The best of ISICEM

przegląd subiektywny
- płynoterapia, hemostaza, OUN

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Katedra i Klinika Anestezjologii i Intensywnej Terapii

UNIWERSYTECKIE CENTRUM KLINICZNE
IM. PROF. K. GIBIŃSKIEGO
Śląskiego Uniwersytetu Medycznego
w Katowicach

Surgeon Shoots Anesthetist Dead During Operation -- Patient Faints

Rio de Janeiro. Reuters. A Brazilian surgeon shot a colleague, who was responsible for the anaesthesia of the patient, during abdominal surgery. While this was happening on Monday. The patient awoke from anaesthesia and, on seeing the bloodbath, fainted.

The Resident who was present attempted to save the life of the anaesthetist then ended the abdominal operation. The surgeon was long gone over the mountains.

There was disagreement regarding the surgery between the two doctors, members of a private clinic at Macae, near Rio de Janeiro, where the operation took place. During the dispute, the 60 year old surgeon, Marcelino Pereira da Silva took out a revolver and put three shots into the head of Elimson Ribeiro Elias, age 40. Search is on for the surgeon.

PŁYNOTERAPIA

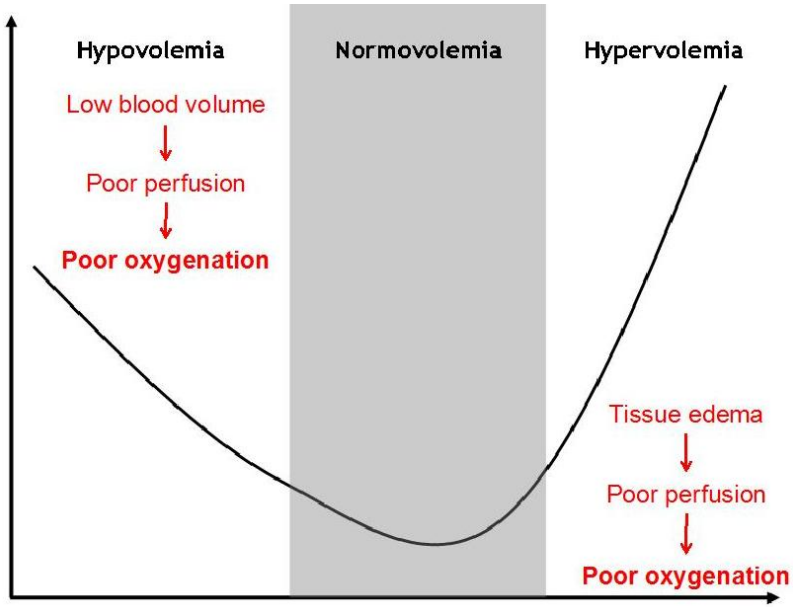
NOT too much…

- ✓ Żaden lek w medycynie nie jest tak bezkrytycznie stosowany jak płyny!!!

SCCS ZABRZE

NOT too much…

- ✓ Przeciążenie układu krążenia
- ✓ Zaburzenia krzepnięcia (+ ↓ Ca2+ + ↓ temp + ↓ pH)
- ✓ Upośledzone gojenie



Bellamy, BJA 2006

Jak dawkować płyny?

MODEL STATYCZNY: OBSERWACJA ZNACZNIKA

- ↑ przepuszczalności śródbłonka (porażenie glikokaliksu, SIRS)
- ↕ dystrybucji: przesunięcia płynowe (intra ↔ extra vascular)
- ↓ eliminacji nerkowej
- ↕ rzutu serca

MODEL DYNAMICZNY: OBSERWACJA KLIRENSU

Zapotrzebowanie bieżące: 1,85 ml /kg mc / h
Reguła geometrycznego uzupełniania strat krwi 3:1
→ 1,5 – 0,75 – 0,35 – 0,2 – 0,2 / co 30-min

Hahn RG, Annual Update in IC&EM 2015

Nie tylko ilość…

	Crystalloids							Gelatins		Starches		
	Lactated Ringer's	Acetated Ringer's	Hartmann's solution	PlasmaLyte	Sterofundin ISO*	ELO-MEL isoton	Ionolyte	Isoplex	Gelaspan	Hextend	Tetraspan	Volulyte
Na^+ [mEq L^{-1}]	130	132	131	140	145	140	137	145	151	143	140	137
K^+ [mEq L^{-1}]	4	4	5	5	4	5	4	4	4	3	4	4
Ca^{2+} [mEq L^{-1}]	3	3	4	–	5	5	–	–	2	5	5	–
Mg^{2+} [mEq L^{-1}]	–	–	–	3	2	3	3	1.8	2	0.9	2	3
Cl^- [mEq L^{-1}]	109	110	111	98	127	108	110	105	103	124	118	110
Lactate [mEq L^{-1}]	28	–	29	–	–	–	–	25	–	28	–	–
Acetate [mEq L^{-1}]	–	29	–	27	24	45	34	–	24	–	24	34
Malate [mEq L^{-1}]	–	–	–	–	5	–	–	–	–	–	5	–
Gluconate [mEq L^{-1}]	–	–	–	23	–	–	–	–	–	–	–	–
Dextrose [g L^{-1}]	–	–	–	–	–	–	–	–	–	–	–	–
Gelatin [g L^{-1}]	–	–	–	–	–	–	–	40	40	–	–	–
HES [g L^{-1}]	–	–	–	–	–	–	–	–	–	60	60	60
Dextran [g L^{-1}]	–	–	–	–	–	–	–	–	–	–	–	
In-vivo SID [mEq L^{-1}]	28	29	29	50	29	45	34	46	56	28	29***	34
Osmolarity [mOsm L^{-1}]	278	277	279	294	309	302	286	284	284	307	297	287

Langer, Anaesthesiol Intens Ther 2015

Osocze

- Osmolarność = 291 mOsm/l
- [Na+] = 142 mM/l
- [Cl-] = 103 mM/l
- [K+] = 4,5 mM/l
- [Mg++] = 1 mM/l
- [Ca++] = 2,5 mM/l
- Bufor → HCO3-

0,9% NaCl

Journal of Zhejiang University-SCIENCE B (Biomedicine & Biotechnology)
ISSN 1673-1581 (Print); ISSN 1862-1783 (Online)
www.zju.edu.cn/jzus; www.springerlink.com
E-mail: jzus@zju.edu.cn

Review:

0.9% saline is neither normal nor physiological

Heng LI[§1], Shi-ren SUN[§2], John Q. YAP[3], Jiang-hua CHEN[1], Qi QIAN[†‡4]

1l 0,9% NaCl = 9g NaCl

→ 154 mM Na+

→ 154 mM Cl-

Solution	Na^+ (mmol/L)	K^+ (mmol/L)	Cl^- (mmol/L)	Ca^{2+} (mg/dl)	Mg^{2+} (mg/dl)
Normal serum*	135–145	3.6–5.2	98–107	8.9–10.1	1.7–2.3
Saline	154	0	154	0	0
Lactated Ringer's (LR)	131	5.0	111	2.7	0
Hartmann's solution	129	5.0	109	4.0	0
Ringer's acetate (RA)	130	5.4	112	0.9	1.0
Plasma-Lyte	140	5.0	98	0	3.0

