CONGRESSO NAZIONALE IRC 2023

Vicenza

Italian Resuscitation Conference 2023

20 • 21 OTTOBRE

Vicenza Convention Centre

LA RIVOLUZIONE DEI SISTEMI

IRC | Italian Resuscitation Council

FLUIDO TERAPIA IN ETA' PEDIATRICA

Davide Silvagni

UOC Pronto Soccorso Pediatrico

Azienda Ospedaliera Universitaria Integrata Verona

Fluidi

- ✓ Perché?
- ✓ Quali?
- ✓ Quando?
- ✓ Quanto?

Perché i fluidi?

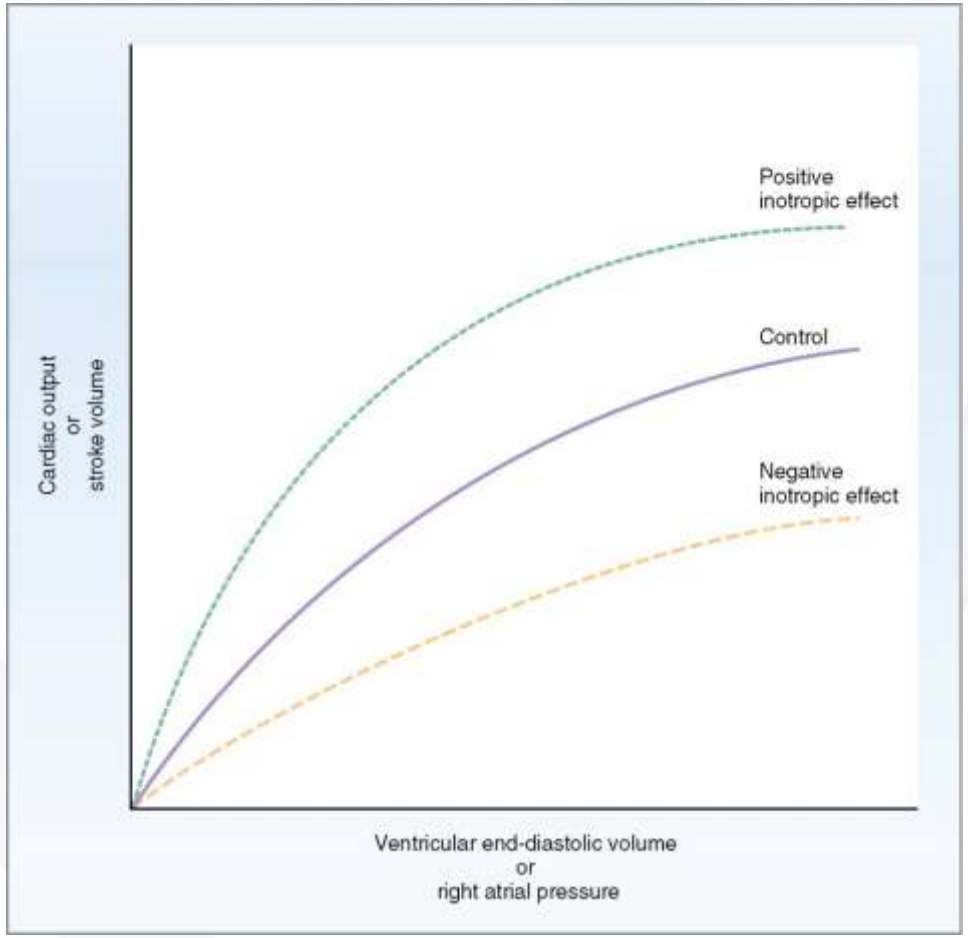
↑ volume nel circolo venoso

↓

↑ precarico

↓

↑ Pressione atrio dx



Fisiopatologia

- ✓ L'attività cardiaca del lattante è caratterizzata da una maggiore contrattilità con ridotta capacità di aumentare lo stroke volume
- ✓ Il compenso emodinamico dipende più dall'aumento della FC che dal precarico
- ✓ Con l'aumento della FC e del precarico aumenta la richiesta di O2

