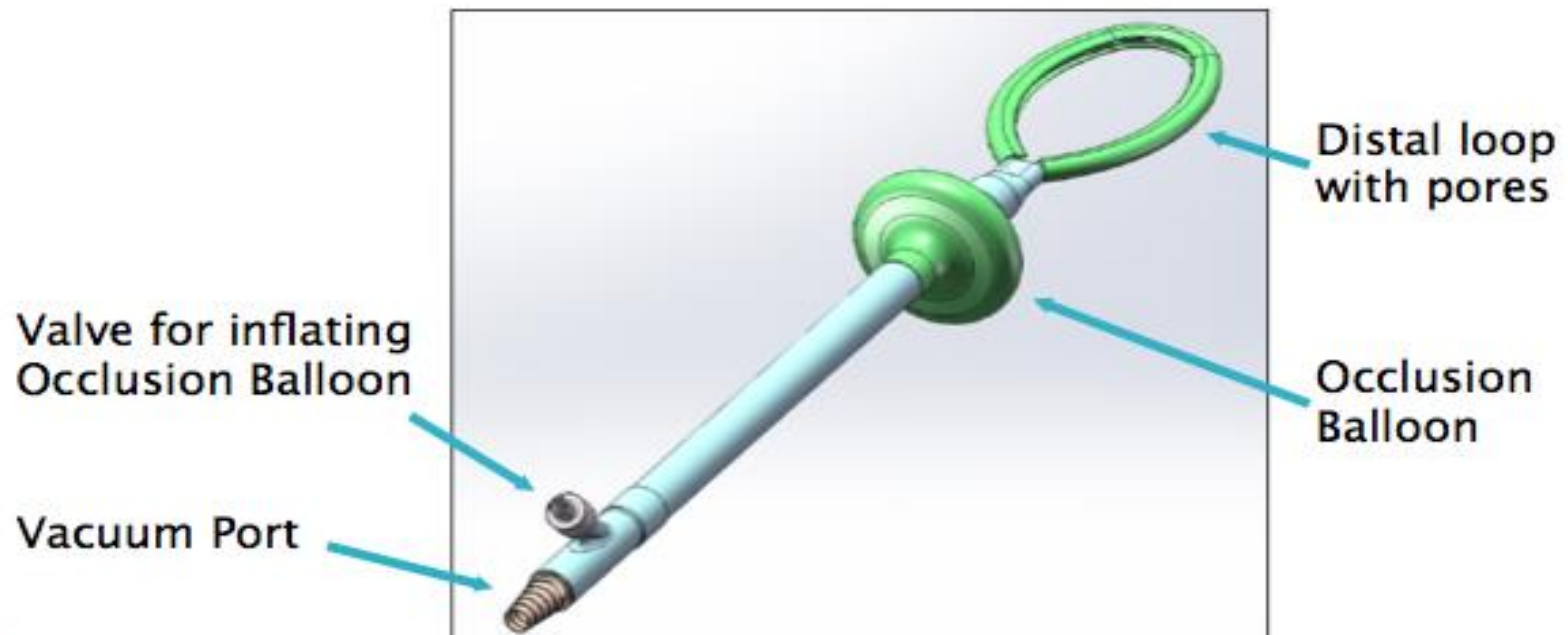
The decremental pattern of more complex interventions used demonstrates that the algorithm provide a logical management pathway to reduce blood transfusions, hysterectomies, admissions to intensive care units, and maternal deaths.

The ebb Complete Tamponade System



Control of Postpartum Hemorrhage Using Vacuum Induced Uterine Tamponade

InPress Device



Jan Segnitz MD, Yuditia Purwosunu MD, Wydiastuti MD, Amelia Degenkolb MS, S. Arulkumaran MD

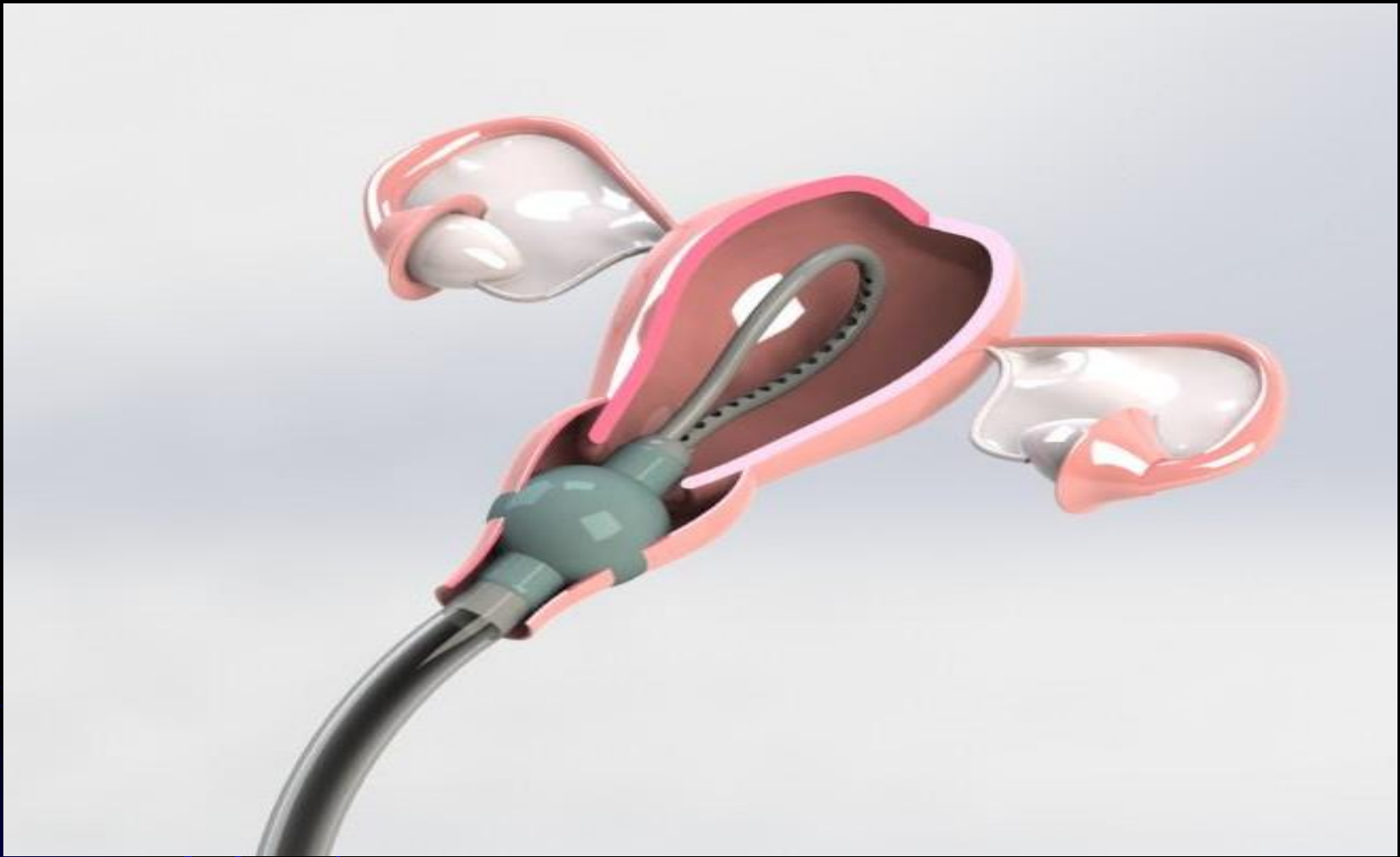
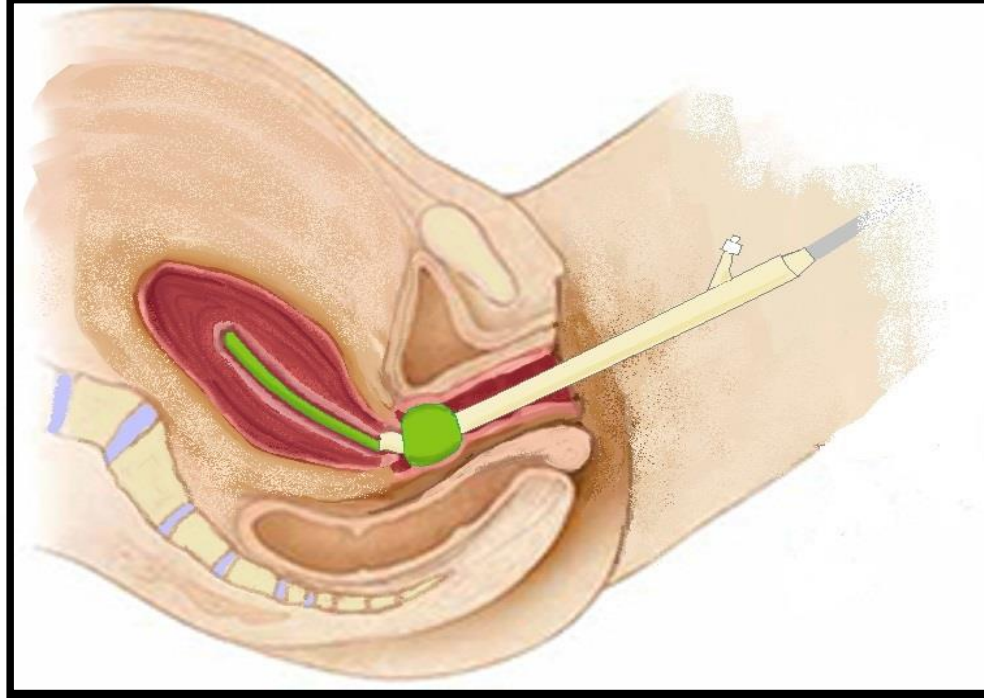
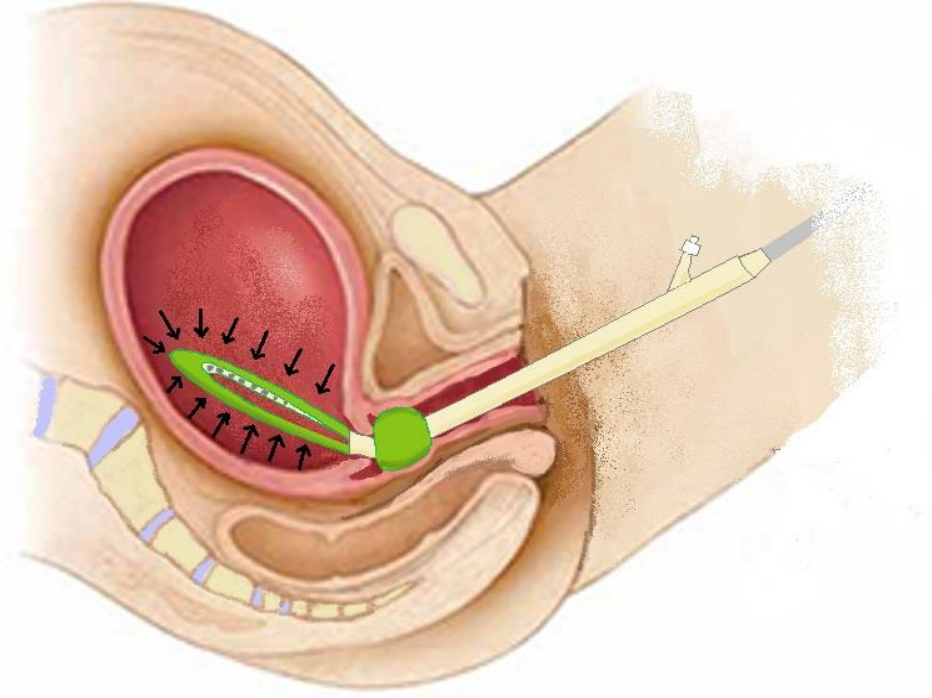