6l 0,9% NaCl =

- BE -2 → -9
- Cl- 105 → 115
- SID 40 → 31

Reddy S, Annual Update in IC&EM 2016

6l 0,9% NaCl =

- BE -2 → -9
- Cl- 105 → 115
- **SID 40 → 31**

Reddy S, Annual Update in IC&EM 2016

SID = Strong Ion Difference

↓↓↓

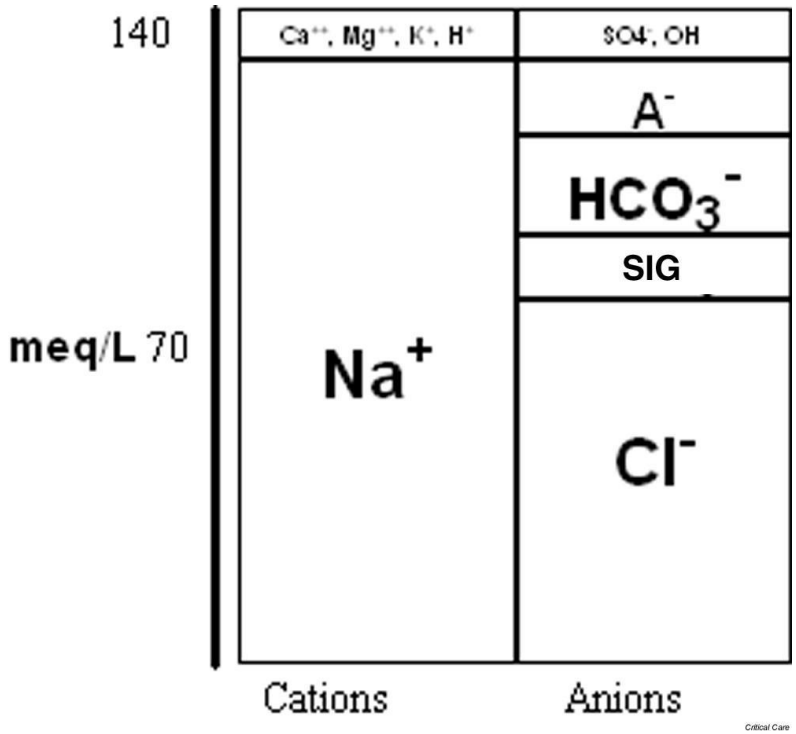
SID = [Na+] + [K+] – [Cl-] – [słabe kwasy]

↓↓↓

SID = [Na+] – [Cl-]

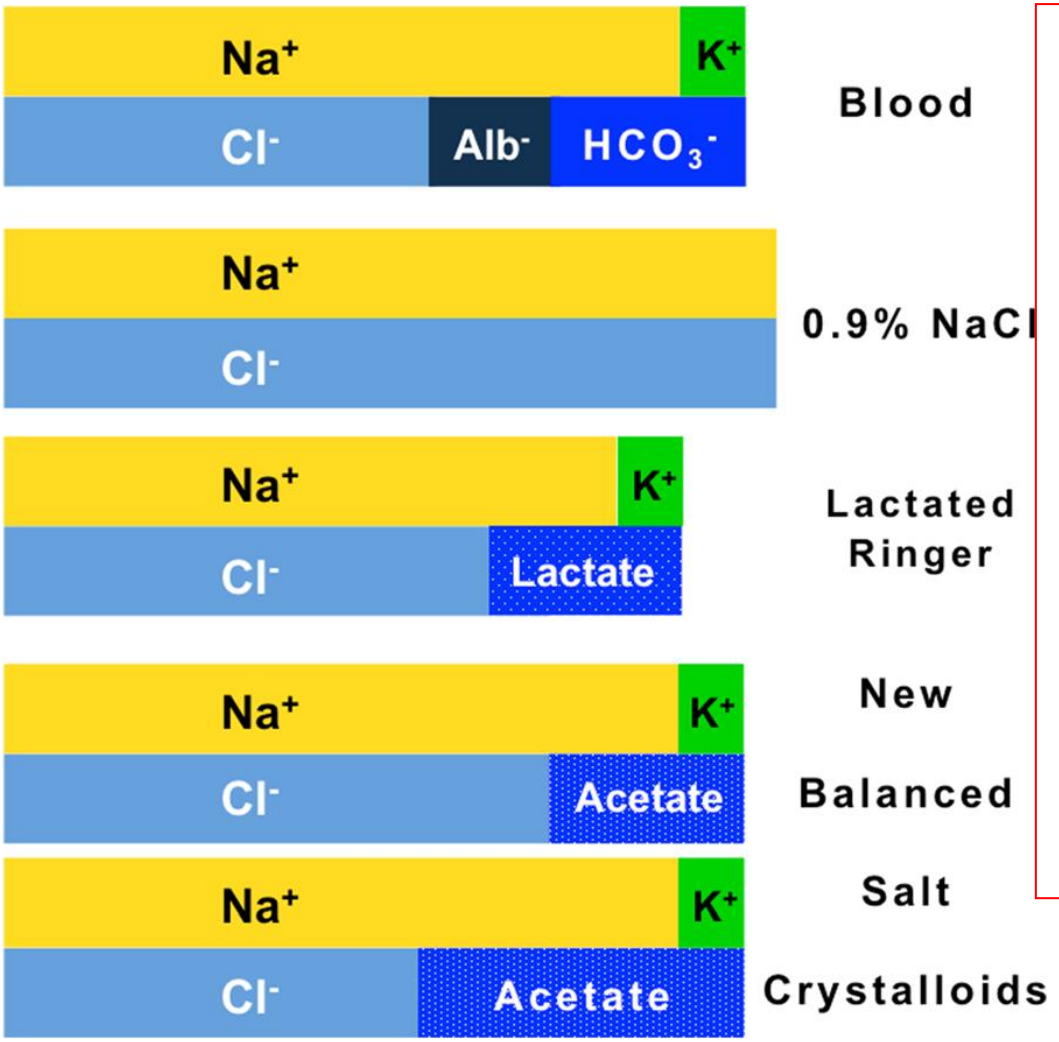
Reddy S, Annual Update in IC&EM 2016

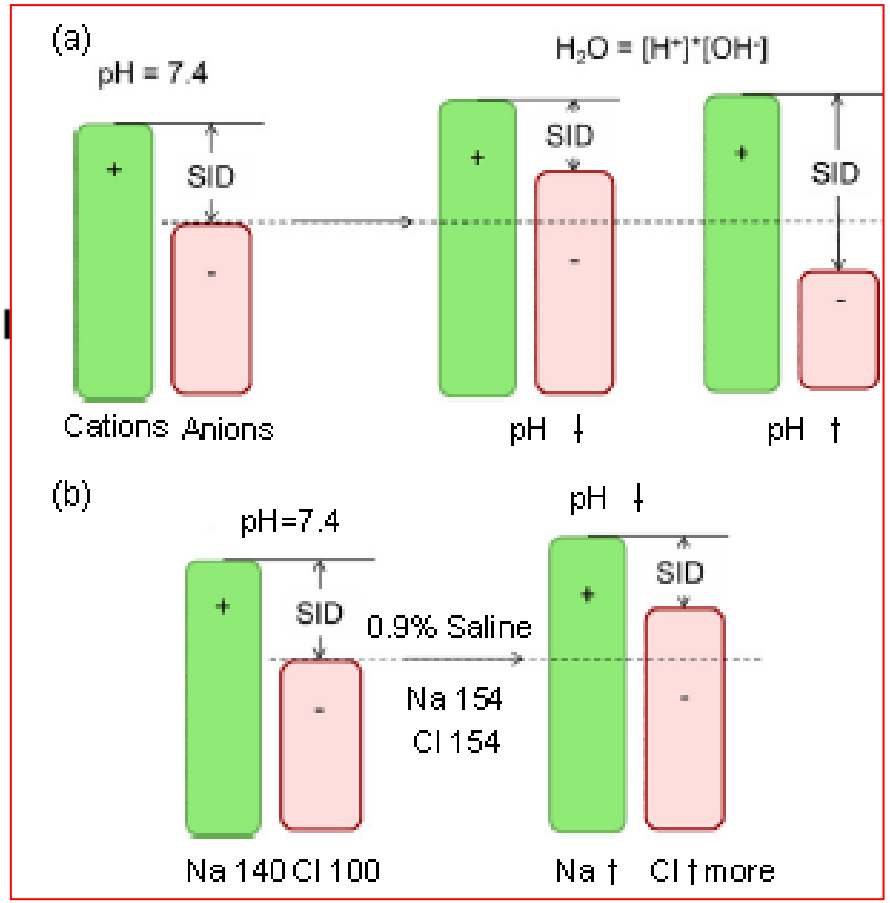
$$pH \propto \log \frac{[HCO_3]}{S \times P_aCO_2}$$



