Prise en charge du choc septique de l'enfant

XVIIème journée des pédiatres des urgences
28 Septembre 2016
Paris

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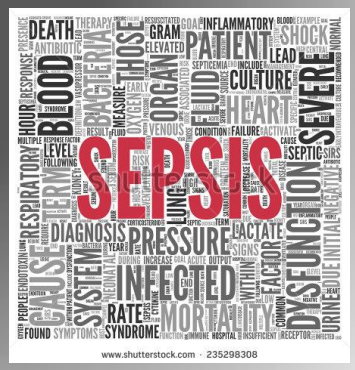
Ecole Doctorale Biologie Santé, Université de Lille 2

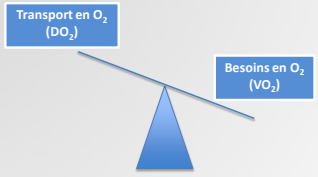


Plan

1. Introduction
2. Définition
3. Early goal directed therapy
4. Algorithme de prise en charge
5. Conclusions

1- Introduction

Le choc, c'est quoi?



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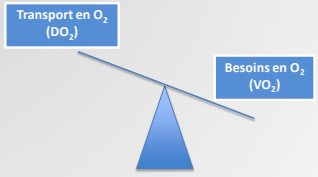
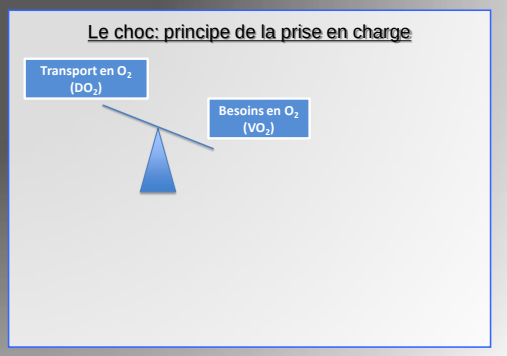
Le choc, c'est quoi?



Le transport en O2 est insuffisant pour satisfaire aux besoins cellulaires en O2

1- Introduction

Le choc: principe de la prise en charge



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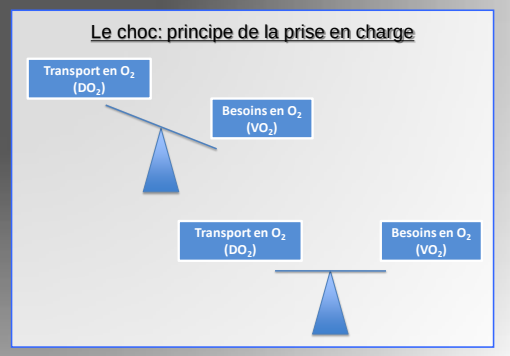

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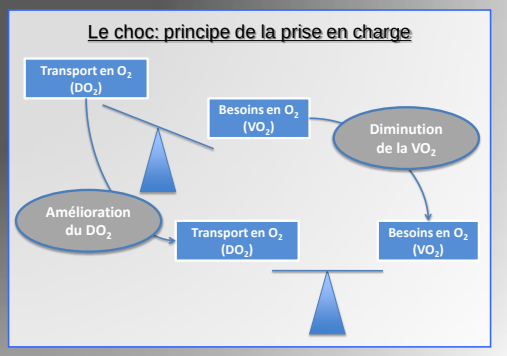

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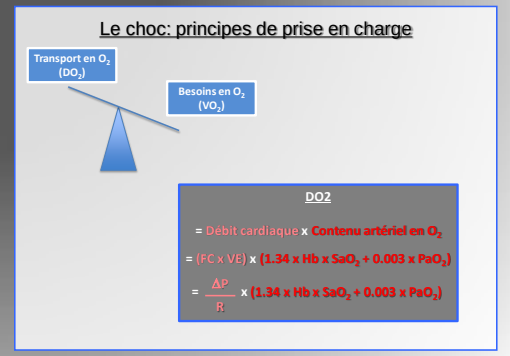
Le choc: principes de prise en charge