S.L. Weiss et al. / Journal of Cardiothoracic and Vascular Anesthesia 00 (2019) 1–9

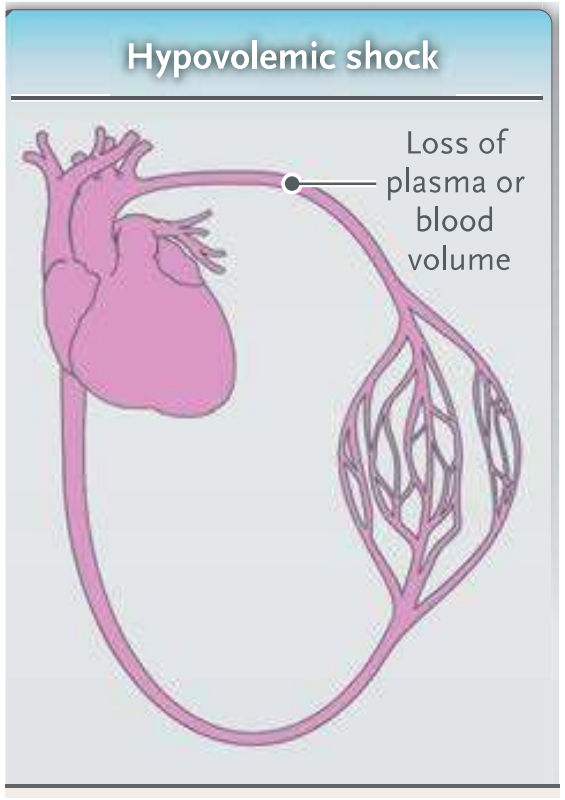
SHOCK

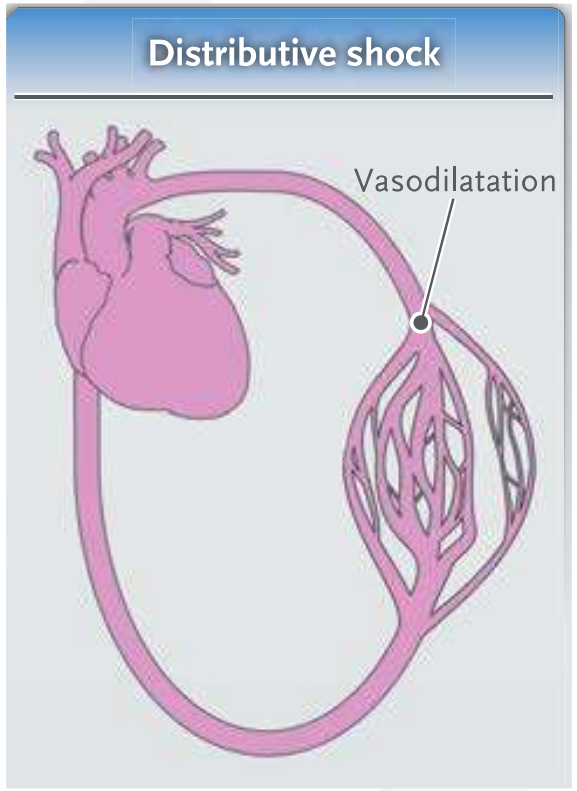
*Shock **is not one disease** but the end stage of many different pathologies and there are many subtypes*