Figure 1. InPress Technologies device, an innovation that aids in postpartum uterine contraction.



An occlusion balloon, built into the device shaft, was inflated at the level of the external cervical os, to create a uterine seal. The distal end of the device was attached by standard suction tubing to a regulated suction source with a one-liter collection canister, and set at 70-mmHg vacuum.

Results: *The suction created an immediate seal at the cervical os, 50 -250 ml of residual blood was evacuated from the uterine cavity into the vacuum canister, the uterus collapsed and regained tone within minutes, and hemorrhaging stopped in all cases. The device remained in place while vaginal and perineal lacerations were easily repaired. The device was left in place for a minimum of one hour, and in our study, up to 6.5 hours.*

Global Health: *Procedures and Instruments*

Control of Postpartum Hemorrhage Using Vacuum-Induced Uterine Tamponade

Yuditiya Purwosunu, MD, Widyastuti Sarkoen, MD, Sabaratnam Arulkumaran, MD, PhD, and Jan Segnitz, MD

BACKGROUND: Postpartum hemorrhage is the leading cause of maternal mortality worldwide. Vacuum-induced uterine tamponade is a possible alternative approach to balloon tamponade systems for the treatment of postpartum hemorrhage resulting from atony.

CONCLUSION: This preliminary investigation suggests that a device designed to create vacuum-induced uterine tamponade may be a reasonable alternative to other devices used to treat atonic postpartum hemorrhage. (*Obstet Gynecol* 2016;0:1–4)

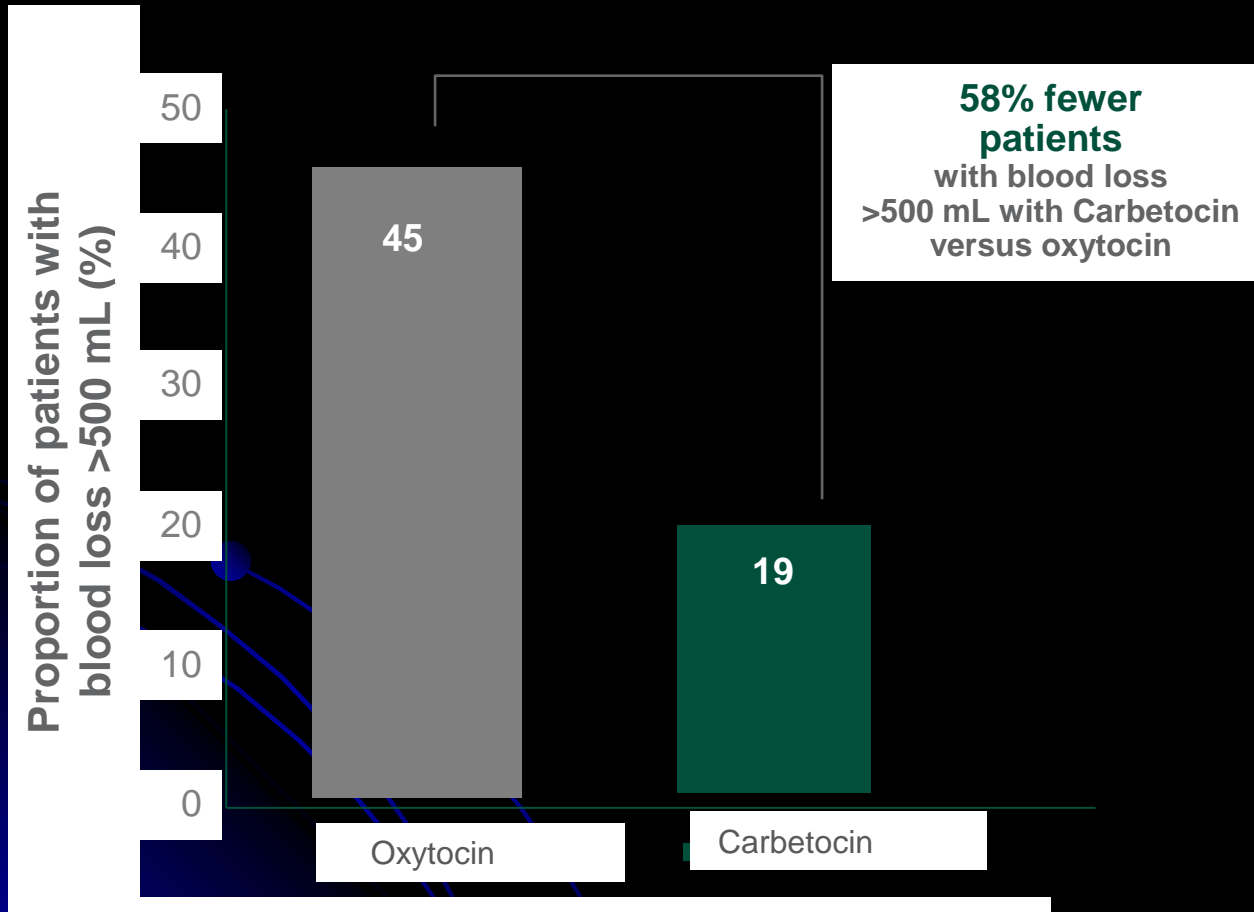
Uterine activity after intravenous injection

	<i>Oxytocin</i>	<i>Carbetocin</i>
Onset of action	< 1 minute	~ 1.5 minutes
Duration of rhythmic contractions	8 minutes	60 minutes

Carbetocin rapidly returns uterine tone

Carbetocin has a long duration of action

- **Carbetocin *reduces*** the risk of major blood loss by more than 50% compared with oxytocin



Borruto F, et al. Arch Gynecol Obstet 2009;280:707–12.



