38° CONGRESO ARGENTINO de PEDIATRÍA

La Niñez de Hoy

DESAFÍO, OPORTUNIDAD Y ESPERANZA

Shock Hemorrágico
Protocolos de transfusión

Tomas Iolster

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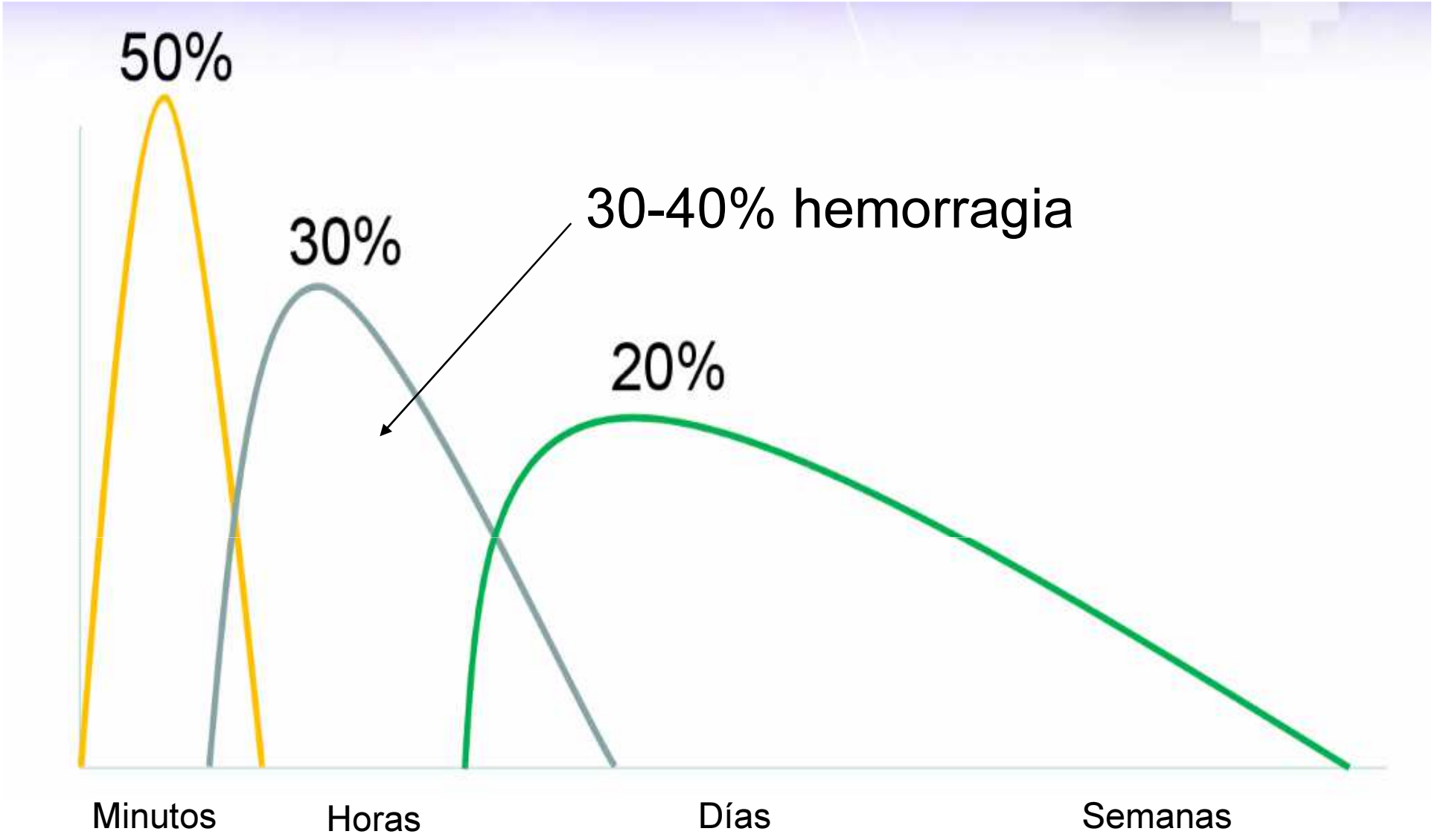
HOSPITAL UNIVERSITARIO AUSTRAL


Pediatría
Trauma
Periquirúrgico
Digestivo
Paciente oncológico



Mortalidad trimodal en trauma

Transfusión masiva

½ volemia respuesta 3 hs

100% volemia en 24 hs

Hemorragia > 10% volemia min.

10 u GR en 24 hs

Transfusión masiva

Sospecha → **Resucitación con control de daño**

- Amputación
- Evisceración
- Heridas penetrantes
- Lesiones de grandes vasos

- Exceso de base > -6
- Presión de pulso disminuida
- Hipotensión + Fast+
- Alteración de coagulación RIN > 1.5
- Hipotermia

Seguimiento

- Saturación venosa cental
- Índice de shock
- Ácido láctico

Resucitación con control de daño

Proactivo en lugar de reactivo

1. Control agresivo de la hemorragia
2. Reemplazar volumen manteniendo agresivamente la coagulación
3. Evitar la hipotermia
4. Hipotensión permisiva?

Requiere….

Diagnóstico temprano de pacientes de riesgo
Minimizar utilización de cristaloides
Adecuado manejo de hemoderivados

Detener la hemorragia

STOP THE BLEED

No matter how rapid the arrival of professional emergency responders, bystanders will always be first on the scene. A person who is bleeding can die from blood loss within five minutes, therefore it is important to quickly stop the blood loss.

"Stop the Bleed" is a nationwide campaign to empower individuals to act quickly and save lives.

*Remember to be aware of your surroundings and move yourself and the injured person to safety, if necessary.

Call 911.

Bystanders can take simple steps to keep the injured alive until appropriate medical care is available. Here are three actions that you can take to help save a life:

COMPRESS

Expose to find where the bleeding is coming from and apply **firm, steady, pressure** to the bleeding site with bandages or clothing

* = Wound

TOURNIQUET

If the bleeding doesn't stop, **Place** a tourniquet 2-3 inches closer to the torso from the bleeding. (The tourniquet may be applied & secured over clothing).

Pull the strap through the buckle, **Twist** the rod tightly, **Clip** and secure the rod with the clasp or the Velcro strap.

+ One type of tourniquet is depicted.

COMPRESS AGAIN

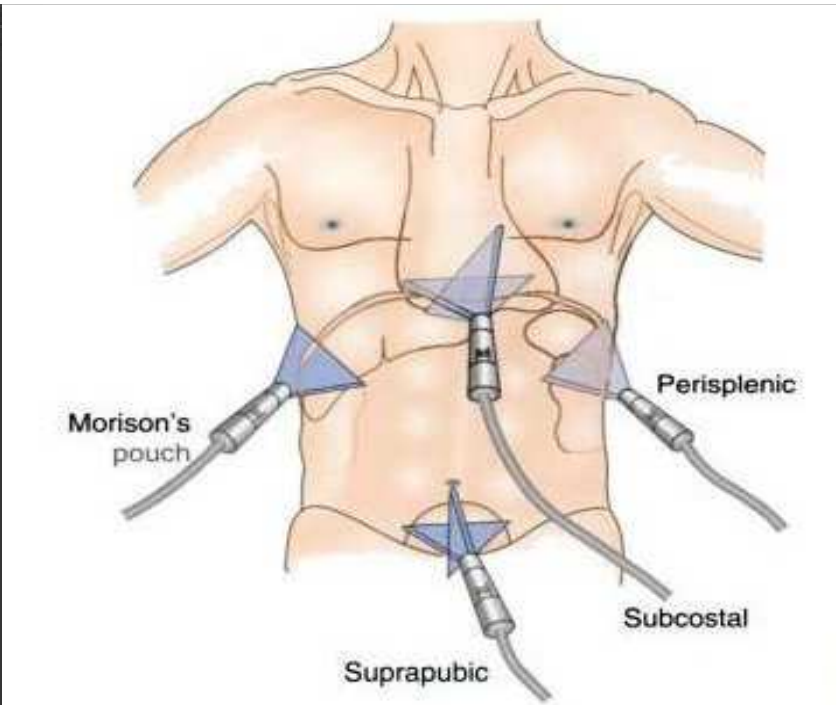
If the bleeding still doesn't stop, **Place** a second tourniquet closer to the torso from first tourniquet.

Pull the strap through the buckle, **Twist** the rod tightly, **Clip** and secure the rod with the clasp or the Velcro strap

+ One type of tourniquet is depicted.