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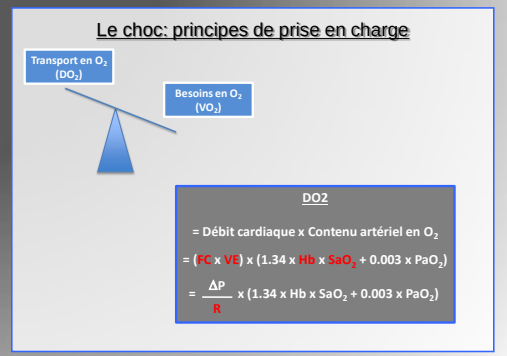
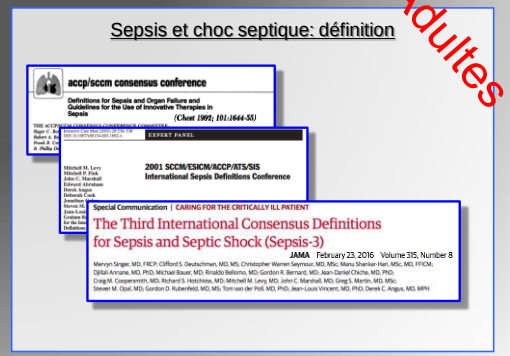


2- Définition du choc septique

Sepsis et choc septique: définition

Adultes



2- Définition du choc septique

Adultes

Sepsis et choc septique: définition: Sepsis-3

- Disparition de la notion de sepsis sévère
- Choc septique:
  - Sous-catégorie de sepsis
  - Anomalies circulatoires et cellulaires/métaboliques suffisamment sévères pour augmenter la mortalité
  - Diagnostic:
    - Sepsis
    - Malgré réanimation liquidienne adéquate:
      - Besoin de vasopresseurs pour MAP ≥ 65mmHg
      - Lactate > 2mmol/L (18mg/dL)

JAMA February 23, 2016 Volume 315, Number 8

2- Définition du choc septique

Adultes

Sepsis et choc septique: définition: Sepsis-3

« *The task force focused on adult patients yet recognizes the need to develop similar updated definitions for pediatric populations and the use of clinical criteria that take into account their age-dependent variation in normal physiologic ranges and in patho-physiologic responses* »

JAMA February 23, 2016 Volume 315, Number 8

2- Définition du choc septique

Special Article

International pediatric sepsis consensus conference: Definitions for sepsis and organ dysfunction in pediatrics*

Pediatr Crit Care Med 2005 Vol. 6, No. 1

Ibrahim Goldstein, MD; Brett Giroir, MD; Adrienne Randolph, MD; and the Members of the International Consensus Conference on Pediatric Sepsis

*SIRS**

The presence of at least two of the following four criteria, one of which must be abnormal temperature or leukocyte count:

- Core† temperature of >38.5°C or <36°C.
- Tachycardia, defined as a mean heart rate >2 so above normal for age in the absence of external stimulus, chronic drugs, or painful stimuli; or otherwise unexplained persistent elevation over a 0.5- to 4-hr time period OR for children <1 yr old: bradycardia, defined as a mean heart rate <10th percentile for age in the absence of external vagal stimulus, β-blocker drugs, or congenital heart disease; or otherwise unexplained persistent depression over a 0.5-hr time period.
- Mean respiratory rate >2 so above normal for age or mechanical ventilation for an acute process not related to underlying neuromuscular disease or the receipt of general anesthesia.
- Leukocyte count elevated or depressed for age (not secondary to chemotherapy-induced leukopenia) or >10% immature neutrophils.

Infection

A suspected or proven (by positive culture, tissue stain, or polymerase chain reaction test) infection caused by any pathogen OR a clinical syndrome associated with a high probability of infection. Evidence of infection includes positive findings on clinical exam, imaging, or laboratory tests (e.g., white blood cells in a normally sterile body fluid, perforated viscus, chest radiograph consistent with pneumonia, petechial or purpuric rash, or purpura fulminans)

Sepsis

SIRS in the presence of or as a result of suspected or proven infection.