$$pH = pK_1' + \log[SID - A_{tot} / (1 + 10^{(pKa - pH)})] / (S \times PCO_2)$$

SID vs płynoterapia





Santi, Ital J Pediatr 2015

Hyperchloremia with reduction in plasma SID

- Smooth muscle vascular cell contraction
- Increase in norepinephrine and angiotensin II-induced vasoconstriction
- Tubulo-glomerular feedback: reduction in RBF and GFR – possible pre-renal kidney injury
- Decreased diuresis, fluid overload, renal capsula stretch and interstitial edema – further reduction in RBF

Suspected hypovolemia/ hypoperfusion

Metabolic Acidosis

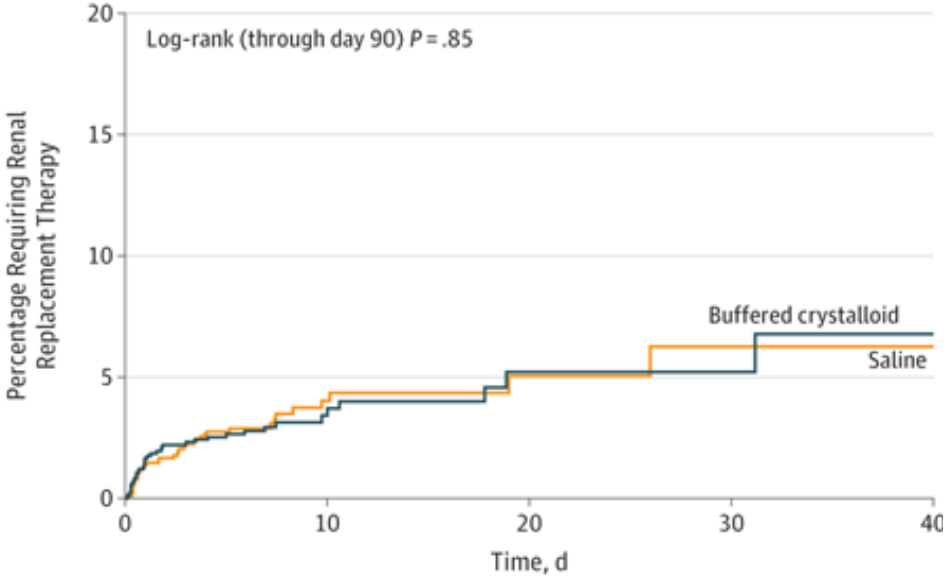
- Nausea and vomiting, abdominal discomfort
- Reduction in gastric mucosal blood flow
- NO and proinflammatory cytokines production, immunomodulation
- Decrease in systemic blood pressure

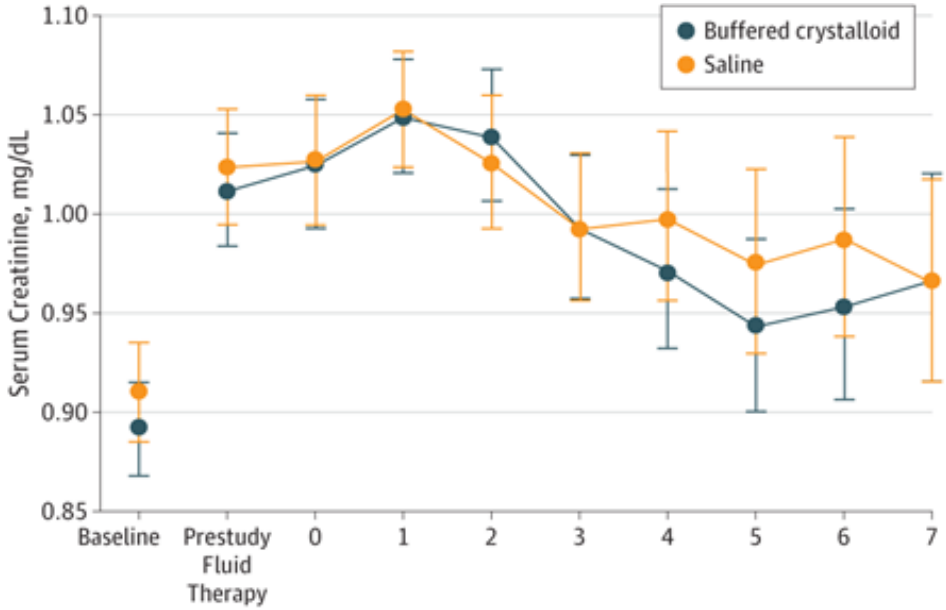
Reddy S, Annual Update in IC&EM 2016 Langer, Anaesthesiol Intens Ther 2015

JAMA. 2015 Oct 27;314(16):1701-10. doi: 10.1001/jama.2015.12334.

Effect of a Buffered Crystalloid Solution vs Saline on Acute Kidney Injury Among Patients in the Intensive Care Unit: The SPLIT Randomized Clinical Trial.

Young P[1], Bailey M[2], Beasley R[3], Henderson S[4], Mackle D[3], McArthur C[5], McGuinness S[6], Mehrtens J[7], Myburgh J[8], Psirides A[9], Reddy S[3], Bellomo R[10]; SPLIT Investigators; ANZICS CTG.





HEMOSTAZA

Table 1 Reversing agents for currently available anticoagulants and antiplatelet agents

	Time until restoration of hemostasis after cessation of therapeutic dose	Reversing agent	Remark
Vitamin K antagonists	Warfarin: 60–80 h Acenocoumarol: 18–24 h Phenprocoumon: 8–10 days	Vitamin K i.v: reversal in 12–16 h Vitamin K orally: reversal in 24 h PCCs: immediate reversal	Dose of vitamin K or PCCs depends on INR and bodyweight
Heparin	3–4 h	Protamine sulfate 25–30 mg; immediate reversal	1 mg of protamine per 100 anti-Xa units given in the last 2–3 h
LMW heparin	12–24 h	(Partially) protamine sulfate 25–50 mg; immediate (partial) reversal	1 mg of protamine per 100 anti-Xa units given in the last 8 h
Pentasaccharides	Fondaparinux: 24–30 h Idraparinux: 5–15 days Idrabiotaparinux: 5–15 days	Recombinant factor VIIa 90 ug/kg; immediate thrombin generation* Avidin for idrabiotaparinux*	Based on laboratory end-points, no systematic experience in bleeding patients
Oral factor Xa inhibitors	Dependent on compound, usually within 12 h	Prothrombin complex concentrate (3000 U)*	Based on laboratory end-points, no systematic experience in bleeding patients
Oral thrombin inhibitors	Dependent on compound, usually within 12 h	Idracizumab*	
Aspirin	5–10 days (time to produce unaffected platelets)	DDAVP (0.3–0.4 ug/kg) and/or platelet concentrate; reversal in 15–30 min	Cessation not always required, also dependent on clinical situation and indication
Clopidogrel **Prasugrel**	1–2 days	Platelet concentrate, possibly in combination with DDAVP (0.3–0.4 ug/kg); reversal in 15–30 min	Cessation not always desirable, also dependent on clinical situation and indication