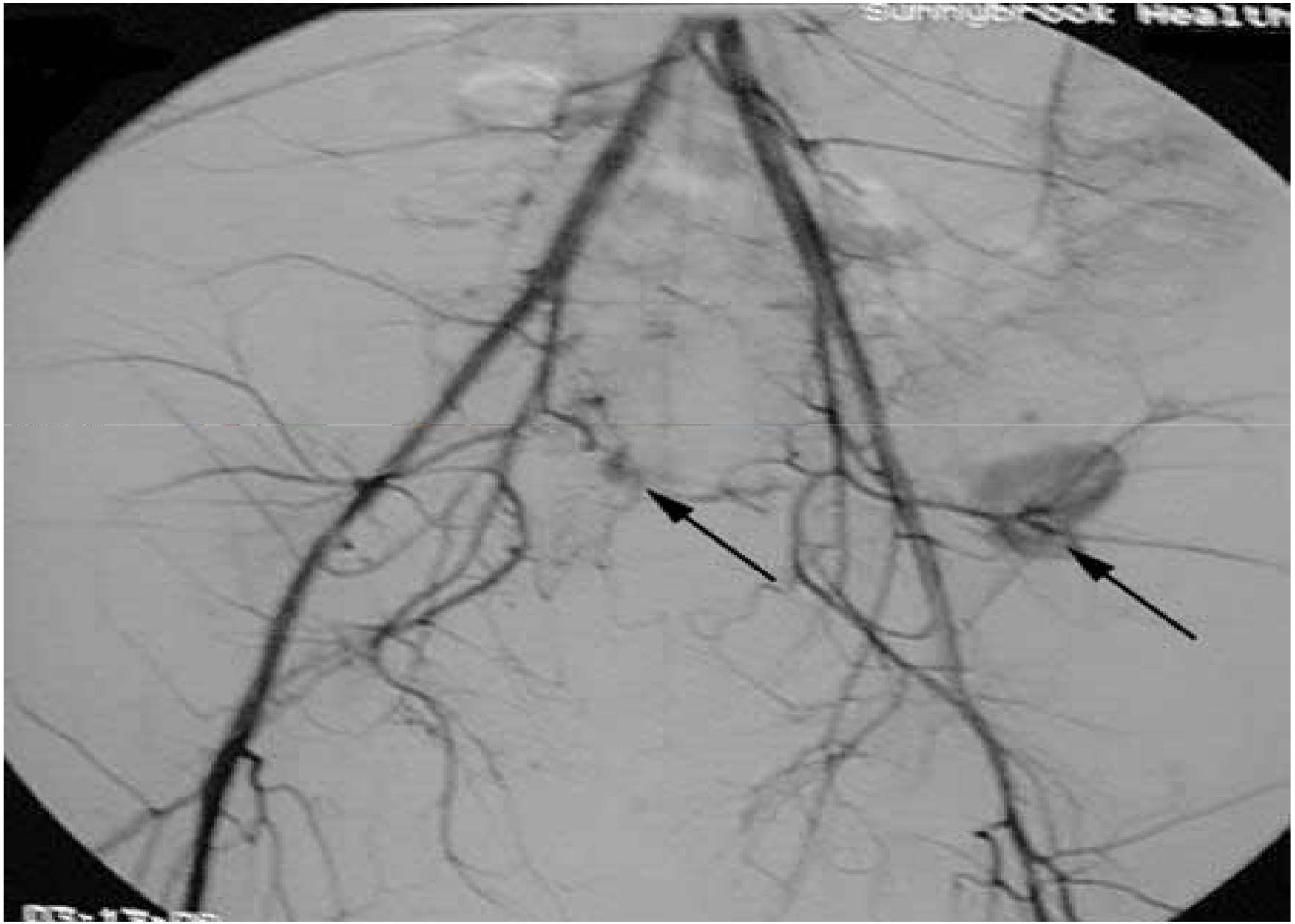
* = Wound

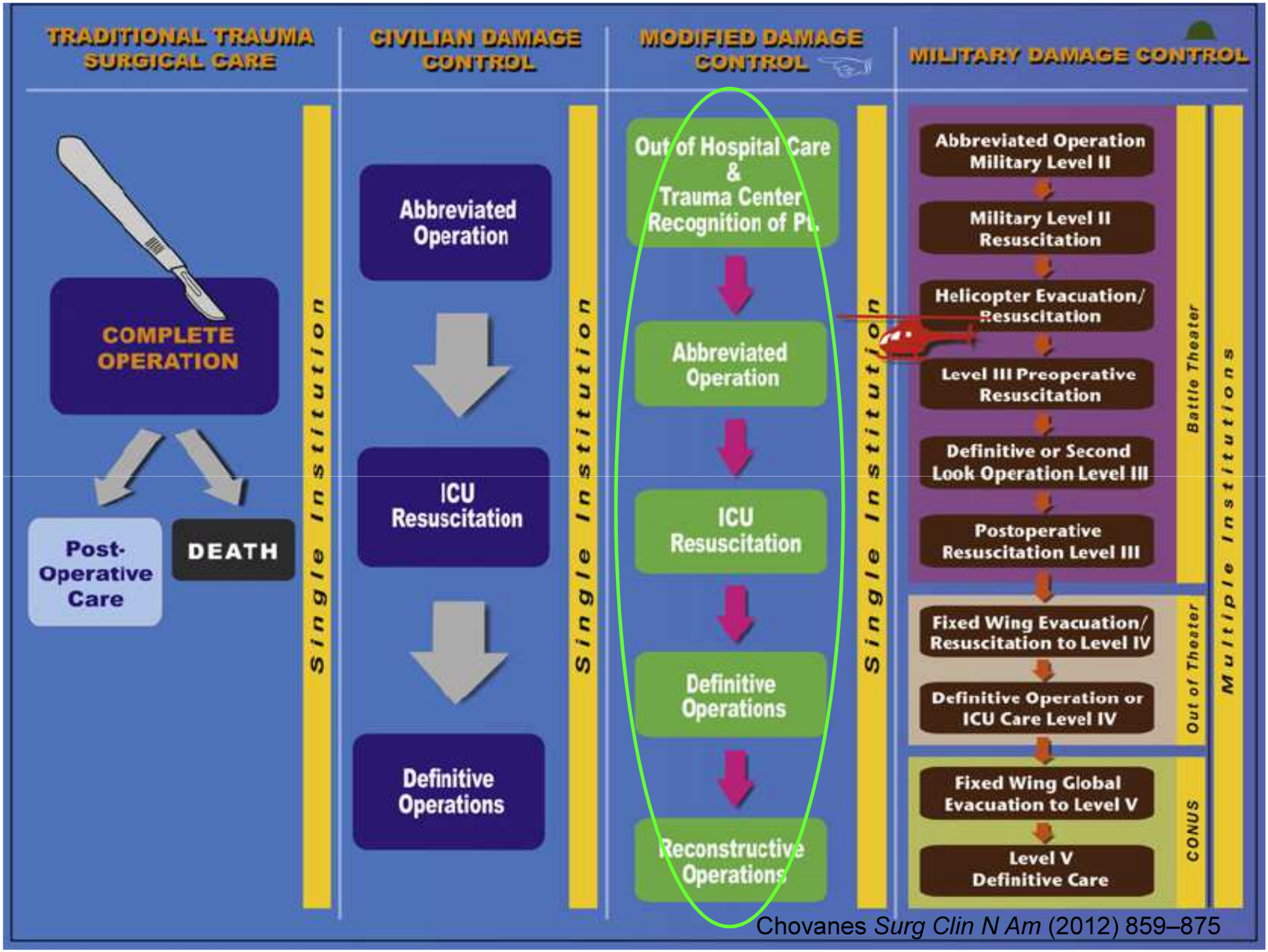

Abdomen
Name:
TB:CINE


Morison's
pouch
Perisplenic
Subcostal
Suprapubic

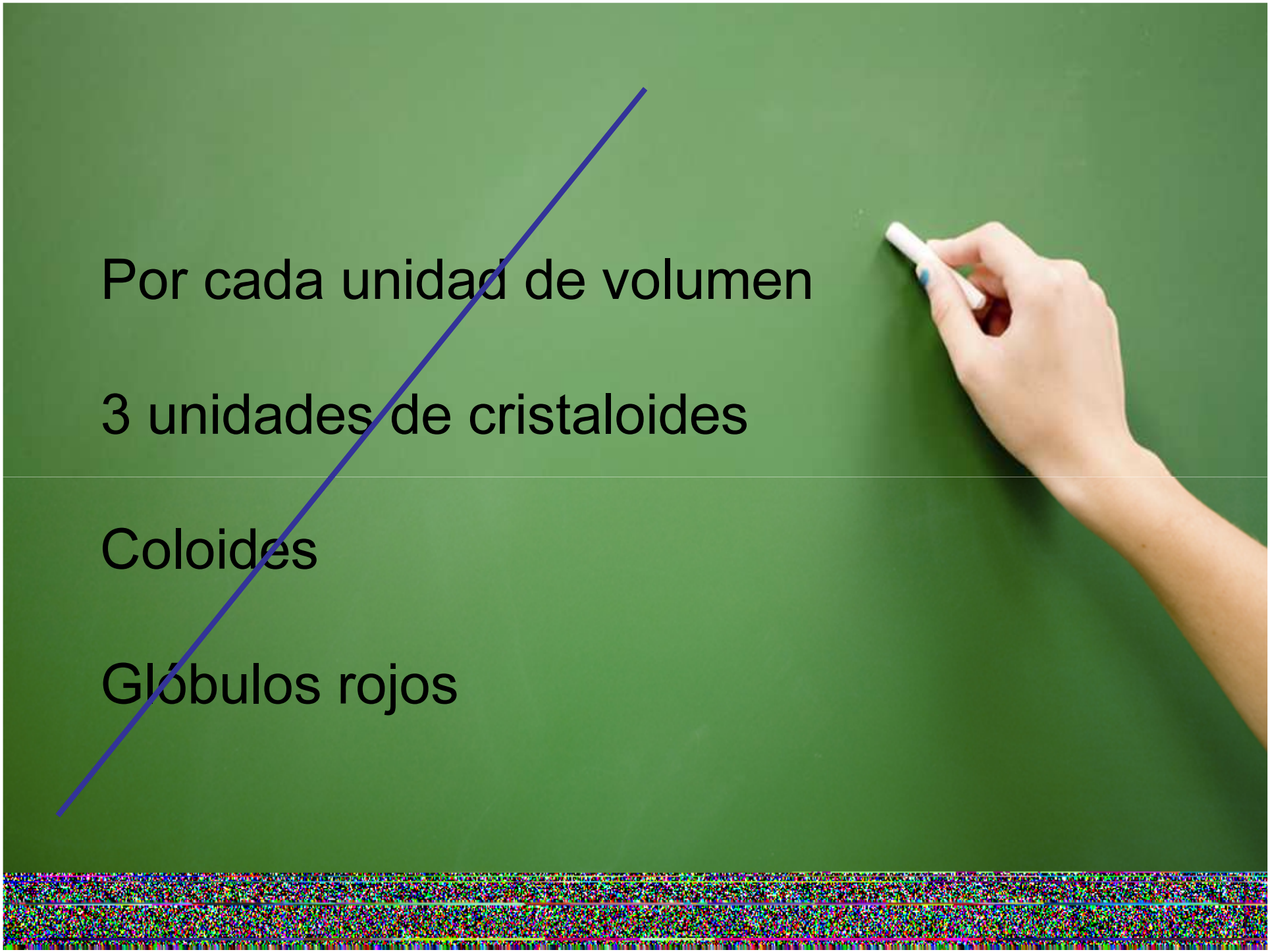

C
L
B
C

Detener la hemorragia





Chovanes *Surg Clin N Am* (2012) 859–875

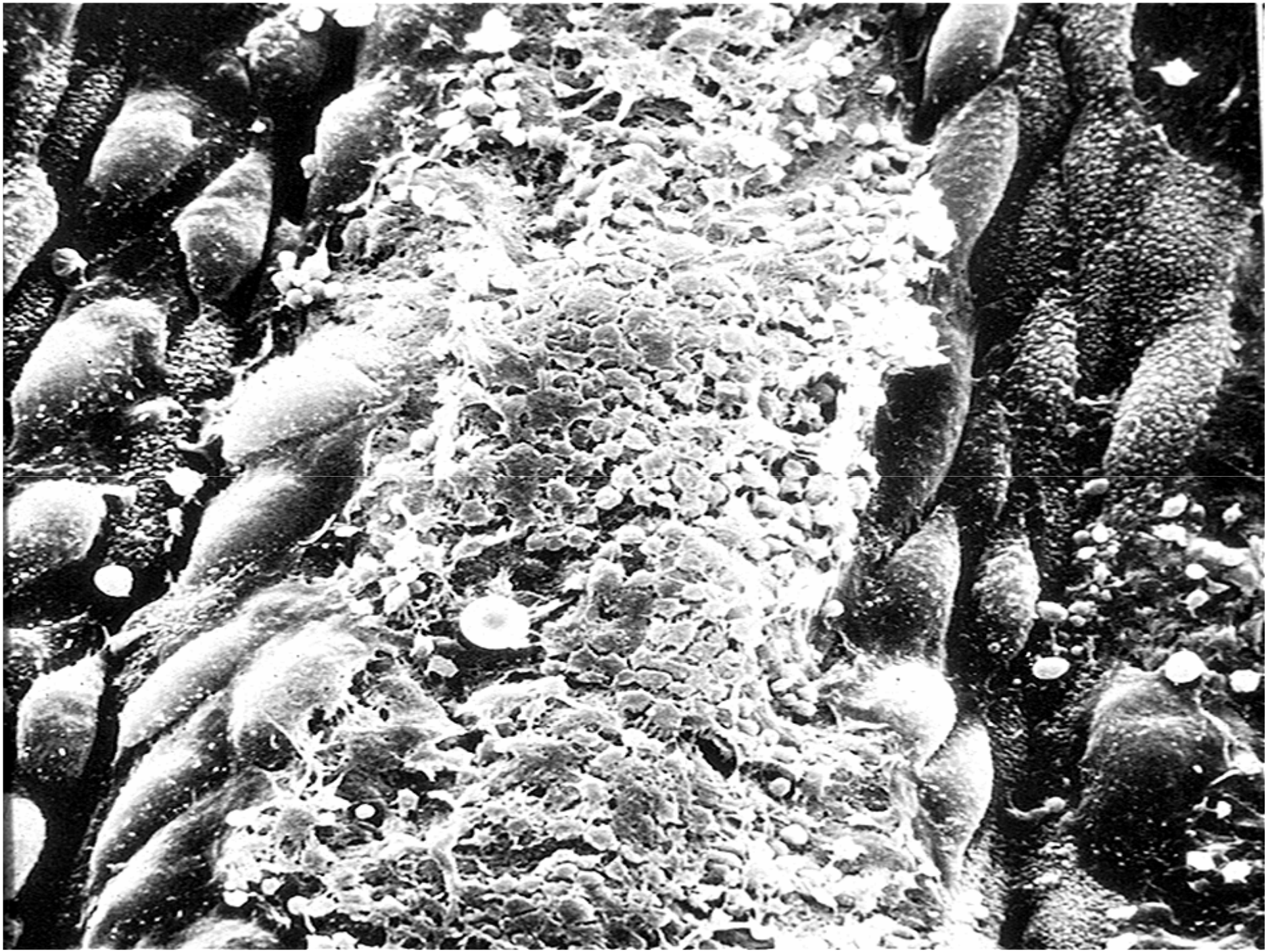

Por cada unidad de volumen
3 unidades de cristaloides
Coloides
Glóbulos rojos

Dilución

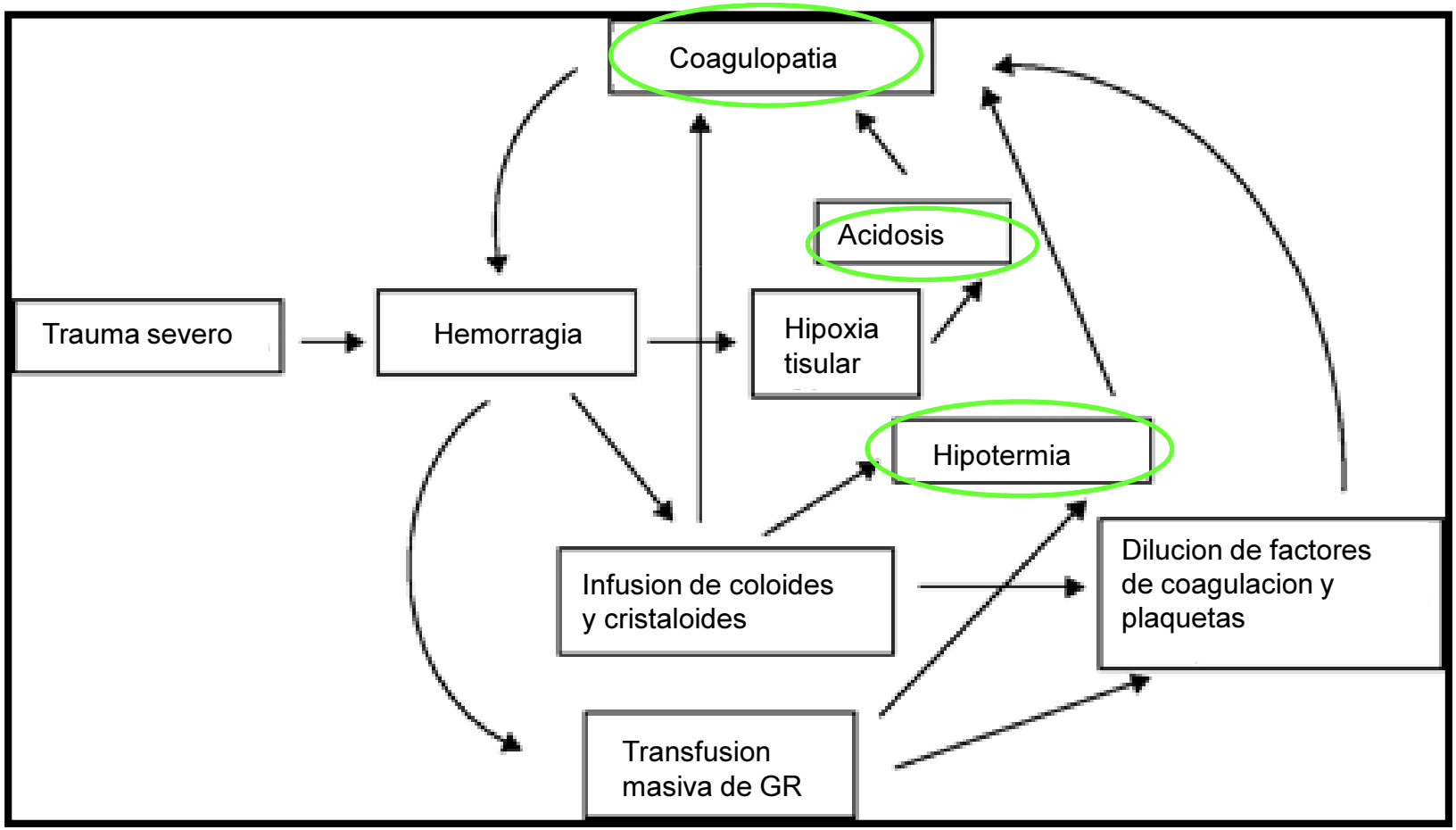
Glóbulos rojos

Factores de coagulación

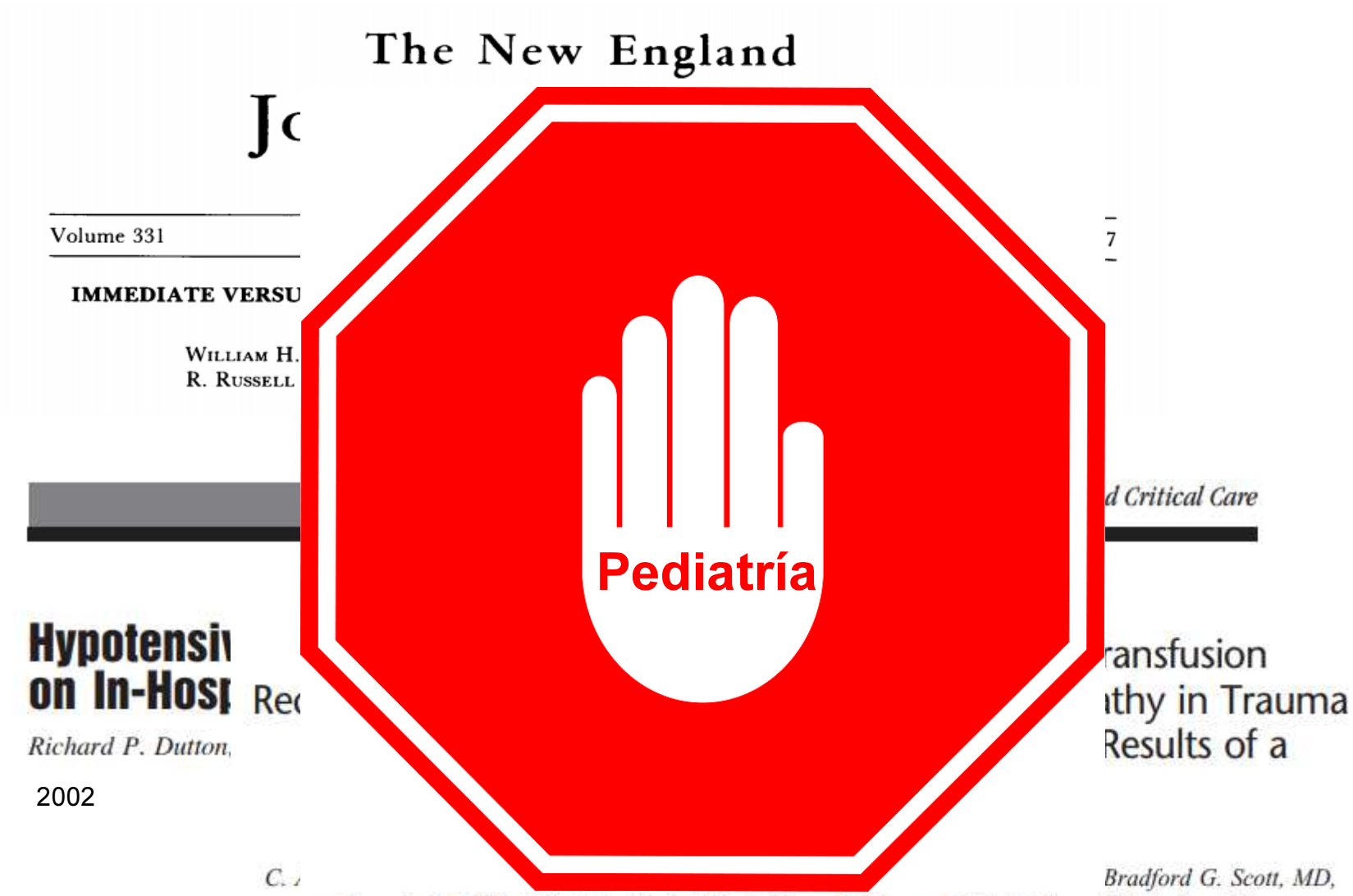
Plaquetas



Mecanismos de daño



Resucitación hipotensiva vs normotensiva