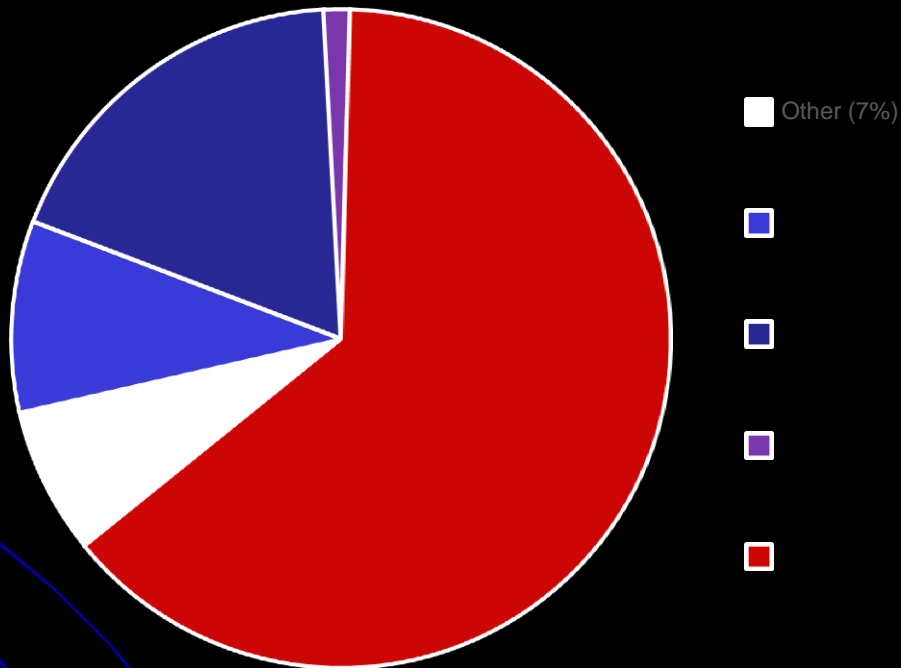
www.womantrial.Lshtm.ac.uk

Trials Coordinating Centre, Room 180
London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT

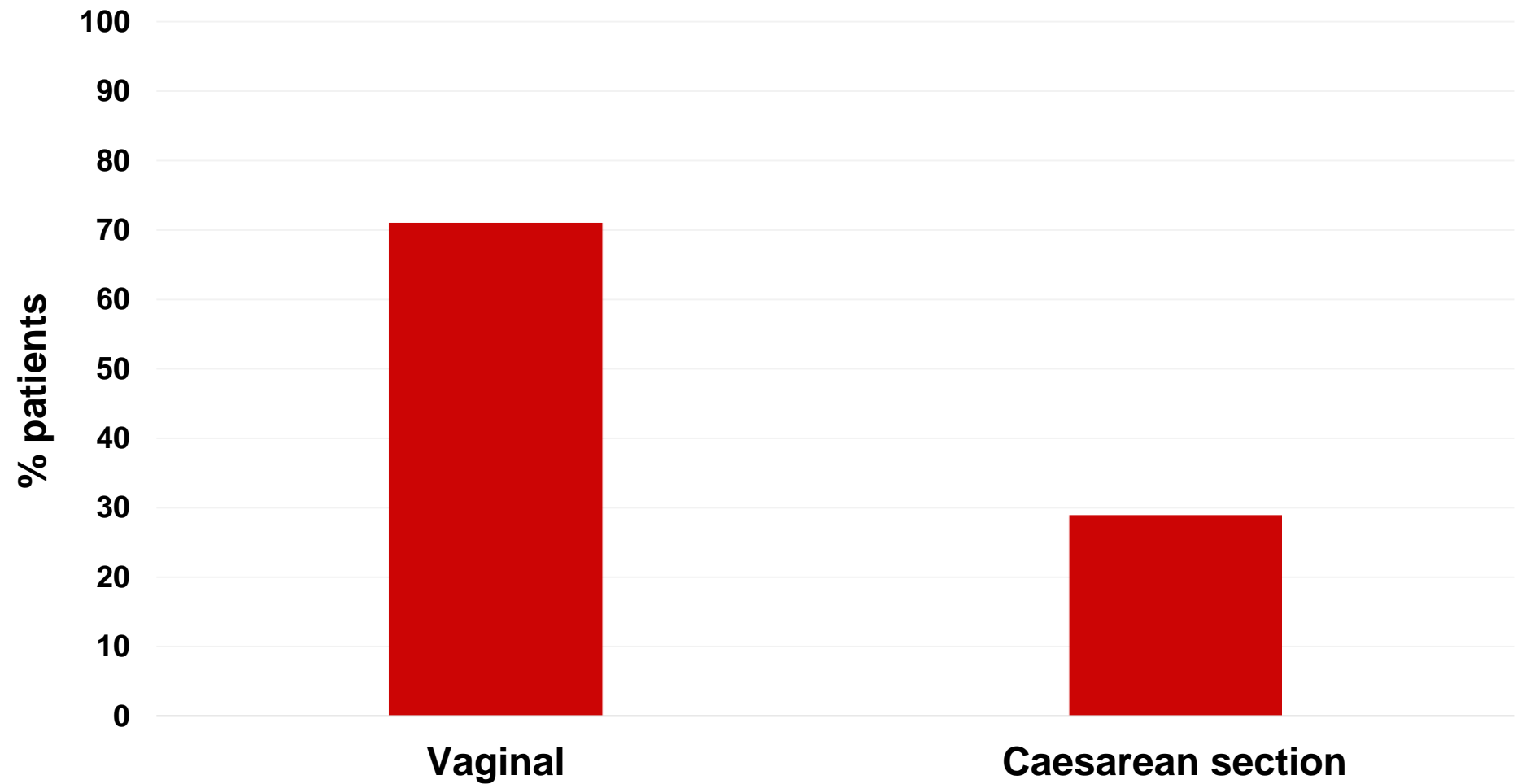
Tel +44(0)20 7299 4684, Fax +44(0)20 7299 4663
Email: thewomantrial@Lshtm.ac.uk