Emergency reversal strategies for anticoagulants and antiplatelet agents

Levi M, Annual Update in IC&EM 2016

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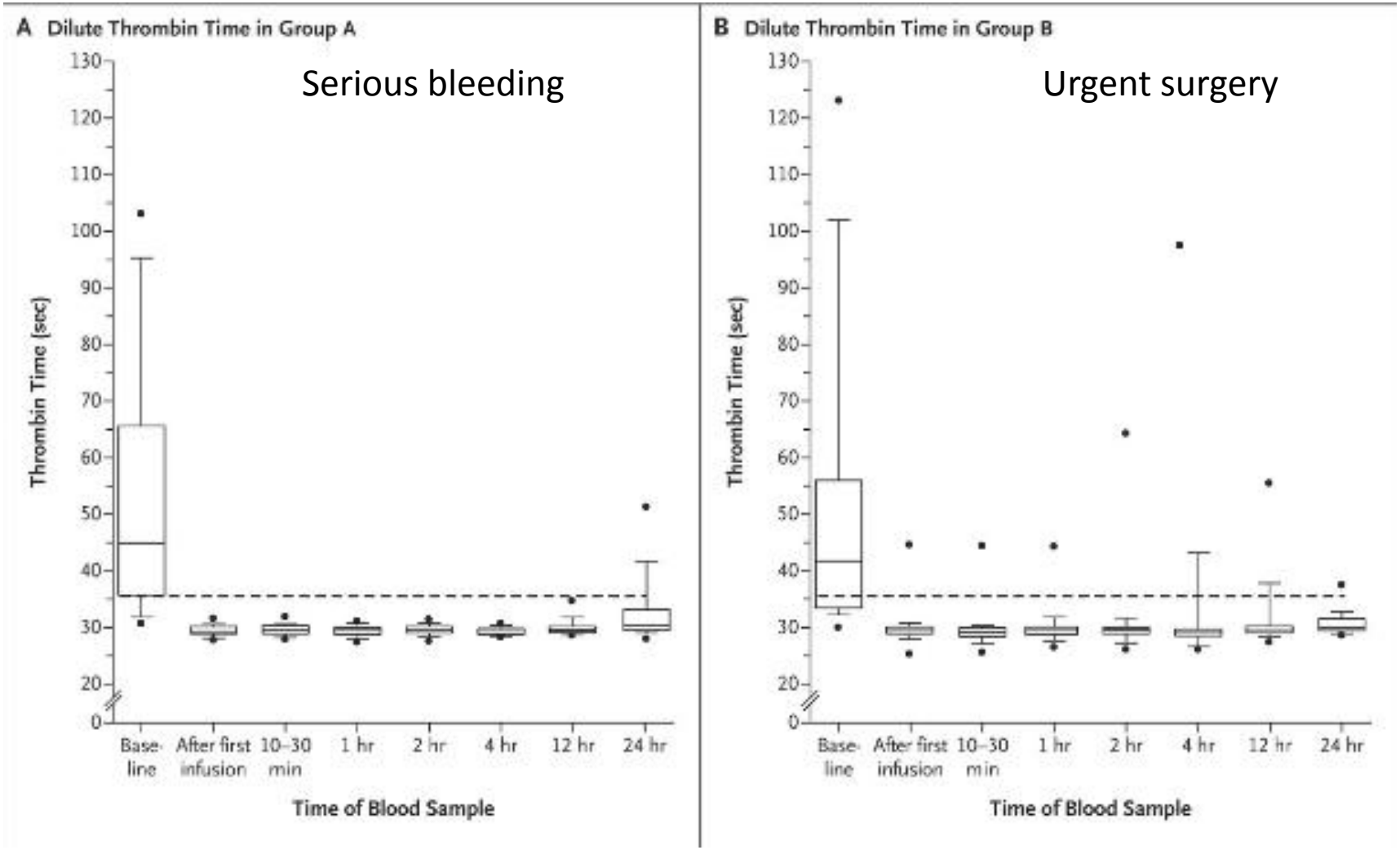
Emergency reversal strategies for anticoagulants and antiplatelet agents

Levi M, Annual Update in IC&EM 2016

N Engl J Med. 2015 Aug 6;373(6):511-20. doi: 10.1056/NEJMoa1502000. Epub 2015 Jun 22.

Idarucizumab for Dabigatran Reversal.

Pollack CV Jr[1], Reilly PA, Eikelboom J, Glund S, Verhamme P, Bernstein RA, Dubiel R, Huisman MV, Hylek EM, Kamphuisen PW, Kreuzer J, Levy JH, Sellke FW, Stangier J, Steiner T, Wang B, Kam CW, Weitz JI.



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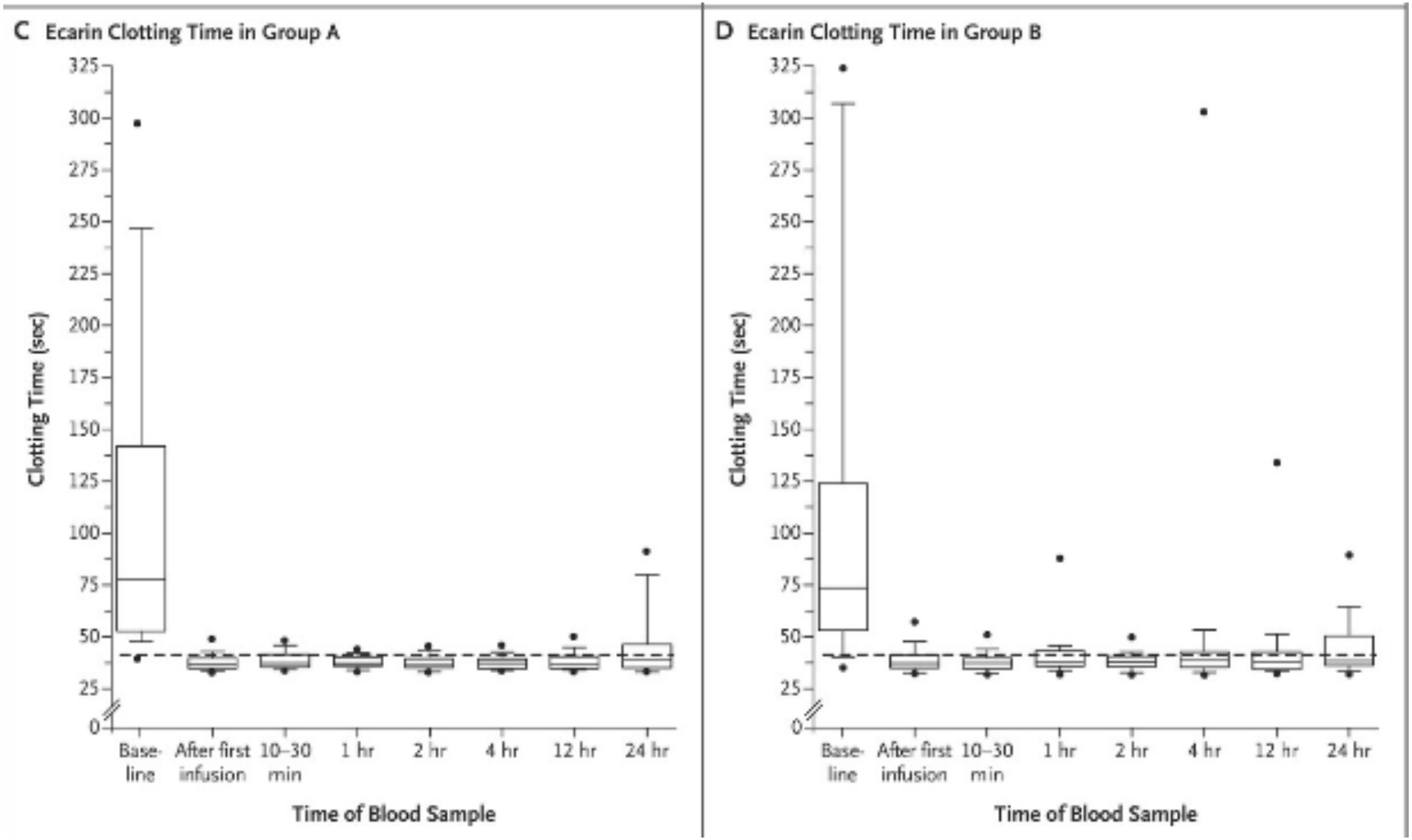