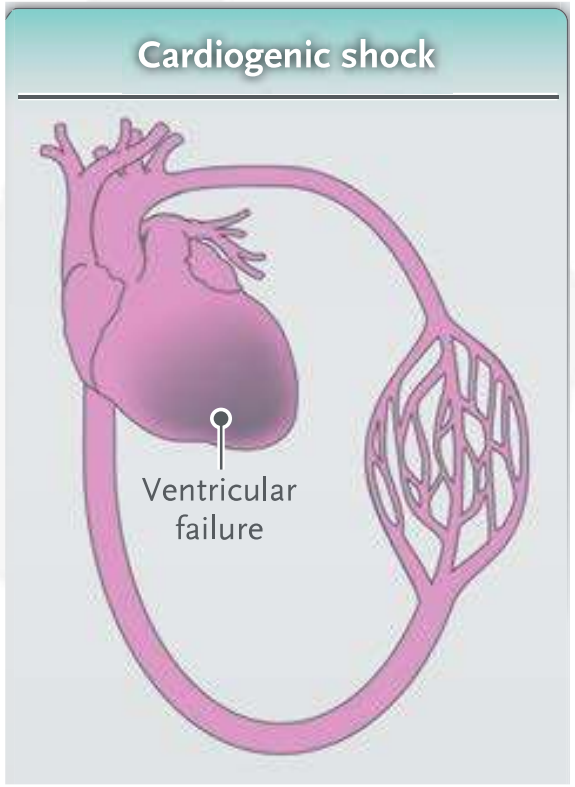
***Treatment should be individualised** taking into consideration the underlying aetiology and pathophysiology, age context comorbidities and available resources*

European Resuscitation Council Guidelines 2021:
Paediatric Life Support

Quale tipo di shock







Vincent JL, De Backer D: Circulatory schock NEJM 2103; 369: 1726-34

Fluids are drugs: type, dose and toxicity

Karthik Raghunathan[a], Andrew D. Shaw[a,b], and Sean M. Bagshaw[c]

- ✓ Il tipo di fluido, la quantità e la velocità influiscono sull'outcome
- ✓ I fluidi possono avere effetti collaterali soprattutto oltre il breve termine

Myburgh JA et al NEJM 2013

QUALE FLUIDO?

CRISTALLOIDI

Balanced crystalloids are the first choice and normal saline is an acceptable alternative

We suggest using balanced/buffered crystalloids rather than 0,9% saline for the initial resuscitation of children with septic shock or othe sepsis associated organ dysfunction

European Resuscitation Council Guidelines 2021: Paediatric Life Support

Quale fluido?

Cristalloidi?

	Plasma	Fisiologica 0,9%	Ringer Lattato
OSMOLARITA'	**291**	**308**	**276**
Sodio	± 140	154	131
Potassio	± 4,5		5,0
Calcio	± 2,4		2,0
Magnesio	+ 1,0		
Cloro	± 105	154	109
Bicarbonato	± 24		
Lattato	1-2		29
Acetato			
Gluconato			
Anion GAP	12-20	0	0

35 **0** **22**

Cristalloidi?

La soluzione fisiologica non è fisiologica…

- ✓ Rischio di acidosi ipercloremica
- ✓ Ipercloremia riduce riassorbimento tubulare di Cl -> vasocostrizione arteriolare riduce GFR
- ✓ Ipercloremia aumenta stato infiammatorio altera microcircolo
- ✓ Studi retrospettivi Cl oltre 5 mmol/l peggiora outcome

Buffered solutions versus 0.9% saline for resuscitation in critically ill adults and children (Review)

We found no effect of buffered solutions on preventing in-hospital mortality compared to 0.9% saline solutions in critically ill patients. The certainty of evidence for this finding was high, indicating that further research would detect little or no difference in mortality. The effects of buffered solutions and 0.9% saline solutions on preventing acute kidney injury were similar in this setting. The certainty of evidence for this finding was low, and further research could change this conclusion. Patients treated with buffered solutions showed lower chloride levels, higher levels of bicarbonate, and higher pH. The certainty of evidence for these findings was very low. Future research should further examine patient-centred outcomes such as quality of life. The three ongoing studies once published and assessed may alter the conclusions of the review.

Results varied in terms of the time points at which they were reported, the unit of measurement used, and the measures reported. The total amount of fluid given as fluid therapy was not recorded. Only four studies involved children. These children were less sick than participants included in the adult trials, and kidney damage was not reported. The three ongoing studies once published and assessed may alter the conclusions of this review.