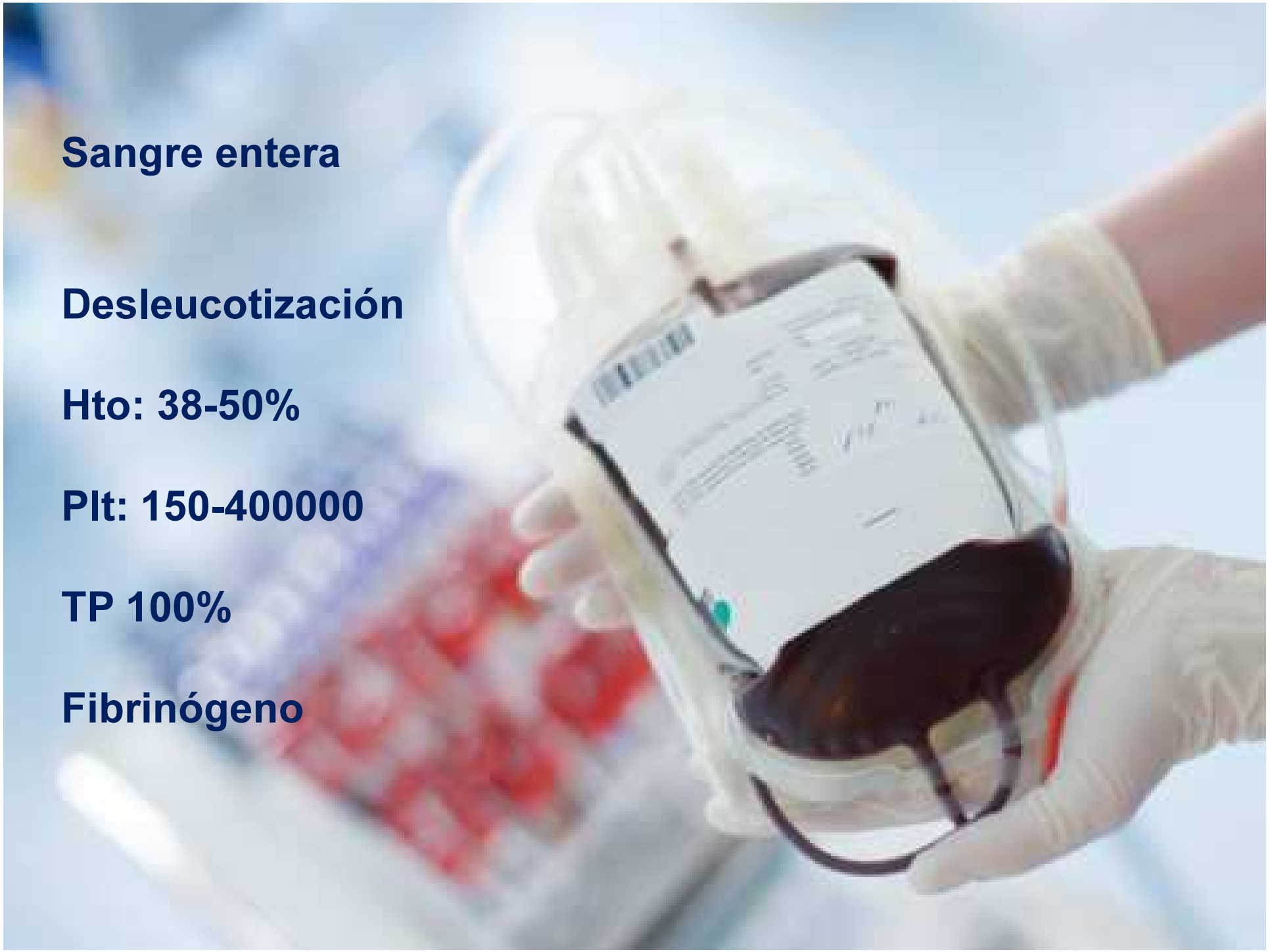


SHOCK, Vol. 41, No. Supplement 1, pp. 62–69, 2014

WHOLE BLOOD: THE FUTURE OF TRAUMATIC HEMORRHAGIC SHOCK RESUSCITATION

Alan D. Murdock,[*†] Olle Berséus,[‡] Tor Hervig,[§‖] Geir Strandenes,[§¶] and Turid Helen Lunde[§]

[*]Department of Surgery, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania; [†]Air Force Medical Operations Agency, Lackland AFB, Texas; [‡]Department of Transfusion Medicine, Orebro University Hospital, Orebro, Sweden; [§]Department of Immunology and Transfusion Medicine, Haukeland University Hospital; [‖]Institute of Clinical Science, University of Bergen; and [¶]Norwegian Navy Special Command Forces, Haakonsvern, Bergen, Norway


Sangre entera
Desleucotización
Hto: 38-50%
Plt: 150-400000
TP 100%
Fibrinógeno

INFINIA

LA EVOLUCIÓN DEL COMBUSTIBLE


N-SUPER


016
015
RED CELLS IN ADDITIVE SOLUTION
LEUCOCYTE DEPLETED
FOR NEONATAL USE
STORE AT 4 °C ± 2°C
PACK FIVE
50.0 ml
Rh D NEGATIVE
Expiry Date:
LOT
Pack Type
REF
DO NOT VENT
Additional Information
HbS Neg, CMV Neg.
NEG: HT,K,Jka,S,Cw

Hemoderivados

The Ratio of Blood Products Transfused Affects Mortality in Patients Receiving Massive Transfusions at a Combat Support Hospital