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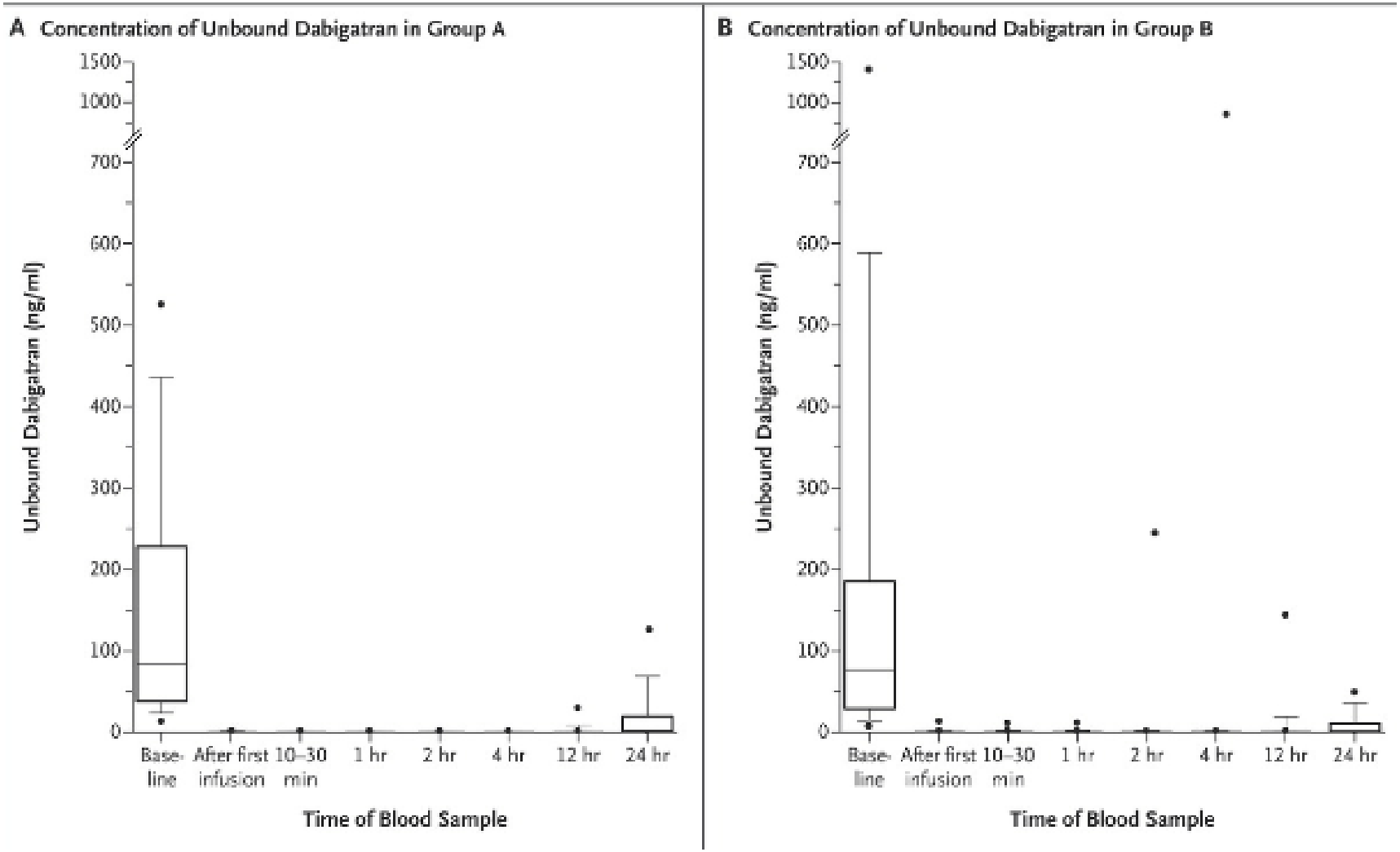
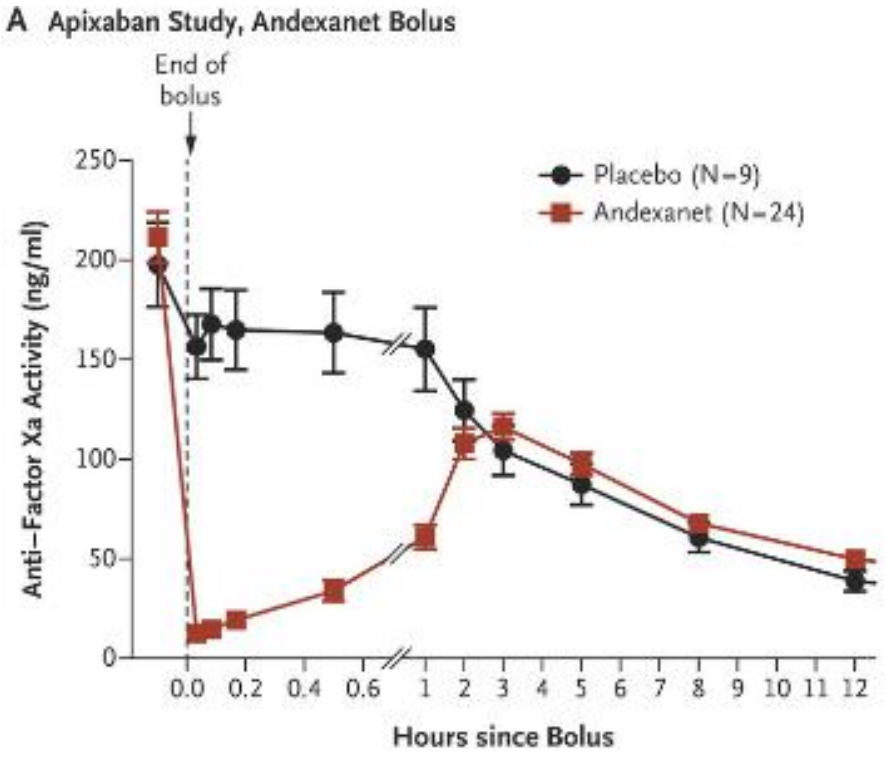
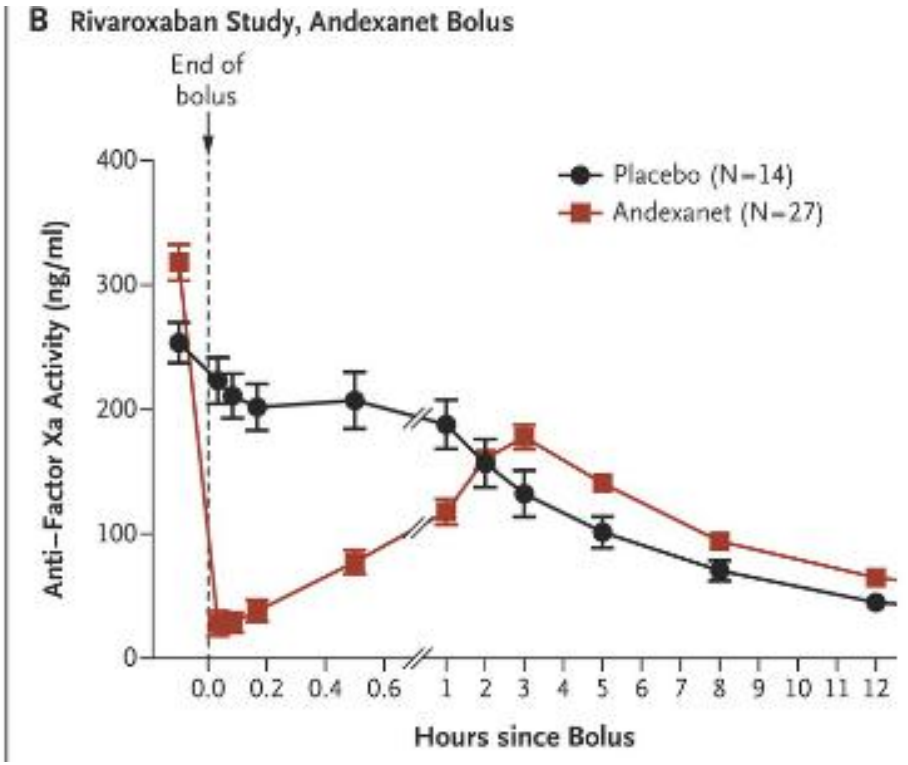