Cochrane Library

Cochrane Database of Systematic Reviews

Balanced Versus Unbalanced Fluid in Critically Ill Children: Systematic Review and Meta-Analysis*

March 2022 • Volume 23 • Number 3
Pediatric Critical Care Medicine

DATA SYNTHESIS: Among 481 references identified, 13 met inclusion criteria. In the meta-analysis of three randomized controlled trials with a population of 162 patients, we found a greater mean change in serum bicarbonate level (pooled estimate 1.60 mmol/L; 95% CI, 0.04–3.16; $p = 0.04$) and pH level (pooled mean difference 0.03; 95% CI, 0.00–0.06; $p = 0.03$) after 4–12 hours of rehydration with balanced versus unbalanced fluids. No differences were found in chloride serum level, acute kidney injury, renal replacement therapy, or mortality.

CONCLUSIONS: Our systematic review found some evidence of improvement in blood pH and bicarbonate values in critically ill children after 4–12 hours of fluid bolus therapy with balanced fluid compared with the unbalanced fluid. However, a randomized controlled trial is needed to establish whether these findings have an impact on clinical outcomes before recommendations can be generated.

Cristalloidi vs colloidi

Albumina non inferiore a cristalloidi

ma…

- ✓ Maggiori costi
- ✓ Ridotta disponibilità
- ✓ Emoderivato

European Resuscitation Council Guidelines 2021: Paediatric Life Support

Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children

20. We *suggest* using crystalloids, rather than albumin, for the initial resuscitation of children with septic shock or other sepsis-associated organ dysfunction (weak recommendation, moderate quality of evidence). PICO 15

QUANDO?

Shock cardiogeno

Once confirmed the general approach is to avoid fluid resuscitation.

However..

Children with proven preload insufficiency might benefit from cautious fluid resuscitation

European Resuscitation Council Guidelines 2021: Paediatric Life Support

Clinical Update in Pediatric Sepsis: Focus on Children With Pre-Existing Heart Disease

S.L. Weiss et al. / Journal of Cardiothoracic and Vascular Anesthesia 00 (2019) 1–9

Shock ipovolemico

*A **non bolus** approach to IV fluid resuscitation is advisable*

EXCEPT

When associated with septic shock

European Resuscitation Council Guidelines 2021:
Paediatric Life Support

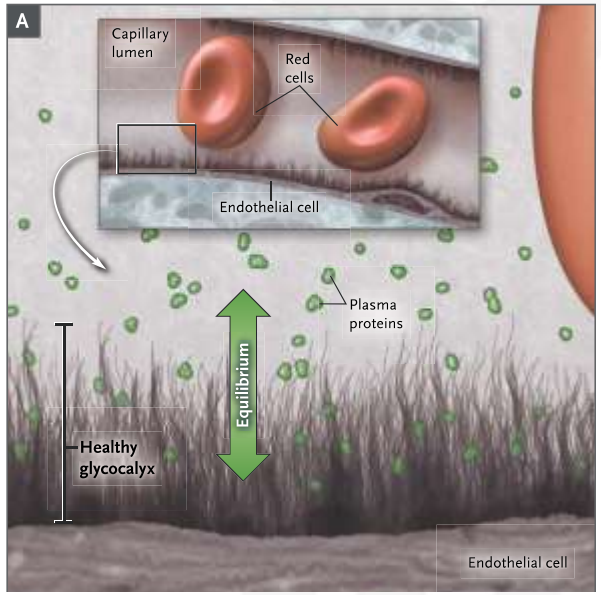
Shock settico

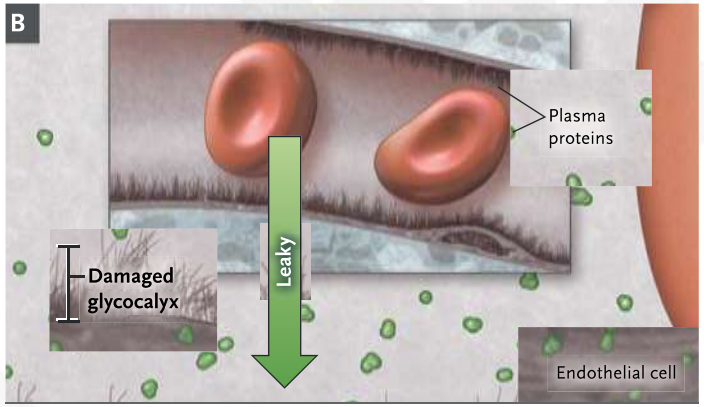
In healthcare systems with availability of intensive care, we *suggest* administering up to 40-60 mL/kg in bolus fluid (10-20 mL/kg per bolus) over the first hour, titrated to clinical markers of cardiac output and discontinued if signs of fluid overload develop, for the initial resuscitation of children with septic shock or other sepsis-associated organ dysfunction (weak recommendation, low quality of evidence). PICO 17

Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children

Quando i fluidi sono troppi…

- ✓ Danno del glicocalice
- ✓ Sovraccarico di fluidi
- ✓ Peggioramento della funzionalità renale
- ✓ ARDS
- ✓ Interferenza nel sistema di compenso del simpatico

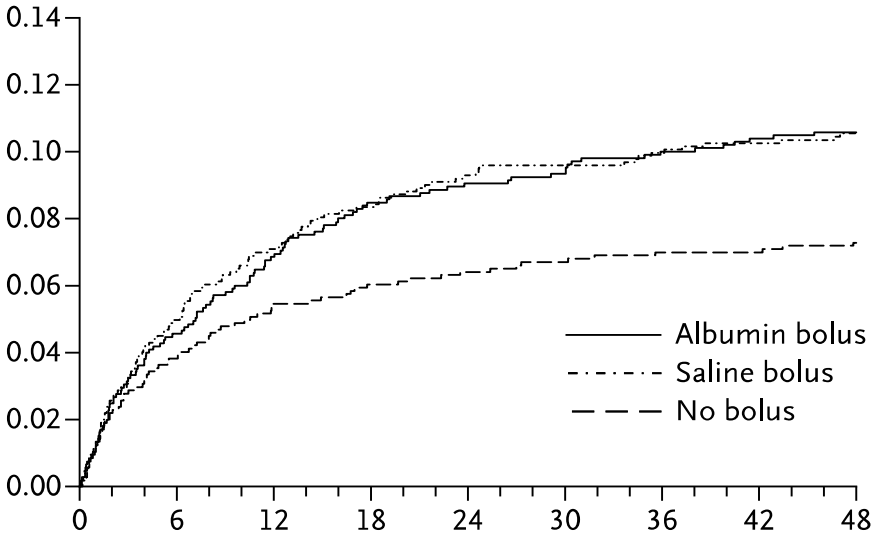




The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JUNE 30, 2011 VOL. 364 NO. 26

Mortality after Fluid Bolus in African Children with Severe Infection



In conclusion, the results of this study challenge the importance of bolus resuscitation as a lifesaving intervention in resource-limited settings for children with shock who do not have hypotension and raise questions regarding fluid-resuscitation guidelines in other settings as well.

- RCT su 2396 bambini con infezione grave
- 20 ml/kg vs mantenimento

LIMITI

- ✓ In 1/3 dei pazienti assenti i criteri di shock
- ✓ Assenza PICU
- ✓ Alto tasso di malaria
- ✓ Cut off trasfusione 5 g/dl

QUANTI?

Shock settico

10 ml/kg

*This smaller volume enables **faster reassessment***

BUT

does not necessarily limit the total amount of fluid to be given in the first hour of treatment (up to 40-60 ml/Kg)

European Resuscitation Council Guidelines 2021: Paediatric Life Support

Reassessment

Clinical signs combined with biochemical values (pH, lactate)

*give an acceptable test performance when **combined***

but not when considered individually

European Resuscitation Council Guidelines 2021:
Paediatric Life Support

Point of care ultrasound

- ✓ L'ecocardiografia point of care misura il diametro della VCI, la sua collassabilità e la funzionalità del ventricolo sinistro
- ✓ Questi parametri correlano con lo stato volemico e il precarico e predicono la risposta clinica alla somministrazione di fluidi
- ✓ Permette di orientare sul tipo di shock
- ✓ In alcuni studi pilota su bambini critici l'uso dell'ecografia point of care ha cambiato con successo l'approccio terapeutico