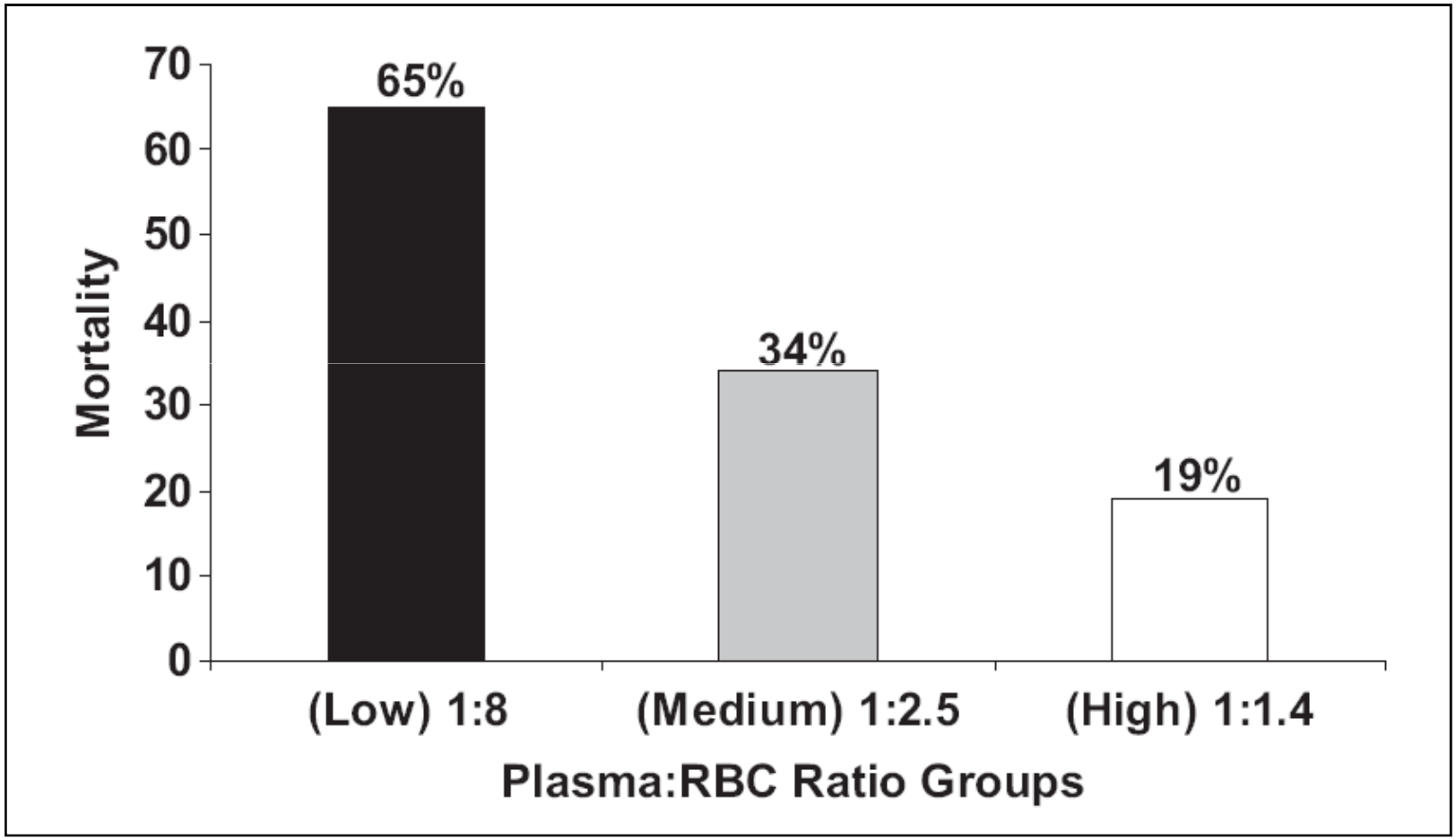
J Trauma. 2007;63:805–813.

Matthew A. Borgman, MD, Philip C. Spinella, MD, Jeremy G. Perkins, MD, Kurt W. Grathwohl, MD, Thomas Repine, MD, Alec C. Beekley, MD, James Sebesta, MD, Donald Jenkins, MD, Charles E. Wade, PhD, and John B. Holcomb, MD

- Estudio restrospectivo: 245 pacientes con trauma relacionado a combate que requirieron >10U GRS entre 2003 y 2005

- Compararon mortalidad en relación a la relación plasma/GR

Hemoderivados



Componentes

Original Investigation

Transfusion of Plasma, Platelets, and Red Blood Cells in a 1:1:1 vs a 1:1:2 Ratio and Mortality in Patients With Severe Trauma

The PROPPR Randomized Clinical Trial

JAMA, 2015

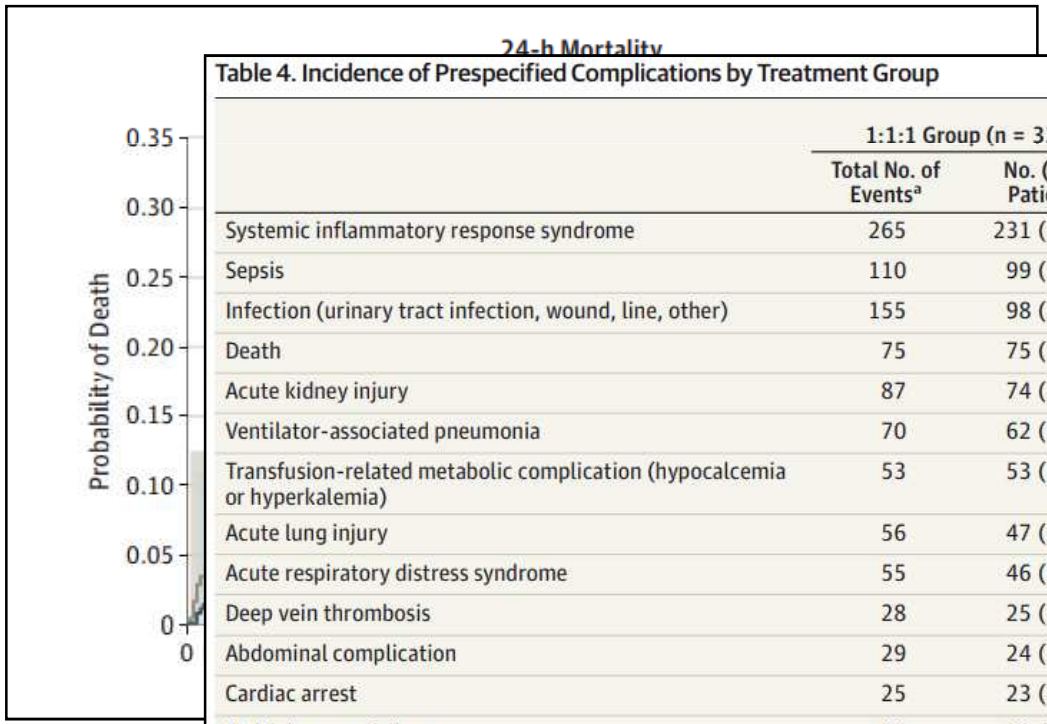


Table 4. Incidence of Prespecified Complications by Treatment Group

	1:1:1 Group (n = 338)		1:1:2 Group (n = 342)		Difference Between Groups in Percentage of Patients With Event, % (95% CI)[c]
	Total No. of Events[a]	No. (%) of Patients[b]	Total No. of Events[a]	No. (%) of Patients[b]	
Systemic inflammatory response syndrome	265	231 (68.3)	239	216 (63.2)	5.2 (−2.1 to 12.3)
Sepsis	110	99 (29.3)	102	91 (26.6)	2.7 (−4.2 to 9.5)
Infection (urinary tract infection, wound, line, other)	155	98 (29.0)	146	106 (31.0)	−2.0 (−8.9 to 5.0)
Death	75	75 (22.2)	89	89 (26.0)	−3.8 (−10.3 to 2.7)
Acute kidney injury	87	74 (21.9)	93	85 (24.9)	−3.0 (−9.4 to 3.5)
Ventilator-associated pneumonia	70	62 (18.3)	65	58 (17.0)	1.4 (−4.4 to 7.2)
Transfusion-related metabolic complication (hypocalcemia or hyperkalemia)	53	53 (15.7)	60	59 (17.3)	−1.6 (−7.2 to 4.1)
Acute lung injury	56	47 (13.9)	66	57 (16.7)	−2.8 (−8.3 to 2.7)
Acute respiratory distress syndrome	55	46 (13.6)	57	48 (14.0)	−0.4 (−5.7 to 4.9)
Deep vein thrombosis	28	25 (7.4)	24	24 (7.0)	0.4 (−3.6 to 4.4)
Abdominal complication	29	24 (7.1)	23	22 (6.4)	0.7 (−3.3 to 4.6)
Cardiac arrest	25	23 (6.8)	30	27 (7.9)	−1.1 (−5.2 to 3.0)
Multiple organ failure	24	20 (5.9)	18	15 (4.4)	1.5 (−1.9 to 5.1)
Symptomatic pulmonary embolism	14	14 (4.1)	13	13 (3.8)	0.3 (−2.8 to 3.5)

Sin embargo… los casos de trauma requiriendo resucitación con control de daño / transfusión masiva son:

-Raros en la práctica pediátrica

-Entornos estresantes y alborotados

- Se recuerda utilizar GR, pero no otros productos de la sangre

Protocolos de transfusión masiva

Solución? Protcolos pre-existentes para para la entrega tiempo-oportuna de una mezcla de productos apropiada desde el banco de sangre al área clínica

- Mejora la comunicación
- Asegura monitoreo de laboratorio adecuado
- Reduce tiempos de entrega
- Reduce burocracia

……*busca optimizar un proceso*

The Journal of TRAUMA® Injury, Infection, and Critical Care

Damage Control Hematology: The Impact of a Trauma Exsanguination Protocol on Survival and Blood Product Utilization 2008

Bryan A. Cotton, MD, Oliver L. Gunter, MD, James Isbell, MD, Brigham K. Au, BS, Amy M. Robertson, MD, John A. Morris, Jr., MD, Paul St. Jacques, MD, and Pampee P. Young, MD, PhD

10 U GR, 4 U PFC, 2 U Pl

Table 2 Univariate Analyses of Primary ar
Secondary Outcome Measures

Variable	Pre-TEP (n = 117)	TEP (n = 94)
30-d mortality (%)	65.8	51.1
24-h blood product use (units)	39 ± 28	31.8 ± 19
24-h RBC use (units)	19.8 ± 12.8	18.8 ± 11
24-h FFP use (units)	12.4 ± 12.5	9.9 ± 7
24-h PLT use (units)	6.8 ± 7.2	3.1 ± 3.
Intraoperative RBC use (units)	11.1 ± 8.5	16 ± 1
Intraoperative FFP use (units)	4.3 ± 4	8.2 ± 6.
Intraoperative PLT use (units)	1.1 ± 2.6	2.2 ± 2.
Intraoperative crystalloid (L)	6.7 ± 4.2	4.9 ± 3.
Unexpected survivors (%)	5.1	22.3
Unexpected deaths (%)	22.2	8.5

* Statistically significant at $p < 0.05$.