N Engl J Med. 2015 Dec 17;373(25):2413-24. doi: 10.1056/NEJMoa1510991. Epub 2015 Nov 11.

Andexanet Alfa for the Reversal of Factor Xa Inhibitor Activity.

Siegal DM[1], Curnutte JT, Connolly SJ, Lu G, Conley PB, Wiens BL, Mathur VS, Castillo J, Bronson MD, Leeds JM, Mar FA, Gold A, Crowther MA.





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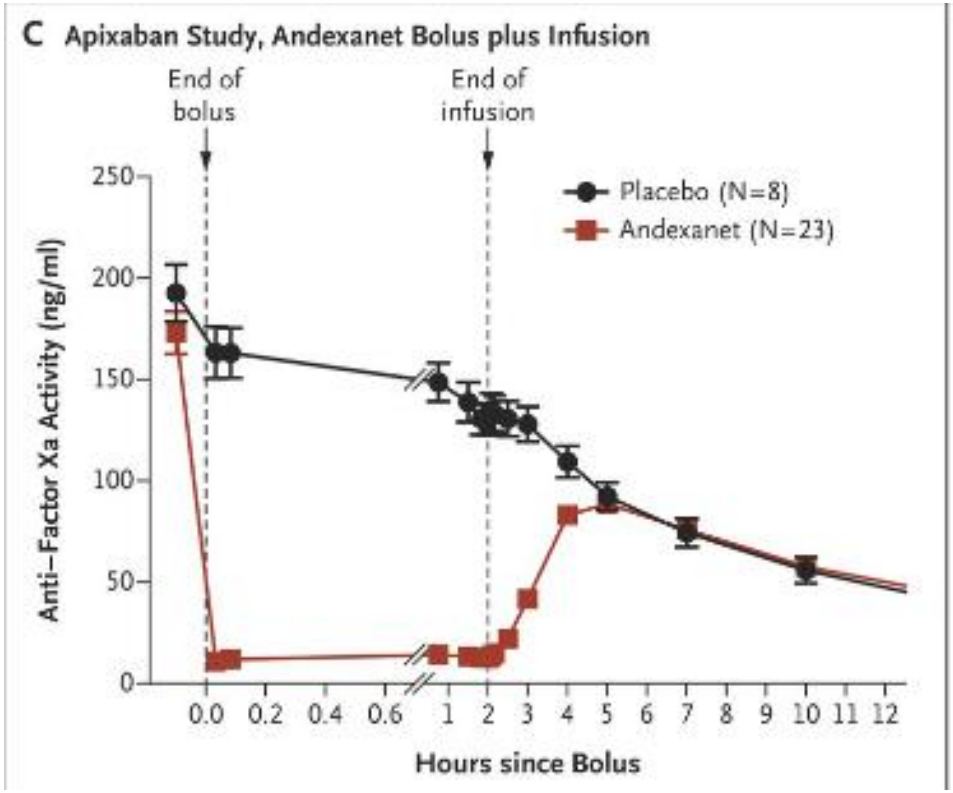
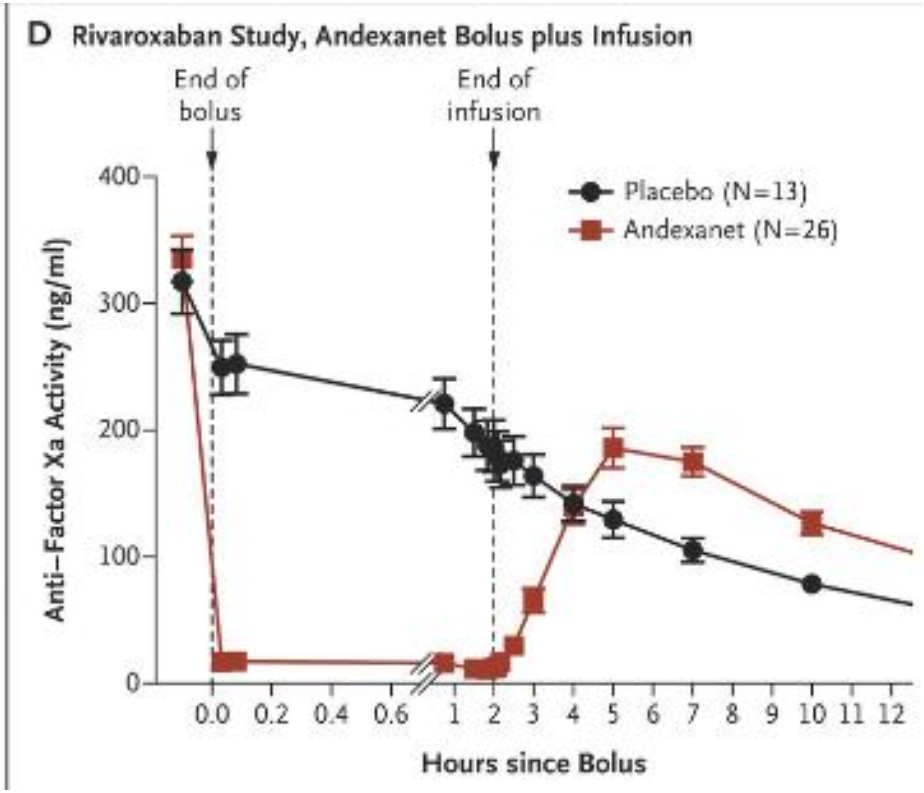