Primary cause of haemorrhage



Type of delivery



Cause of death

OTHER CAUSES

Amniotic fluid embolism

Anaesthetic
complication

Aspiration pneumonia

Blood transfusion
reaction

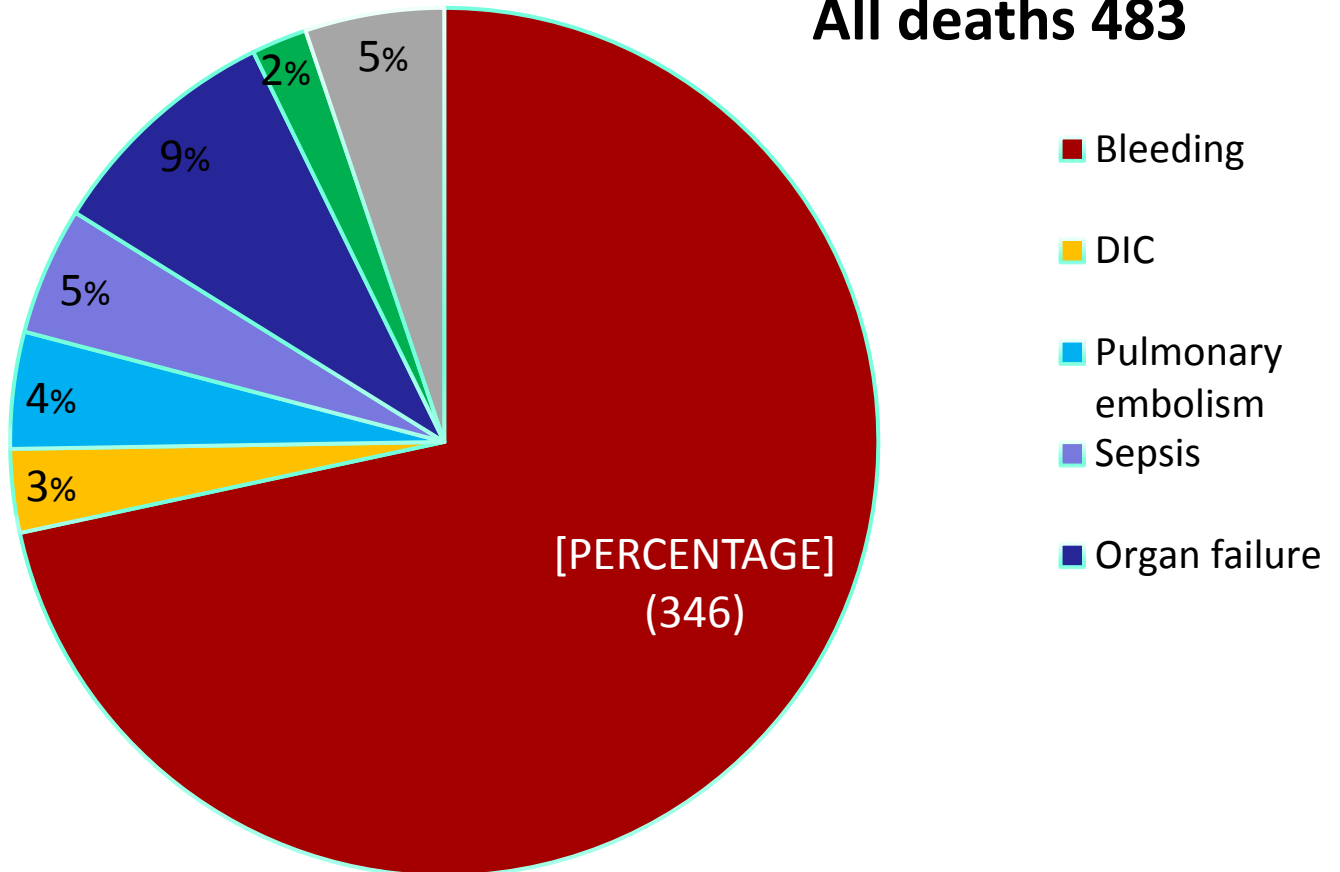
Diabetic ketoacidosis

HELLP syndrome

Uremic encephalopathy

Unknown

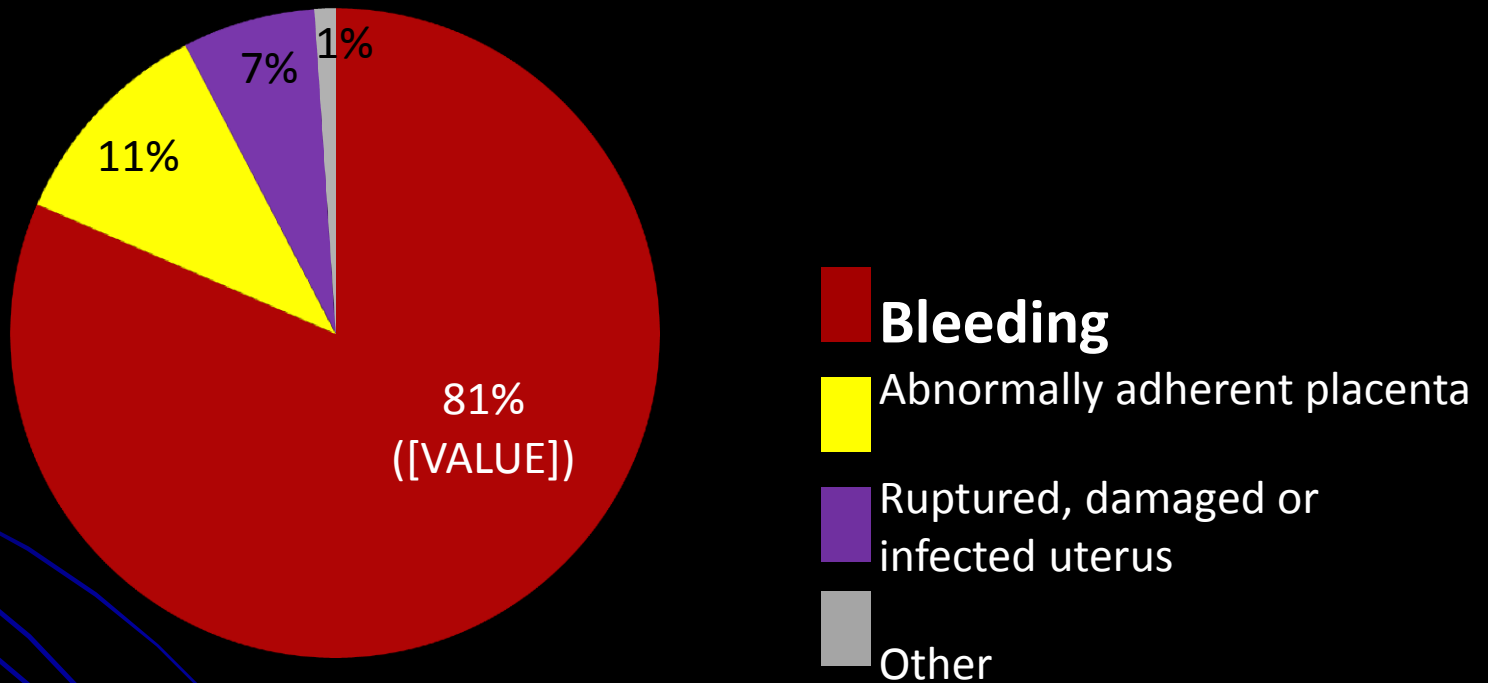
All deaths 483



Death by days since randomisation

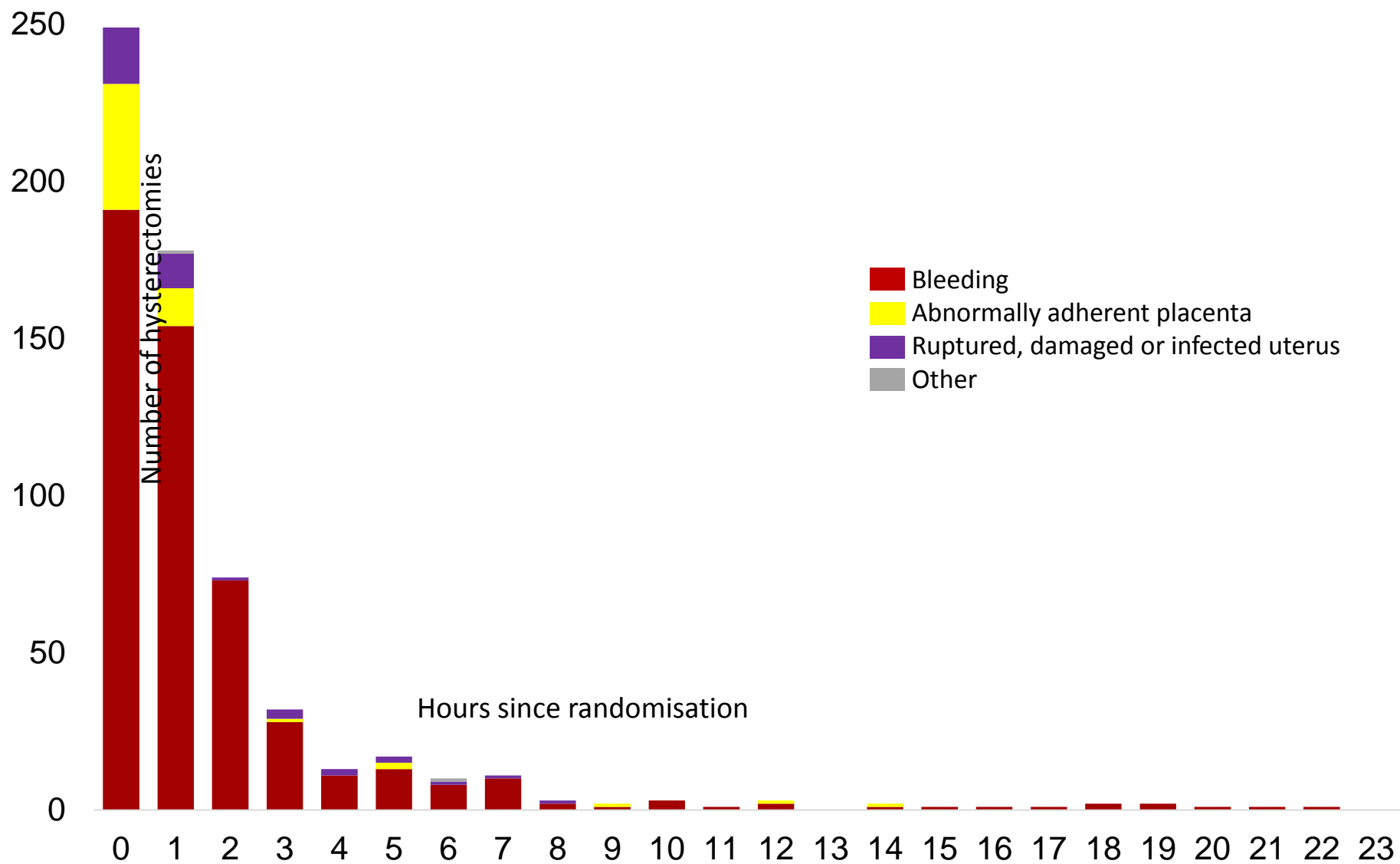


Cause of hysterectomy



1020 women had a hysterectomy – 311 done before randomisation

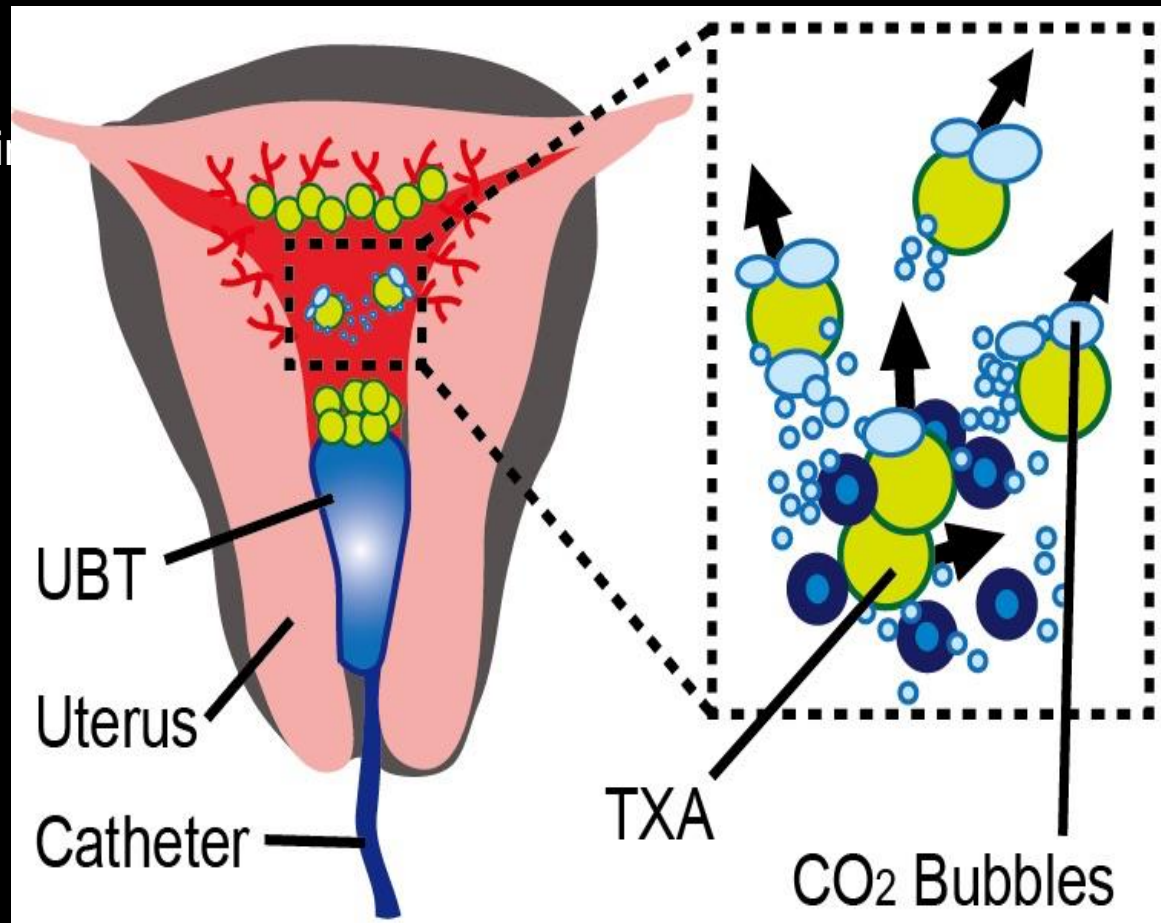
Hysterectomy by hours since randomisation



Synergy of TXA/Thrombin/UBT

In porcine and murine testing gas generating microparticles of CaCO_3 with TXA and thrombin self propel (through lateral propulsion, buoyant rise and convection) to the bleeding site and function hemostatically to halt hemorrhage for traumatic and intraoperative bleeding

Model Concept would be to apply TXA/Thrombin/ CaCO_3 to a UBT both to enhance drug delivery and apply physical Tamponade