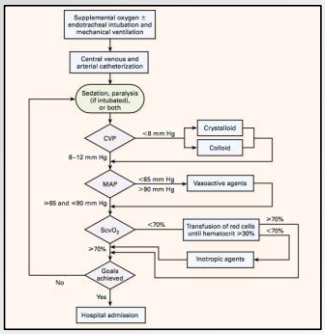
Severe sepsis

Sepsis plus one of the following: cardiovascular organ dysfunction OR acute respiratory distress syndrome OR two or more other organ dysfunctions. Organ dysfunctions are defined in Table 4.

Septic shock

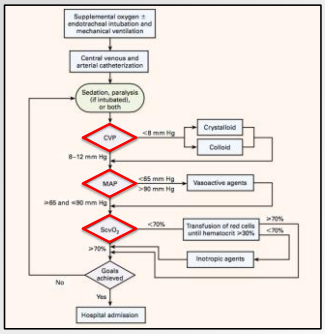
Sepsis and cardiovascular organ dysfunction as defined in Table 4.

3- Early Goal Directed Therapy



N Engl J Med, Vol. 345, No. 19 · November 8, 2001

3- Early Goal Directed Therapy



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3- Early Goal Directed Therapy

TABLE 3. KAPLAN–MEIER ESTIMATES OF MORTALITY AND CAUSES OF IN-HOSPITAL DEATH.*

VARIABLE	STANDARD THERAPY (N=133)	EARLY GOAL-DIRECTED THERAPY (N=130)	RELATIVE RISK (95% CI)	P VALUE
	no. (%)			
In-hospital mortality†				
All patients	61 (46.5)	39 (30.5)	0.58 (0.38–0.87)	0.009
Patients with severe sepsis	19 (30.8)	9 (14.8)	0.46 (0.21–1.03)	0.06
Patients with septic shock	40 (56.8)	29 (42.3)	0.60 (0.36–0.98)	0.04
Patients with sepsis syndrome	44 (45.4)	35 (35.1)	0.66 (0.42–1.04)	0.07
28-Day mortality†	61 (49.2)	40 (33.3)	0.58 (0.39–0.87)	0.01
60-Day mortality†	70 (56.9)	50 (44.3)	0.67 (0.46–0.96)	0.03
Causes of in-hospital death‡				
Sudden cardiovascular collapse	25/119 (21.0)	12/117 (10.3)	—	0.02
Multiorgan failure	26/119 (21.8)	19/117 (16.2)	—	0.27

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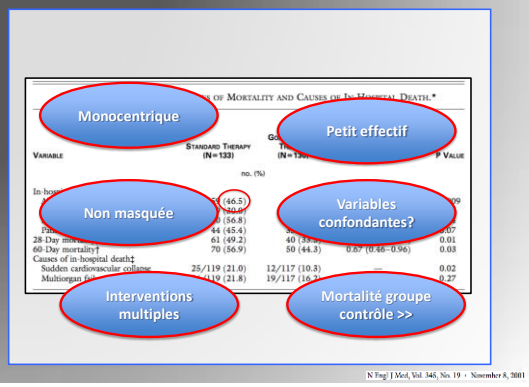
3- Early Goal Directed Therapy



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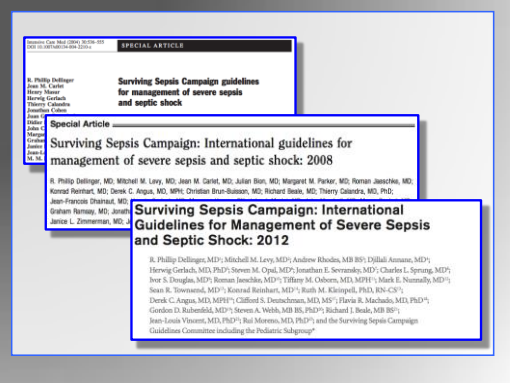