Rational and timely use of coagulation factor concentrates in massive bleeding without point-of-care coagulation monitoring

MASYWNE KRWAWIENIE

↓

ZAHAMUJ HIPERFIBRYNOLIZĘ (10-20 mg TXA)

↓

ZAPEWNIJ TWORZENIE SKRZEPU (4-8 g Fibr + KKP przy PLT<50-100 tys/µl)

↓

USPRAWNIJ TWORZENIE TROMBINY (≤20 IU/kg 4-factor PCC)
(ROZWAŻ FXIII / rFVIIa)

↓

HEMOSTAZA

Grottke O, Annual Update in IC&EM 2015

OŚRODKOWY UKŁAD NERWOWY

Crit Care Med. 2014 Nov;42(11):2350-7. doi: 10.1097/CCM.0000000000000512.

Short- and long-term outcome in elderly patients after out-of-hospital cardiac arrest: a cohort study.

Grimaldi D[1], Dumas F, Perier MC, Charpentier J, Varenne O, Zuber B, Vivien B, Pène F, Mira JP, Empana JP, Cariou A.

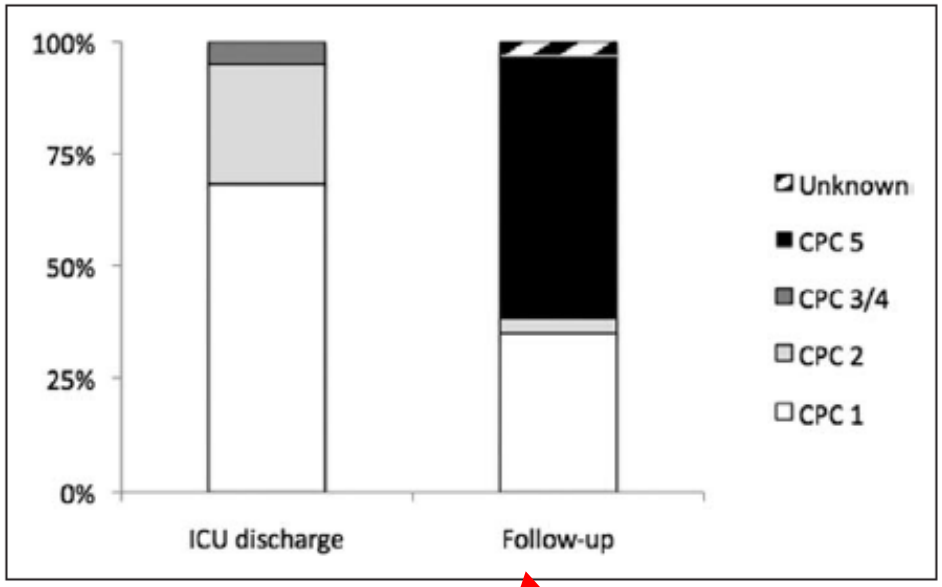


Figure 5. Cerebral Performance Category (CPC) score of survivors ($n = 60$) at ICU discharge and at the end of follow-up. Histogram representation of the respective proportion of patients according to CPC score levels at ICU discharge (*left*) and at end of follow-up (*right*). CPC 5 means death during follow-up.

Variable	OR	95% CI	p
Diabetes mellitus	0.40	0.07–2.38	0.32
Public location of cardiac arrest	1.14	0.58–2.22	0.70
Shockable initial rhythm	1.18	0.43–3.24	0.74
No flow ≤ 3 min	4.06	1.49–11.09	0.006
Low flow ≤ 15 min	2.26	0.79–6.45	0.13
Initial epinephrine dose ≤ 3 mg	1.75	0.61–4.98	0.30
Blood lactate level ≤ 5.1 mmol/L	3.30	1.05–10.39	0.04
Blood creatinine level ≤ 125 µmol/L	1.48	0.53–4.16	0.45
Post–cardiac arrest shock	0.56	0.21–1.51	0.25

OR = odds ratios.

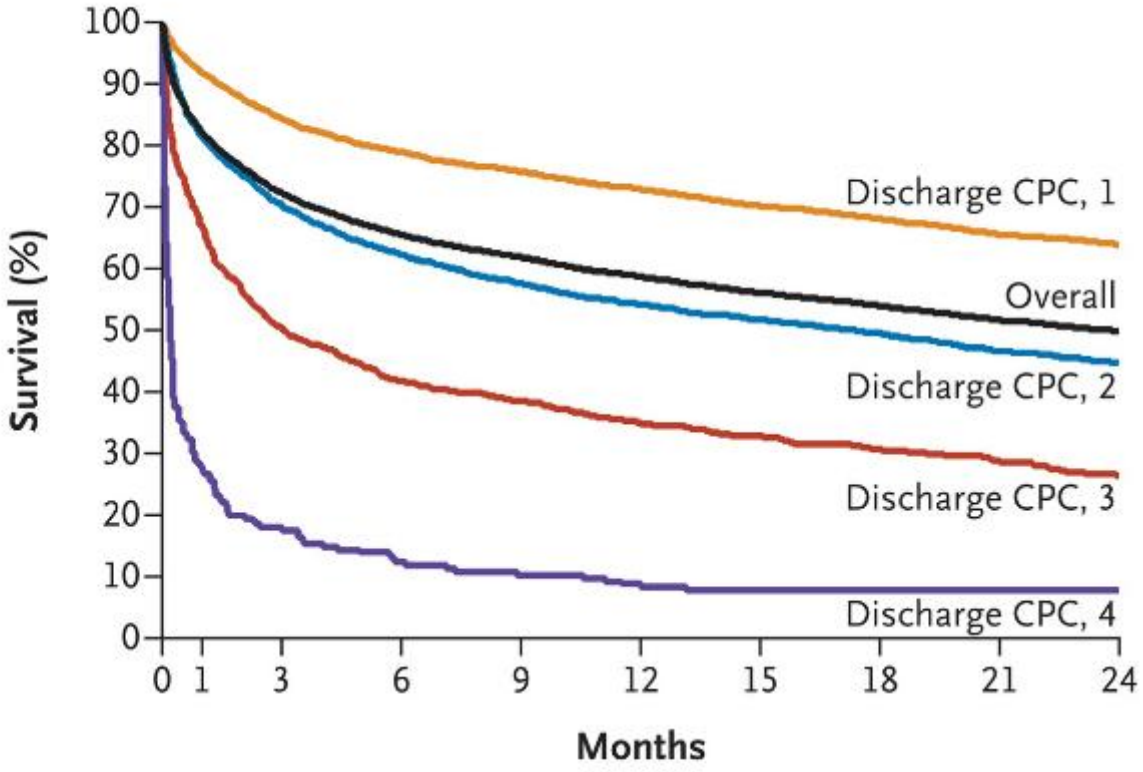
[a]Good outcome as defined by Cerebral Performance Category level 1 or 2.

12 miesięcy!!!

N Engl J Med. 2013 Mar 14;368(11):1019-26. doi: 10.1056/NEJMoa1200657.