TEP, trauma exsanguination protocol; RBC, red bl
fresh frozen plasma; PLT, platelets.

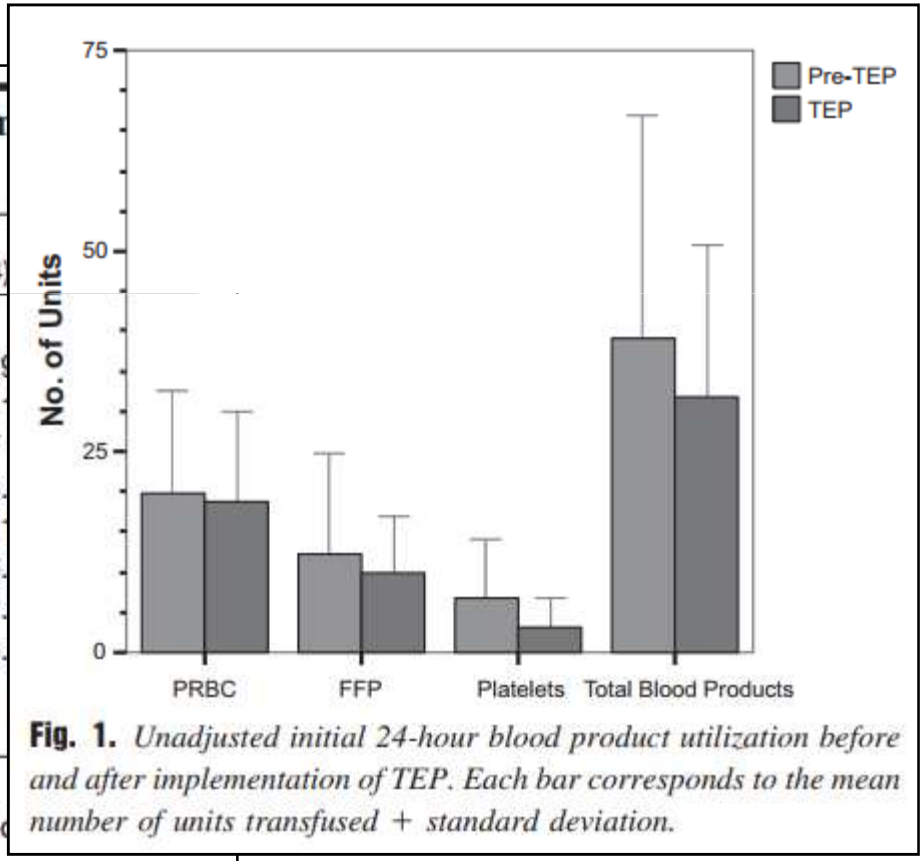


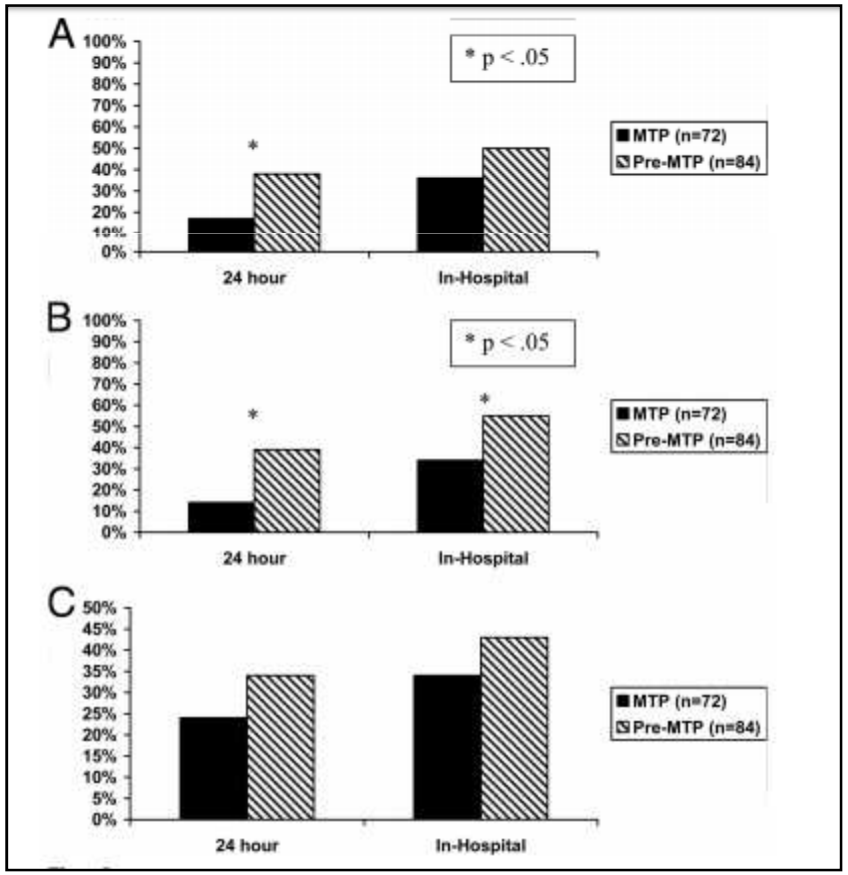
Fig. 1. *Unadjusted initial 24-hour blood product utilization before and after implementation of TEP. Each bar corresponds to the mean number of units transfused + standard deviation.*

The Journal of TRAUMA® Injury, Infection, and Critical Care

Improvements in Early Mortality and Coagulopathy are Sustained Better in Patients With Blunt Trauma After Institution of a Massive Transfusion Protocol in a Civilian Level I Trauma Center

Christopher J. Dente, MD, FACS, Beth H. Shaz, MD, Jeffery M. Nicholas, MD, FACS, Robert S. Harris, MD, Amy D. Wyrzykowski, MD, Snehal Patel, BBA, MS, Amit Shah, BS, Gary A. Vercruysse, MD, David V. Feliciano, MD, FACS, Grace S. Rozycki, MD, FACS, Jeffrey P. Salomone, MD, FACS, and Walter L. Ingram, MD, FACS

116 pacientes comparados contra 84 pre-protocolo



Mortalidad global

Mortalidad trauma contuso

Mortalidad trauma penetrante

Implementation of a management protocol for massive bleeding reduces mortality in non-trauma patients: Results from a single centre audit

N. Martínez-Calle[a], F. Hidalgo[b], A. Alfonso[a], M. Muñoz[c], M. Hernández[a], R. Lecumberri[a], J.A. Páramo[a,*]

Med Intensiva. 2016;40(9):550–559

ELSEVIER

medicina *intensiva*

www.elsevier.es/medintensiva

Table 1 Subgroup characteristics. Demographics, clinical information, transfusion requirements and procoagulant agents use.

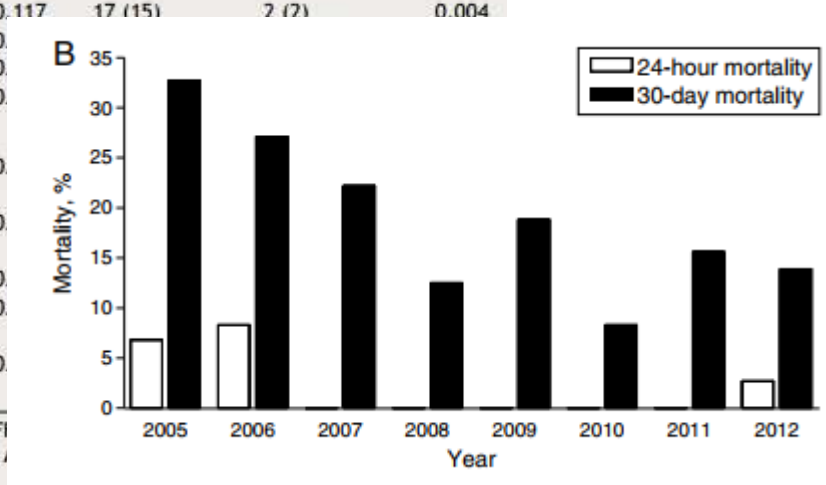
Median age, years						
Male, n (%)						
Patient type						
Oncologic surger						
Cardiovascular s						
Other surgeries,						
Non-surgical ble						
Events per year (n						
Manual activation						
Transfusion requir						
RBC units, medi						
FFP units, medi						
PLT units, medi						
Procoagulant drug						
rFVII, *n* (%)	15 (15)	19 (9)	0.117	17 (15)	2 (2)	0.004
Fibrinogen concentrate, *n* (%)	34 (35)	77 (37)	0.			
PCC, *n* (%)	0 (0)	5 (2)	0.			
Antifibrinolytics, *n* (%)	7 (7)	25 (12)	0.			
Baseline haematologic parameters						
Hemoglobin [g/dL], median (IQR)	10.2 (8.7–12.6)	10.3 (8.5–12.0)	0.			
PLT count [$109\,L^{-1}$], median (IQR)	174 (111–250)	173 (104–249)	0.			
PT activity [%], median (IQR)	83 (54–96)	79 (54–97)	0.			
APTT time ratio, median (IQR)	1.0 (0.8–1.4)	1.1 (0.9–1.4)	0.			
Fibrinogen (mg/dL)	286 (163–408)	324 (206–429)	0.			