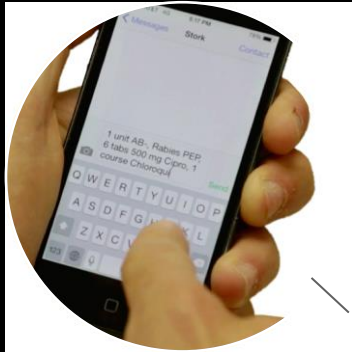
Now, about that drone.....



Stork System: Rapid, On-demand, Aerial Delivery Blood/Uterotonics/Emergency Supplies



1 Health facility orders
blood via mobile



3 Stork can carry up to
1.0 kg in 75 km radius



2 Nest dispatches a
Stork with package



4 Stork drops package at
health facility in 15-45 min

Conclusions: Innovations Now and On the Horizon

Cradle/Microlife Traffic Light Vital Signs Device (SI):
Early Warning Device can be used at any level of the health care system

Phone Pulse Oximeter (O_2 Saturation)

Medications: Carboprost, TXA

NASG to decrease bleeding, reverse shock, stabilize women until definitive care

Abdominal Compression Belt and Butterfly Device

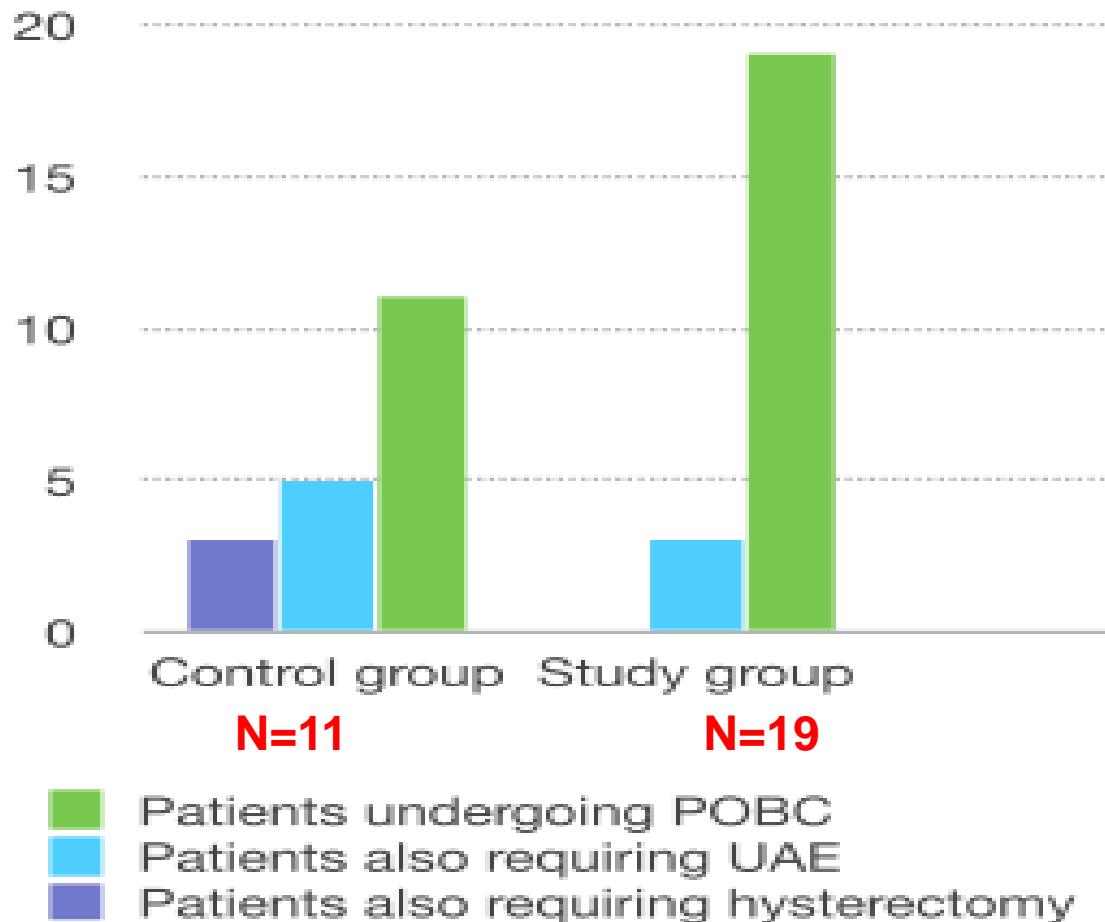
In-press suction device

- Variety of low cost intrauterine tamponade devices
 - DIY condom ; ESM-UBT Kit ; PATH/SINAPI UBT
 - UBC: UBT + $CaCO_3$ /TXA/Thrombin model
- Drones and solar power (blood banks) may bring blood transfusion capacity closer to where women bleed