Long-term outcomes in elderly survivors of in-hospital cardiac arrest.

Chan PS[1], Nallamothu BK, Krumholz HM, Spertus JA, Li Y, Hammill BG, Curtis LH; American Heart Association Get with the Guidelines–Resuscitation Investigators.



Percent Surviving						
Overall	82.0	72.0	65.4	58.5	53.7	49.6
Discharge CPC, 1	91.7	84.2	78.9	72.8	67.9	63.6
Discharge CPC, 2	81.3	69.9	62.1	54.0	49.1	44.7
Discharge CPC, 3	66.4	49.8	41.5	34.8	30.5	26.3
Discharge CPC, 4	27.2	17.4	12.3	8.2	7.7	7.7

Out-of-hospital cardiac arrest and survival to hospital discharge: a series of systematic reviews and meta-analyses

ADRENALINA

Neurological outcome:

- Low-dose (1 mg) vs. high dose (+1 mg) epinephrine: RR 1,203; 95%CI 0,739-1,959; p=0,33
- Low-dose epinephrine vs. placebo or no drugs: RR 1,243; 95%CI 0,940-1,643; p=0,53

Vargas M, Annual Update in IC&EM 2015

Out-of-hospital cardiac arrest and survival to hospital discharge: a series of systematic reviews and meta-analyses

WAZOPRESYNA

Neurological outcome:

- Vasopressin+epinephrine vs. epinephrine: RR 0,815; 95%CI 0,566-1,175; p=0,62
- Vasopressin <10min of CPR vs. >10 min of CPR: RR 0,811; 95%CI 0,559-1,176; p=0,48

Vargas M, Annual Update in IC&EM 2015

Out-of-hospital cardiac arrest and survival to hospital discharge: a series of systematic reviews and meta-analyses

PRE-HOSPITAL HYPOTHERMIA

Neurological outcome:

- Pre-hospital cooling vs. control: RR 0,959; 95%CI 0,830-1,108; p=0,74

Vargas M, Annual Update in IC&EM 2015

Out-of-hospital cardiac arrest and survival to hospital discharge: a series of systematic reviews and meta-analyses

IN-HOSPITAL HYPOTHERMIA

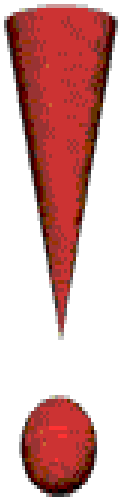
Neurological outcome:

- In-hospital cooling vs. control: RR 0,788; 95%CI 0,556-1,116; p=0,18
- T33°C vs. T≥36°C: RR 1,249; 95%CI 0,877-1,780; p=0,10

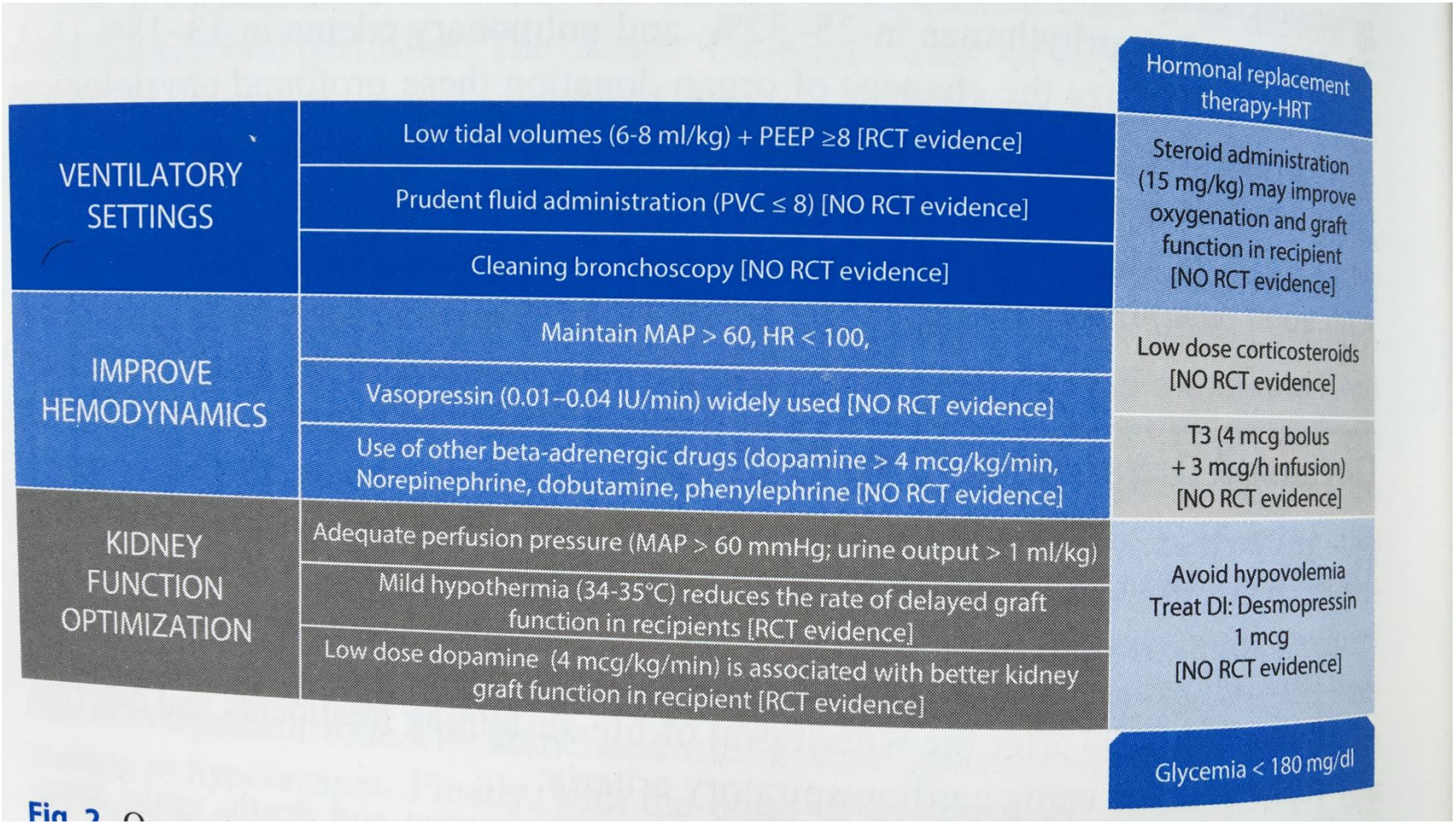
Vargas M, Annual Update in IC&EM 2015

Rokowanie po NZK

- MAP → 75-85 mmHg
- HR → 40-60/min
- NIRS → SatO2 65-70 %
- TTM → temp <37 °C (5 dni!)
- Hgb → 10-12 g%
- Lung protective ventilation → TV 6-8 ml/kg
- PaCO2 → 45-55 mmHg
- PaO2 → 65-150 mmHg



Advances in the management of the potential organ donor after neurologic determination of death



Confalonieri A, Annual Update in IC&EM 2016

Take home message

- Płynoterapia raczej restrykcyjna niż liberalna
- Krystaloidy zbilansowane niż 0,9% NaCl
- Swoiste antidota dla antagonistów cz. II i X
- Hemostatyczne testy POC
- Proste fizjologiczne protokoły leczenia masywnego krwawienia przy braku POC
- Wątpliwa optymalizacja postępowania dla poprawy rokowania neurologicznego po OHCA
- Dbajmy o Dawców!