MTP: massive bleeding protocol; IQR: interquartile range; RBC: red-blood cells; FI
binant factor VII; PCC: prothrombin complex concentrate; PT: prothrombin time;
* *p*, Group 1 vs. Group 2.
** *p*, Group 1 vs. Group 2A vs. Group 2B.

Table 2 MTP effect on transfusion requirements and mortality.

	Before MTP	After MTP		*p*
	Group 1 2005–2006 *N* = 96	Group 2A 2007–2009 *N* = 116	Group 2B 2010–2012 *N* = 92	
Hours to first FFP unit, median (IQR)	3.6 (1.2–6.7)	2.4 (1.2–4.8)	2.2 (0.8–5.2)	**0.001**
Transfusion ratios				
FFP:RBC, median (IQR)	0.44 (0.30–0.67)	0.57 (0.33–0.77)	0.55 (0.33–0.79)	**0.053**
PLT:RBC, median (IQR)	0.10 (0.0–0.15)	0.11 (0.0–0.18)	0.1 (0.0–0.17)	0.429
Mortality				
24-h, *n* (%)	7 (7.3)	0 (0)	1 (1.1)	**0.002**
30-day, *n* (%)	29 (30.2)	21 (18.1)	12 (13.0)	**0.010**

MTP: massive transfusion protocol; IQR: interquartile range; RBC: red-blood cells; FFP: fresh frozen plasma; PLT: platelets.



Improvement of Treatment Outcomes after Implementation of a Massive Transfusion Protocol: A Level I Trauma Center Experience

ANDREW NUNN, M.D.,* PETER FISCHER, M.D.,* RONALD SING, D.O.,* MEGAN TEMPLIN, M.S.,† MICHAEL AVERY, B.S.,† A. BRITTON CHRISTMAS, M.D.†

*From the *Division of Trauma and Surgical Critical Care, Department of Surgery, Carolinas HealthCare System, Charlotte, North Carolina; and †Dickson Advanced Analytics, Carolinas Medical Center, Charlotte, North Carolina*

The American Surgeon, 2017

Retrospectivo,

N: 239 pre protocolo vs 208 post protocolo

Estadia	25.6 d. post	vs 30.6 d. pre; P 0.038
VM	10.6 d. post	vs 13.9 d. pre: P 0.047
Mortalidad	40.1 % post	vs 47.2% pre: P 0.1732

2 Paediatric Massive Transfusion Protocol (PaedMTP) Flow Chart

Canterbury District Health Board

Clinical Team Leader Responsibilities

- Refer to CDHB Paed MTP Checklist
- **Initiate** and prepare QMR022A/B forms
- Send forms via runner
- **Activate** MTP
- Decision made to cease MTP: Call Blood Bank Ext 80310

Blood Bank Responsibilities

- Ensure X-match sample is processed ASAP after O neg release
- Call NZBS TMS after issuing MTP Box Four
- Thaw next box in advance and await request
- Ensure supply of platelets. If no neonatal platelets for Alpha, contact TMS
- BRAVO Box 3: label platelets 'Give 150ml only'
- Provide the freshest red cells possible (less than 14 days)

Contacts

- Blood Bank - Ext 80310
- Coagulation Lab - Ext 80374
- Transfusion Medicine Specialist details available from Blood Bank Ext 80310

Calcium

- If only Calcium Chloride (CaCl) is available give a third of the calcium gluconate (CaGluc) dose
- DO NOT give calcium in same the IV line at the same time as blood components

Additional Treatment Thresholds

- Ongoing haemorrhage after Box 3 - if PR > 1.5 or APTT > 40 consider additional 20mL/kg FFP
- If fibrinogen < 1g/L consider additional 5mL/kg Cryoprecipitate
- If platelets < 75 x10^9/L consider additional 10mL/kg platelets
- If ionized Ca^{++} < 1mmol/L give 0.3mL/kg CaGlu
- See Royal Children's Hospital Hyperkalaemia Guideline

www.rch.org.au/clinicalguide/guideline_index/Hyperkalaemia/

Massiv

Ensure de

ALPHA

0-10 kg

1 adult RBC
O neg or type specific
Give 15mL/kg

WARMING STRA

Pae

REQUEST

MTP BOX ONE
1 adult RBC
1 adult FFP
1 Cryoprecipitate
1 CMV neg Platelet

Give 10mL/kg of each in the following order:
RBC, FFP
RBC, Cryo
0.45mL/kg CaGluc
RBC, FFP
RBC, Platelets
0.45mL/kg CaGluc

Beware of K+

and repeat

Tranexamic Aci

- Loading dose 15mg/kg (ma
- Consider mai infusion: 5mg/kg/hour

- Cryoprecipitate: 100mL

Ring Blood Bank to Activate Paediatric Massive Transfusion Protocol

REQUEST, DELIVER AND TRANSFUSE AS BELOW:

MTP BOX ONE
1 adult RBC
1 adult FFP
1 Cryoprecipitate
1 CMV neg Platelet

Give 10mL/kg of each in the following order:
RBC, FFP
RBC, Cryo
0.45mL/kg CaGluc
RBC, FFP
RBC, Platelets
0.45mL/kg CaGluc