THANK YOU

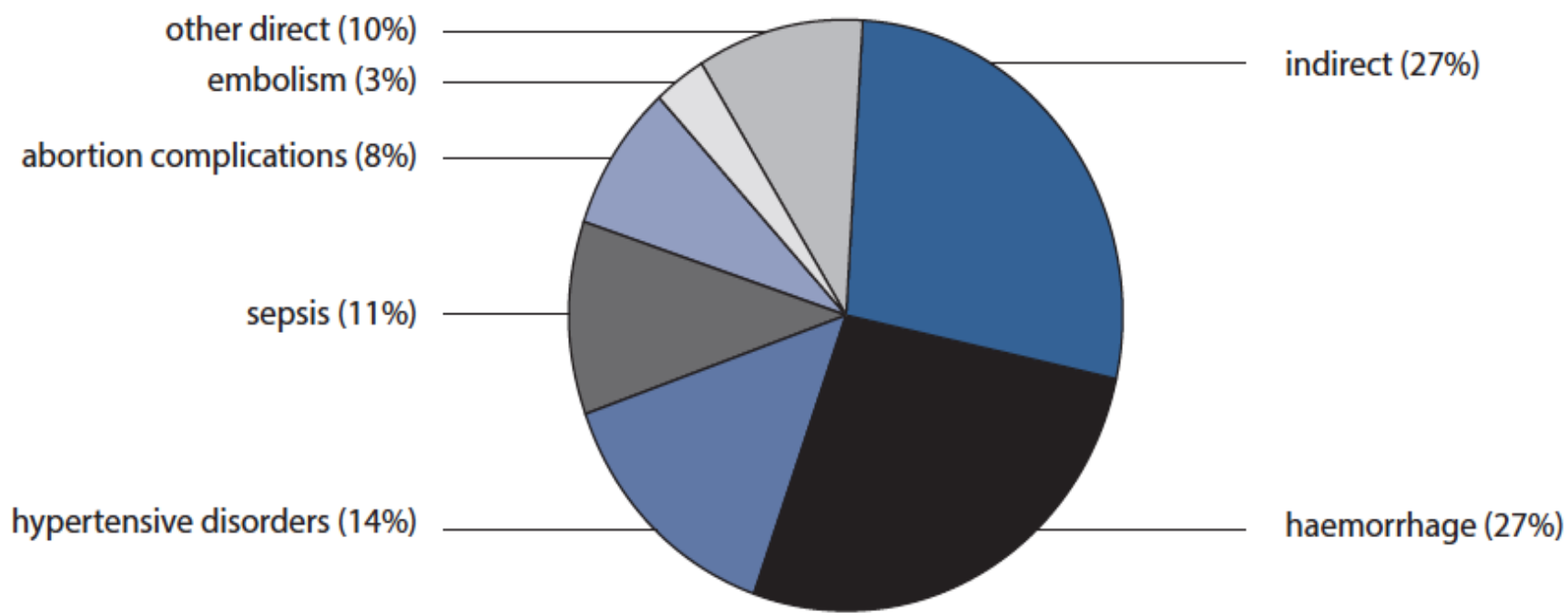


Prevention of PPH & Hysterectomy in patients with Morbidly Adherent Placenta: A cohort study comparing outcomes before & after introduction of Triple-P procedure



Teixidor Viñas, Mireia;
Belli, AM;
Arulkumaran, Sabaratnam;
Chandrabaran, Edwin;
Saint George's Hospital,

FIGURE 3: Global estimates for causes of maternal mortality 2003–2009



Approximately 15 million have PPH and 75,000 die of PPH

What Kills One Woman Every Minute of Every Day?

A HEART ATTACK

B AIDS

C CHILDBIRTH



In Low Resource Countries - deaths due to PPH are higher

PPH causes number of deaths every day and most can be prevented by simple medicines, and conservative Surgical Techniques
Total 800 + die every day = one every 2 minutes
Due to PPH – one every 6 to 8 minutes

Conclusions: Innovations Now and On the Horizon

Triage

Cradle/Microlife Traffic Light Vital Signs Device (SI): Early Warning Device can be used at any level of the health care system

Phone Pulse Oximeter (O_2 Saturation)

Medications: Carboprost, TXA

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Abdominal Compression Belt and Butterfly Device

In-pressure suction device

Variety of low cost intrauterine tamponade devices

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- Drones and solar power (blood banks) may bring blood transfusion capacity closer to where women bleed

A wide-angle photograph of the Taj Mahal in Agra, India, taken from a low angle. The central white marble dome is the focal point, flanked by four minarets. The building is surrounded by a large reflecting pool and manicured gardens. Several people are walking along the paths in the foreground. The sky is clear and blue.

THANK YOU

Phone Pulse Oximeter



Pulse Oximeter noninvasive, measures oxygen saturation by shining infrared light through the finger (measures redness of blood), low oxygen saturation in hypovolemic shock

The Phone Oximeter is a smartphone application which receives data in real time from a connected pulse oximeter

- Minimal Training, <\$50.00/unit
- Developed at University of British Columbia, part of Global PRE-EMPT Peter von Dadleszen & Laura Magee