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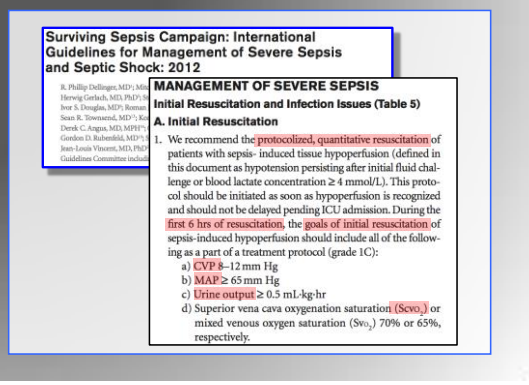

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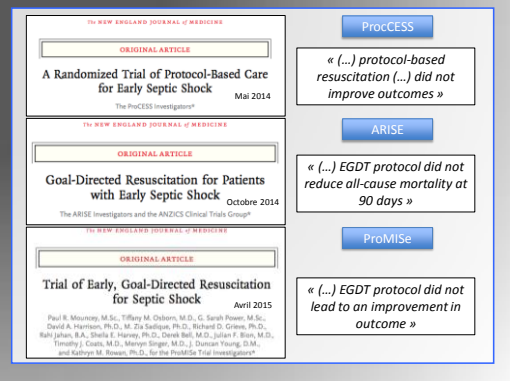

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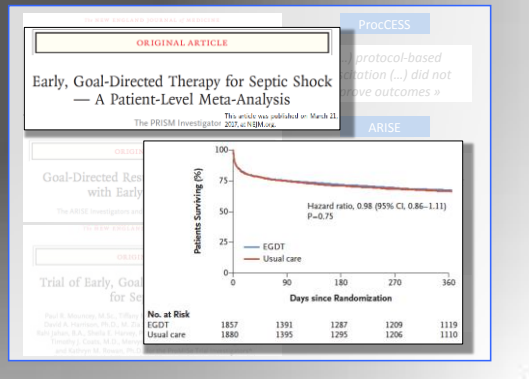

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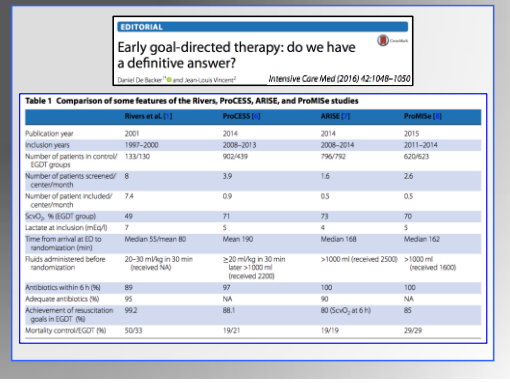


3- Early Goal Directed Therapy


American Journal of Emergency Medicine 34 (2016) 292–294

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Controversies

The end of early-goal directed therapy?*,**

Sameer Sharif, MD*, Julian J. Owen, MD, Suneel Upadhye, MD, MSc

Department of Medicine, McMaster University, Hamilton, ON, Canada

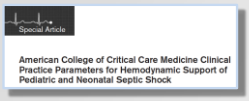
« Ces 3 études confirment qu'une EGDT invasive aux urgences n'est pas nécessaire pour réduire la mortalité du sepsis,
POUR AUTANT QUE
il y ait une reconnaissance précoce du sepsis, une réanimation liquidienne adéquate, une antibiothérapie précoce à large spectre et un transfert vers une unité adaptée »

3- Early Goal Directed Therapy

Chez l'enfant?

3- Early Goal Directed Therapy

Chez l'enfant?