MTP BOX ONE
1 adult RBC
1 adult FFP
0.3mL/kg CaGluc

MTP BOX TWO
1 adult RBC
1 adult FFP
1 Cryoprecipitate
0.3mL/kg CaGluc

MTP BOX THREE
1 adult RBC
1 adult FFP
150mL Platelets
0.3mL/kg CaGluc

MTP BOX ONE
2 adult RBC
2 adult FFP
0.3mL/kg CaGluc

MTP BOX TWO
2 adult RBC
1 adult FFP
2 Cryoprecipitate
0.3mL/kg CaGluc

MTP BOX THREE
2 adult RBC
2 adult FFP
1 adult Platelets
0.3mL/kg CaGluc

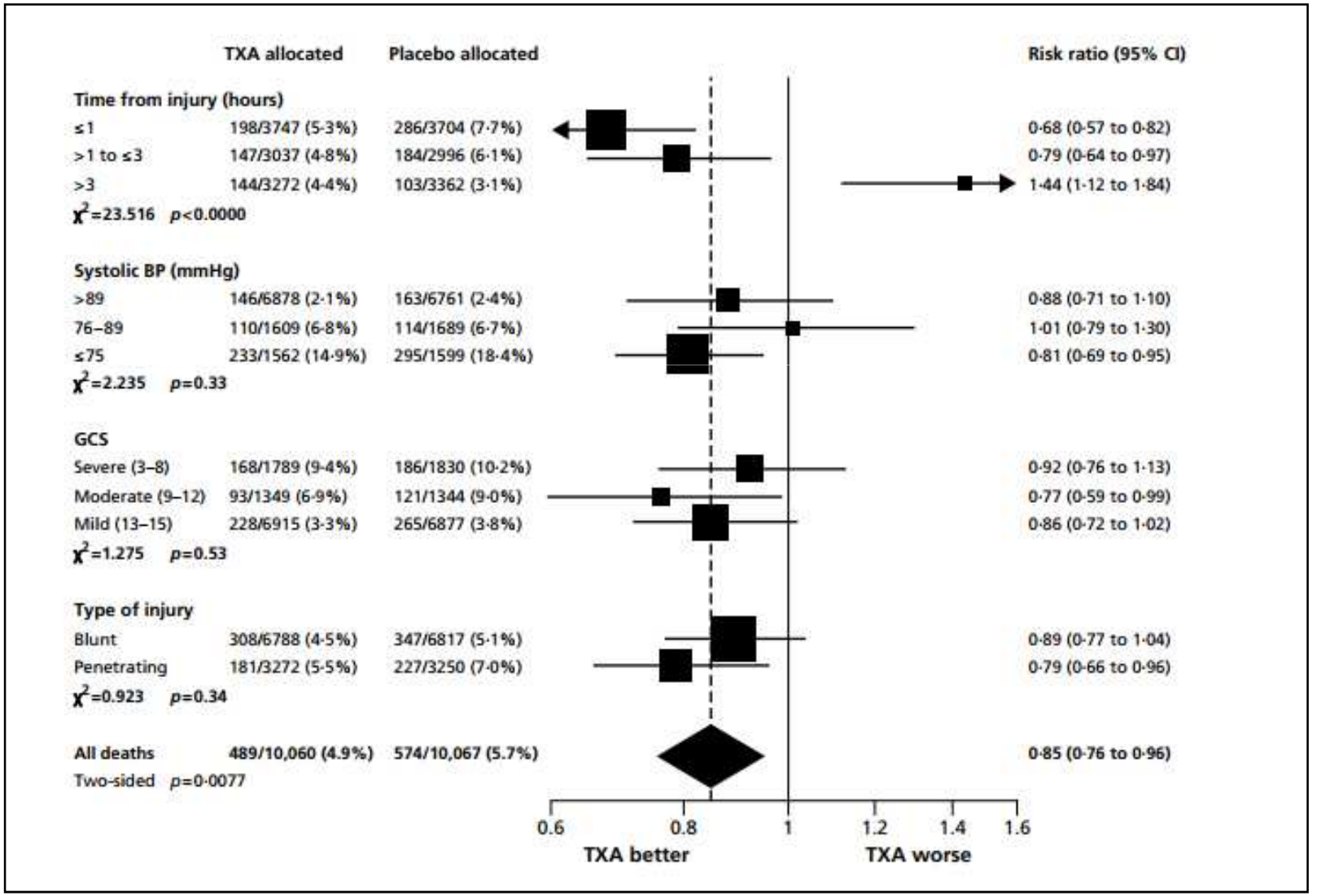
Check:
- Coags
- FBC
- ABGs
- K+ / Ca++

Tranexamic Acid

Check:
- Coags
- FBC
- ABGs
- K+ / Ca++

Acido tranexámico. CRASH 2

274 hospitales, 40 países, 20,211 pacientes adultos



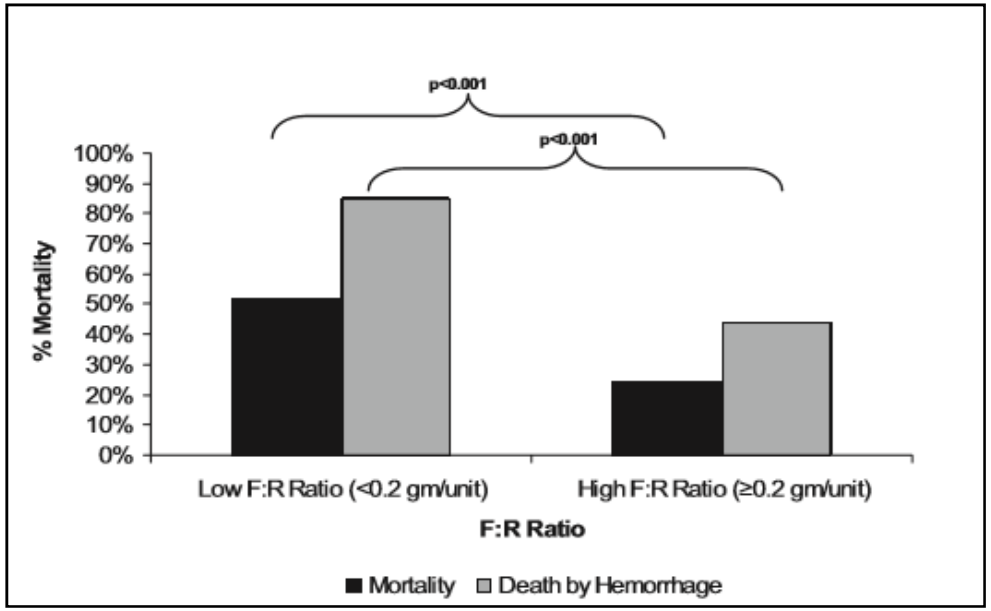
Lancet, 2010

Fibrinógeno

Fibrinolisis/consumo/dilución

<u>Solución:</u>
Reducir fibrinolisis (ácido tranexámico)
Dar fibrinógeno temprano, en dosis mayores

-



Stinger HK et al J Trauma. 2008

Mayor relación fibrinógeno:glóbulos rojos mejora la sobrevida en población militar

Factor VII recombinante

- Disminución del requerimiento de transfusiones
  No efectos sobre mortalidad

Boffard KD, et al. *J Trauma* 2005

- Efectivo en pacientes hipotérmicos. No en acidosis

Kheirabadi BS, et al. *J Trauma* 2007

- Reportes de eventos tromboembólicos

Dutton RP, et al. *JAMA* 2006

Identificación de pacientes apropiados?

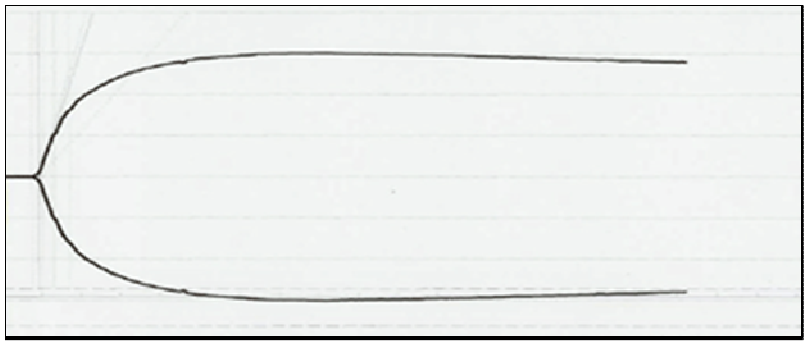
Una vez optimizado el tratamiento quirúrgico y hemoderivados

Tromboelastografía (TEG)

Información rápida para guiar el tratamiento

TEG

Evalúa las propiedades viscoelásticas de la sangre de una forma dinámica y global



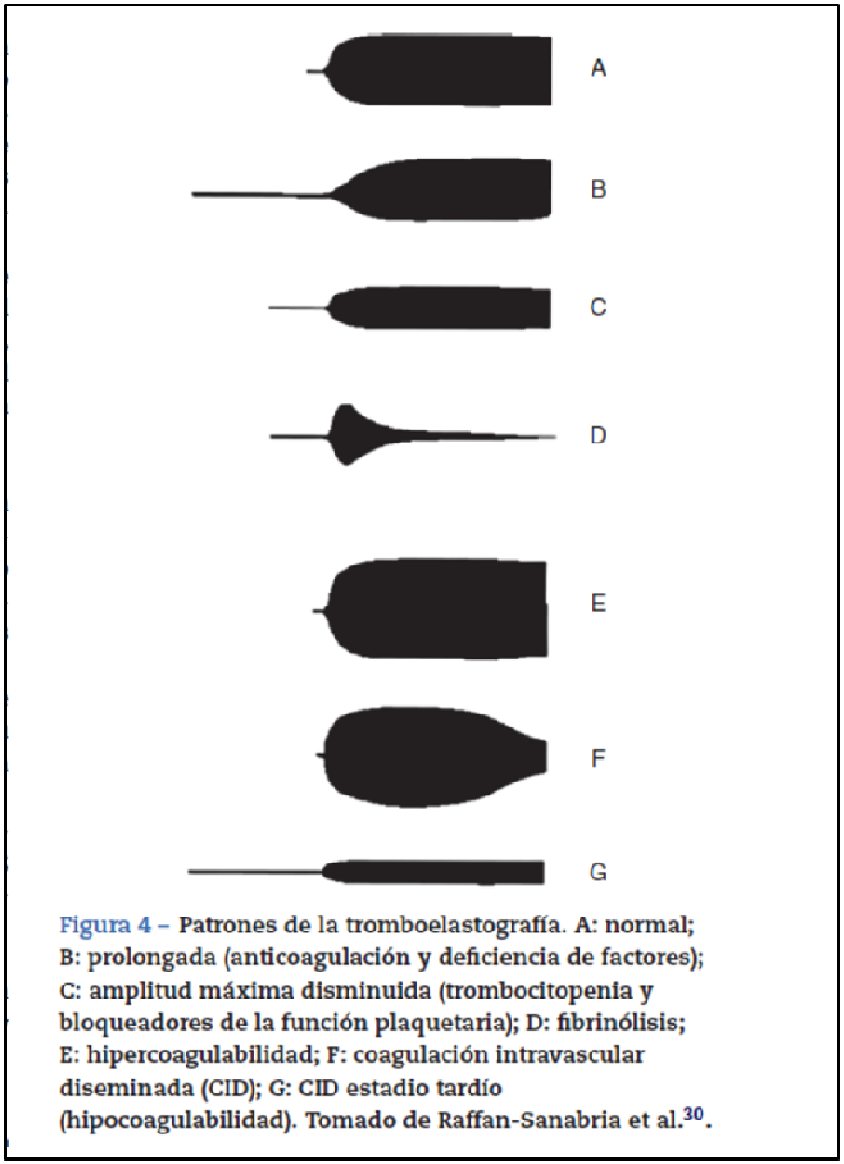


Figura 4 – Patrones de la tromboelastografía. A: normal; B: prolongada (anticoagulación y deficiencia de factores); C: amplitud máxima disminuida (trombocitopenia y bloqueadores de la función plaquetaria); D: fibrinólisis; E: hipercoagulabilidad; F: coagulación intravascular diseminada (CID); G: CID estadio tardío (hipocoagulabilidad). Tomado de Raffan-Sanabria et al.[30].

↓ Utilización hemoderivados

↓ Morbilidad

Cochrane Library

Cochrane Database of Systematic Reviews

Thromboelastography (TEG) or thromboelastometry (ROTEM) to monitor haemostatic treatment versus usual care in adults or children with bleeding (Review)

Wikkelsø A, Wetterslev J, Møller AM, Afshari A

2016

Tener en cuenta…

Control de la vía aérea y ventilación
Acceso vascular
(Agrupar, EAB, AL, Hgr, coag)
Control de hemorragia
Limitar la utilización de cristaloides
Administración temprana de GR
Ácido tranexámico si < 3hs
Utilización de plasma y plaquetas precoz
Estrategia metas coagulación posible?
Considerar crioprecipitados
Temperatura corporal >35°
Controlar calcio
Quirófano

Muchas gracias!!!