HYSTERECTOMY FOR PLACENTA ACRETA WITHOUT REMOVING THE PLACENTA

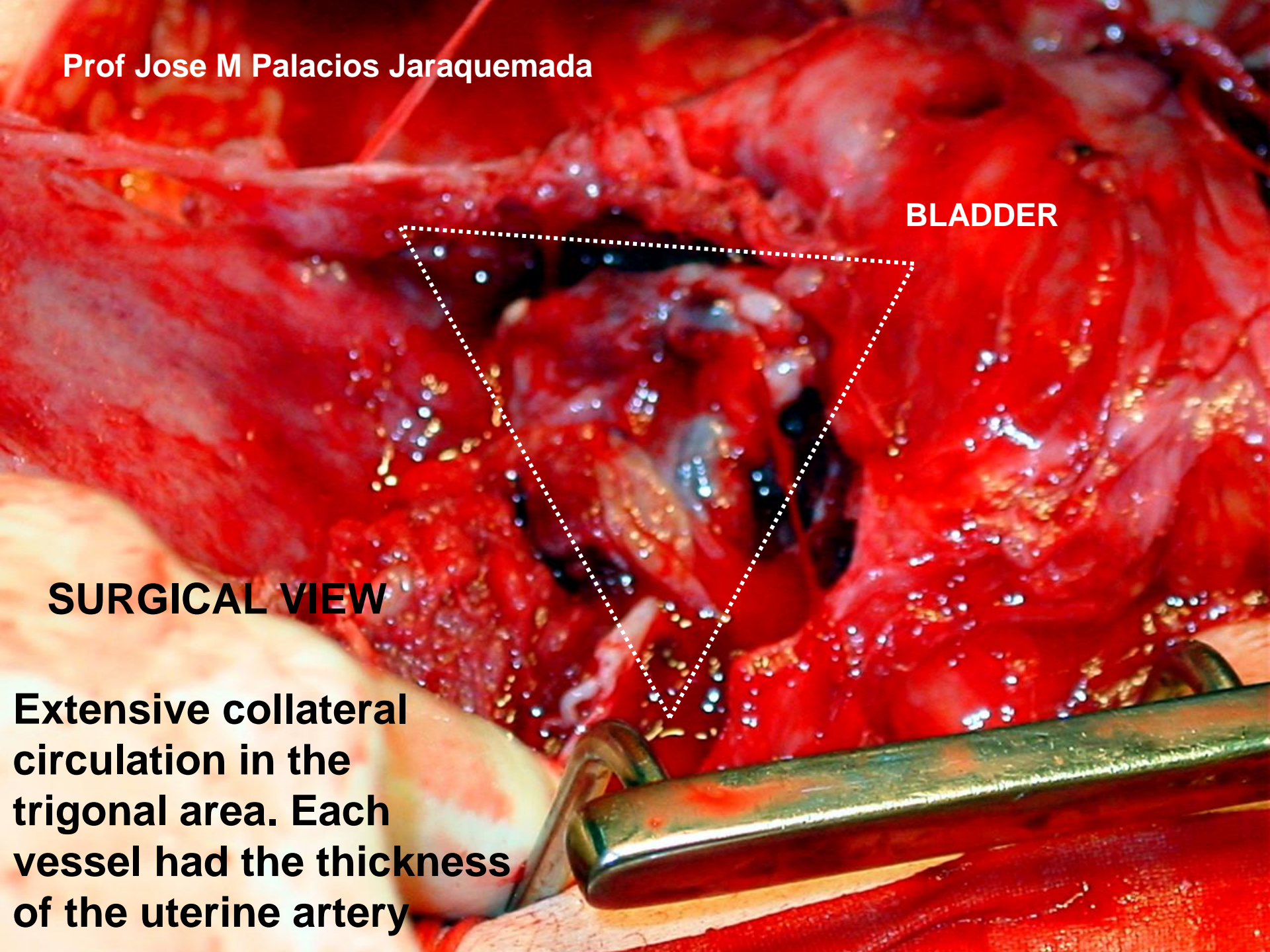


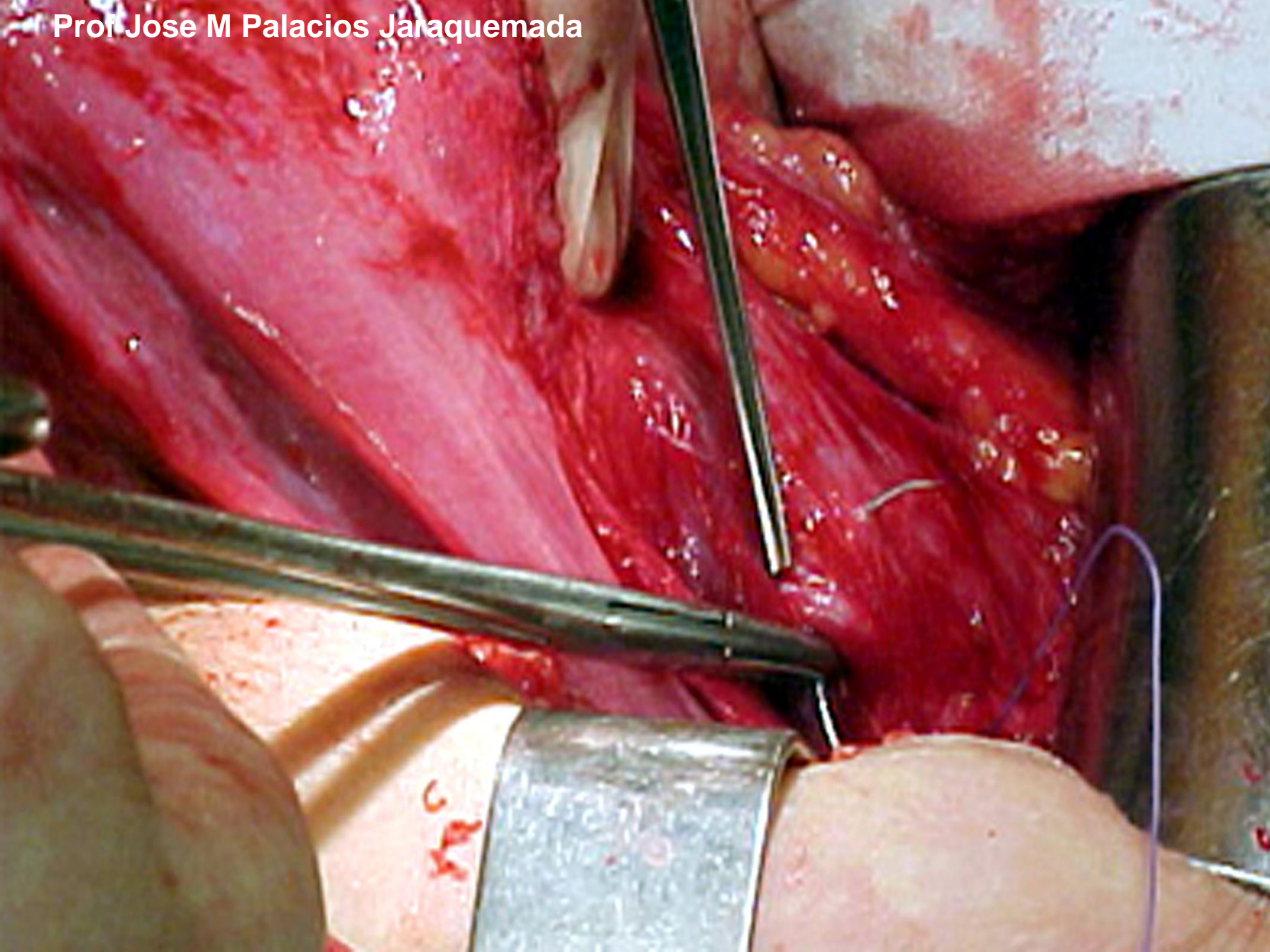
Prof Jose M Palacios Jaraquemada

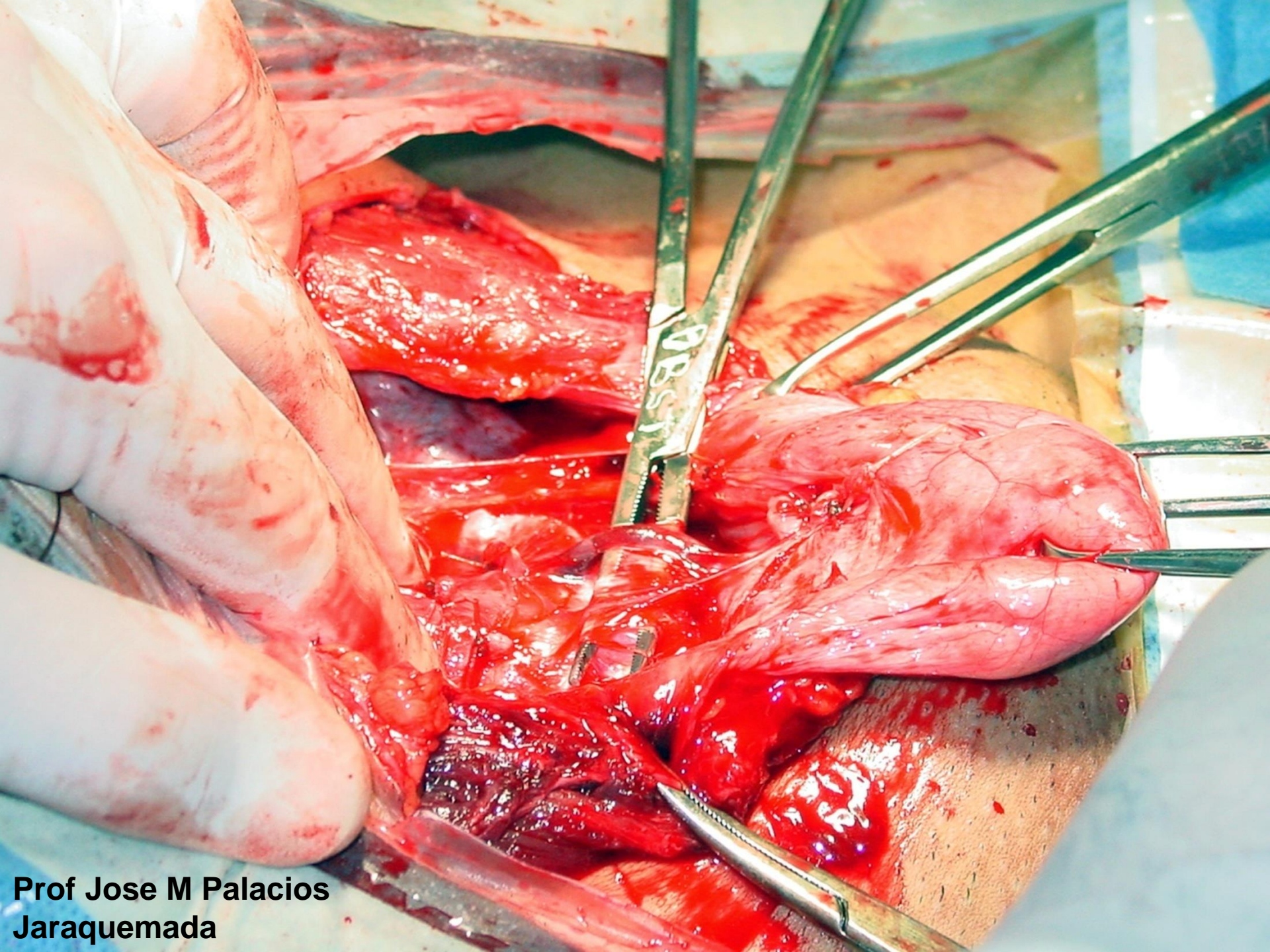
BLADDER

SURGICAL VIEW

Extensive collateral circulation in the trigonal area. Each vessel had the thickness of the uterine artery