Park B et al Point of care ultrasound for pediatric shock. Ped Emergency Care 2015;31(8): 591-598

Point of care ultrasound

Table 1
Rapid Ultrasound in SHock (RUSH) protocol: ultrasonographic findings seen with classic shock states

RUSH Evaluation	Hypovolemic Shock	Cardiogenic Shock	Obstructive Shock	Distributive Shock
Pump	Hypercontractile heart Small chamber size	Hypocontractile heart Dilated heart	Hypercontractile heart Pericardial effusion Cardiac tamponade RV strain Cardiac thrombus	Hypercontractile heart (early sepsis) Hypocontractile heart (late sepsis)
Tank	Flat IVC Flat jugular veins Peritoneal fluid (fluid loss) Pleural fluid (fluid loss)	Distended IVC Distended jugular veins Lung rockets (pulmonary edema) Pleural fluid Peritoneal fluid (ascites)	Distended IVC Distended jugular veins Absent lung sliding (pneumothorax)	Normal or small IVC (early sepsis) Peritoneal fluid (sepsis source) Pleural fluid (sepsis source)
Pipes	Abdominal aneurysm Aortic dissection	Normal	DVT	Normal

Perera P et al: Rapid US in shock on the evaluation of critically ill. Emerg Med Clin Am. 2010; 28: 29-56

...

PRagMatic Pediatric Trial of Balanced vs nOrmaL Saline FlUid in Sepsis: study protocol for the PRoMPT BOLUS randomized interventional trial

Scott L. Weiss[1,2*], Fran Balamuth[2,3], Elliot Long[4,5,6], Graham C. Thompson[7], Katie L. Hayes[2], Hannah Katcoff[8], Marlena Cook[3], Elena Tsemberis[3], Christopher P. Hickey[2], Amanda Williams[4], Sarah Williamson-Urquhart[7], Meredith L. Borland[9], Stuart R. Dalziel[10], Ben Gelbart[5,6,11,12], Stephen B. Freedman[13], Franz E. Babl[4,5,6], Jing Huang[3,14], Nathan Kuppermann[15] and for the Pragmatic Pediatric Trial of Balanced Versus Normal Saline Fluid in Sepsis (PRoMPT BOLUS) Investigators of the PECARN, PERC, and PREDICT Networks

Abstract

Background/aims: Despite evidence that preferential use of balanced/buffered fluids may improve outcomes compared with chloride-rich 0.9% saline, saline remains the most commonly used fluid for children with septic shock. We aim to determine if resuscitation with balanced/buffered fluids as part of usual care will improve outcomes, in part through reduced kidney injury and without an increase in adverse effects, compared to 0.9% saline for children with septic shock.

A trial to determine whether septic shock-reversal is quicker in pediatric patients randomized to an early goal-directed fluid-sparing strategy versus usual care (SQUEEZE): study protocol for a pilot randomized controlled trial

Melissa J. Parker[1,2,3*], Lehana Thabane[1,2,4,5], Alison Fox-Robichaud[6], Patricia Liaw[6], Karen Choong[1,2]
For the Canadian Critical Care Trials Group and the Canadian Critical Care Translational Biology Group

Parker *et al. Trials* (2016) 17:556
DOI 10.1186/s13063-016-1689-2

Start 2017

403 pazienti arruolati

Patient has received initial fluid resuscitation of:

Minimum of 40 mL/kg of isotonic crystalloid (0.9% Normal Saline and/or Ringer's Lactate) and/or colloid (5% albumin) as fluid boluses within the previous 6 hours

Conclusioni

- ✓ I fluidi nello shock si inseriscono in un processo fisiopatologico complesso
- ✓ La richiesta di fluidi dipende dal tipo e dalla fase dello shock
- ✓ I fluidi vanno somministrati con la stessa cautela dei farmaci
- ✓ L'effetto dei fluidi va attentamente monitorato

"I proceed with much caution injecting ounce by ounce of fluid, closing observing the patient"

Thomas Latta 1832