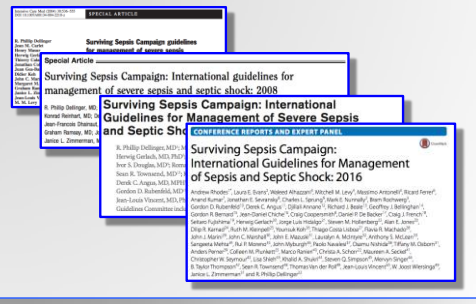

Special Article

American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

« Goal-directed therapy to achieve an ScvO2 greater than 70% is associated with improved outcome »

4- Prise en charge du choc septique

Sepsis et choc septique: survival sepsis campaign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Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock: 2008

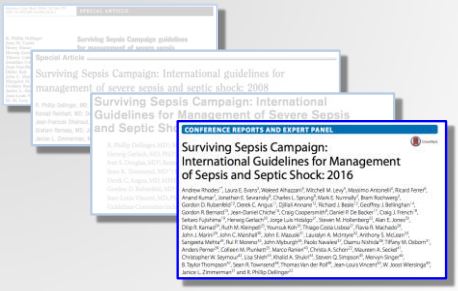
Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock

CONFERENCE REPORTS AND EXPERT PANEL

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

4- Prise en charge du choc septique

Sepsis et choc septique: survival sepsis campaign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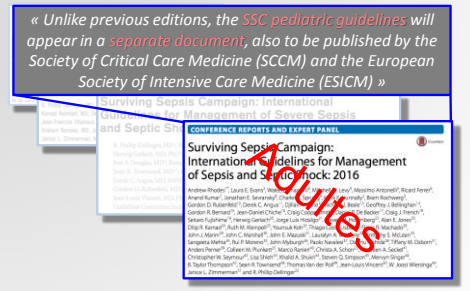
4- Prise en charge du choc septique

Sepsis et choc septique: survival sepsis campaign

« Unlike previous editions, the SSC pediatric guidelines will appear in a separate document, also to be published by the Society of Critical Care Medicine (SCCM) and the European Society of Intensive Care Medicine (ESICM) »


Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock

CONFERENCE REPORTS AND EXPERT PANEL

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Adultes

4- Prise en charge du choc septique

Recommandations pédiatriques disponibles en septembre 2017

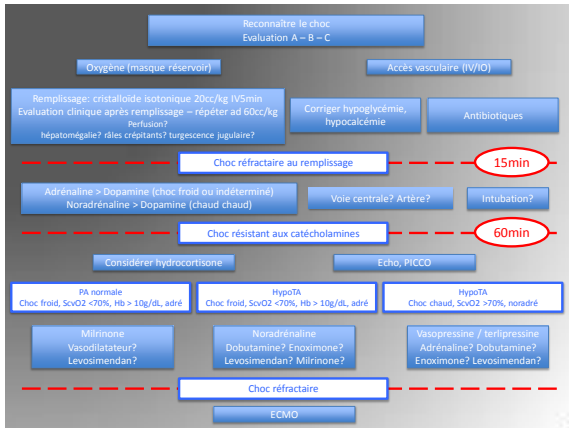
Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012

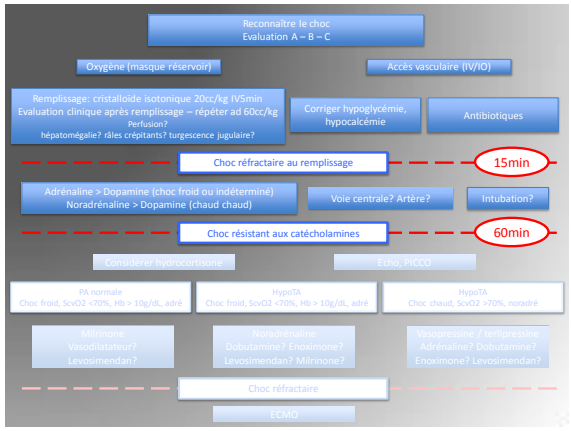
R. Phillip Dellinger, MD[1]; Mitchell M. Levy, MD[2]; Andrew Rhodes, MB BS[3]; Djillali Annane, MD[4]; Herwig Gerlach, MD, PhD[5]; Steven M. Opal, MD[6]; Jonathan E. Sevransky, MD[7]; Charles L. Sprung, MD[8]; Ivor S. Douglas, MD[9]; Roman Jaeschke, MD[10]; Tiffany M. Osborn, MD, MPH[11]; Mark E. Nunnally, MD[12]; Sean R. Townsend, MD[13]; Konrad Reinhart, MD[14]; Ruth M. Kleinpell, PhD, RN-CS[15]; Derek C. Angus, MD, MPH[16]; Clifford S. Deutschman, MD, MS[17]; Flavia R. Machado, MD, PhD[18]; Gordon D. Rubenfeld, MD[19]; Steven A. Webb, MB BS, PhD[20]; Richard J. Beale, MB BS[21]; Jean-Louis Vincent, MD, PhD[22]; Rui Moreno, MD, PhD[23]; and the Surviving Sepsis Campaign Guidelines Committee including the Pediatric Subgroup*