**Prof Jose M Palacios
Jaraquemada**

**MASSIVE
TRIGONAL
INVASION**



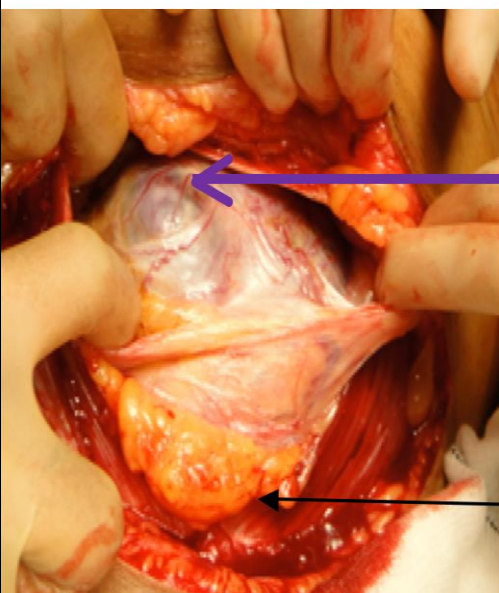
Prof Jose M Palacios Jaraquemada

**EXTENSIVE BLADDER OR PARAMETRIAL INVASION
CONSIDER CONSERVATIVE TREATMENT**

AXIAL SLICE T2

Prof Jose

Figure 2(a). Placing the myometrial incision above the upper border of the placenta



Upper border of the placenta (bulging through the serosa)

Lower 'uterine segment' with placenta invading the urinary bladder

NB. Omentum is attached to the site of uterine perforation through the previous C. Section Scar, earlier in this pregnancy

Figure 2(b). Site of uterine incision above the upper border of the placenta



Placenta Praevia (with percreta)

Triple P Procedure

Pre-op placental

Localisation & incision
above placenta & deliv of
baby

Pelvic devascularisation
Placental non separation
& excision

Edwin Chandraharan
Director – Women's
Health Services
St George's Hospital



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SURGERY AND TECHNOLOGY

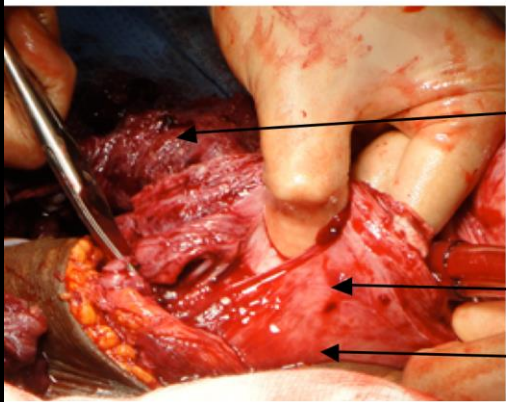
The Triple-P procedure as a conservative surgical alternative to peripartum hysterectomy for placenta percreta

Edwin Chandraharan ^{a,*}, Sridevi Rao ^a, Anna-Maria Belli ^b, Sabaratnam Arulkumaran ^a

^a Department of Obstetrics and Gynaecology, St George's Healthcare NHS Trust, London, UK

^b Department of Interventional Radiology, St George's Healthcare NHS Trust, London, UK

Figure 3 (a) Myometrial Excision (placenta still attached to the myometrial wall)

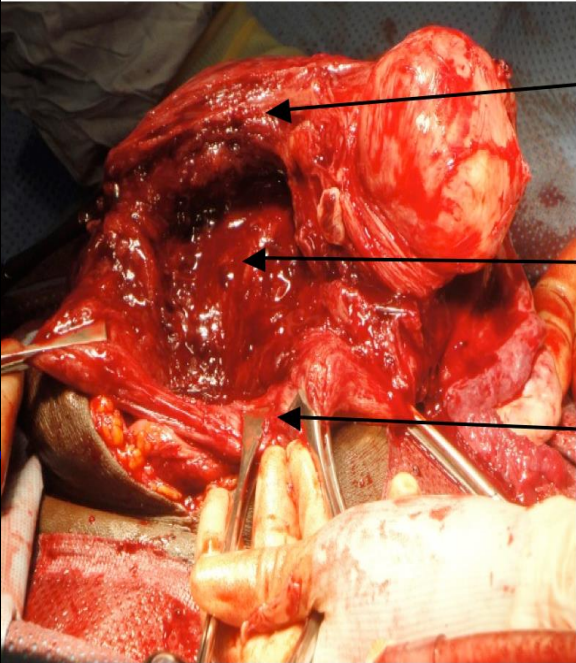


Placenta is still attached to the myometrium

Excision of the myometrium with morbidly adherent placenta after delivery of the fetus. (2 cm of myometrium above the bladder reflection is preserved to enable closure)

Figure 3 C. Uterus after myometrial excision

Post Delivery
Reduction of blood flow with inflation of balloon
Excision of placenta with myometrium
Compression sutures +
Use of perclot
Suturing of uterine wall
Embolisation if needed



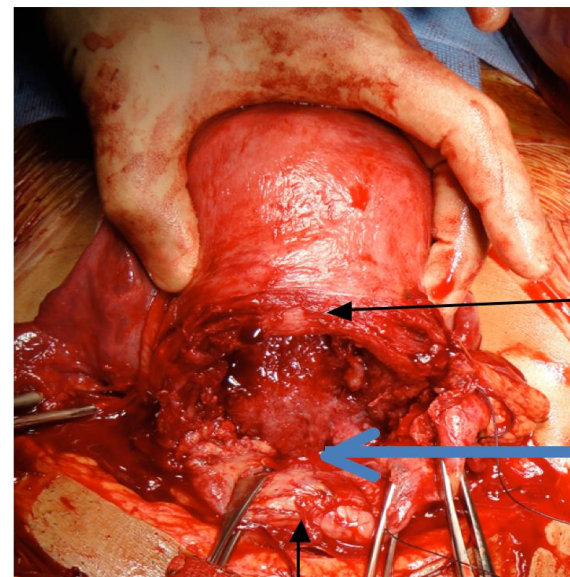
Superior lip of uterine incision (with a fibroid, in this case)

'Myometrial Defect' after myometrial excision

Inferior lip of myometrial incision

NB. It is important to ensure that approximately 2 cm of myometrial tissue is present to ensure optimum closure and haemostatic clamps are applied to the myometrial edges rapidly to avoid excessive blood loss

Figure 4 Eversion of the lower uterine edge to apply compression sutures to line of placental invasion into the bladder

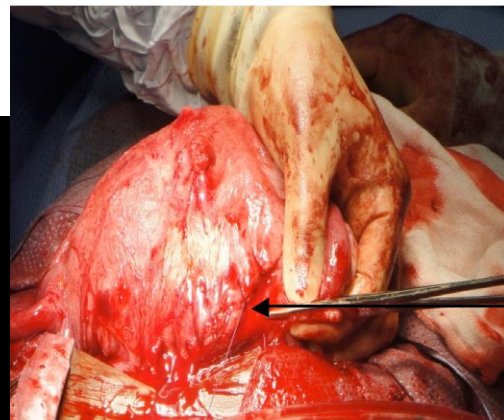


Superior lip of the uterine incision after myometrial excision

Line of trophoblastic invasion into the posterior wall of urinary bladder: area to apply haemostatic sutures, after separation of the placenta

Inferior lip of uterine incision is everted to expose the line of invasion of placenta into the bladder base

Figure 5. Uterus after 'Triple X 'Procedure



'Myometrial defect' after closure