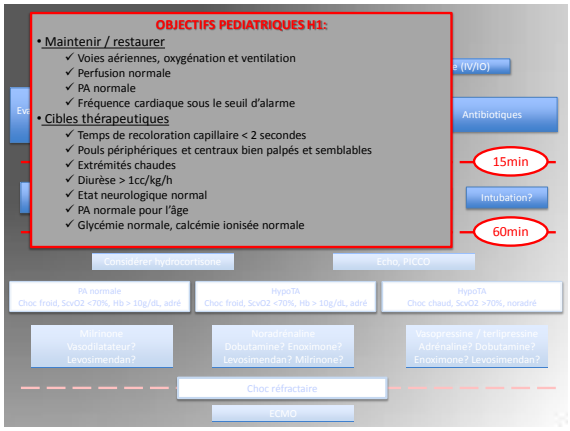
Special Article

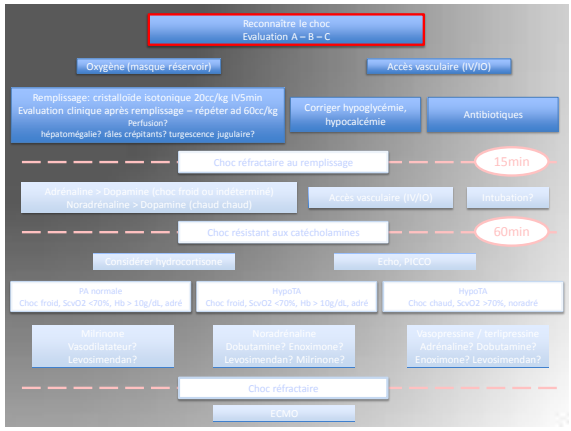
(Crit Care Med 2017; 45:1061–1093)

American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock









4- Prise en charge du choc septique: première heure

Approche systématisée: A – B – C

A = Airway
- Libre et sûr?
- A risque d'obstruction?
- Obstrué?

4- Prise en charge du choc septique: première heure

Approche systématisée: A – B – C

A = Airway
- Libre et sûr?
- A risque d'obstruction?
- Obstrué?

B = Breathing: FVTO
- Fréquence respiratoire?
- Volume?
- Travail?
- Oxygénation?

4- Prise en charge du choc septique de l'enfant: première heure

Approche systématisée: A – B – C

A = Airway
- Libre et sûr?
- A risque d'obstruction?
- Obstrué?

B = Breathing: FVTO
- Fréquence respiratoire?
- Volume?
- Travail?
- Oxygénation?

C = Circulation: FC – 4P
- Fréquence cardiaque?
- Précharge?
- Pouls?
- Perfusion cutanée?
- Pression artérielle?

4- Prise en charge du choc septique: première heure

B = Breathing

Fréquence, Volume, Travail, Oxygnéation

Age	Fréquence respiratoire normale (limite supérieure)
1 mois	35 (55)
1 an	30 (40)
2 ans	25 (30)
6 ans	20 (25)
12 ans	15 (20)

Oxygénation: SpO2
- Prise en charge initiale (choc): O2 masque réservoir, 15L/min
- Place de l'oxygène à haut débit?
- Ensuite: à titrer pour SpO2 94-98%

4- Prise en charge du choc septique: première heure

A & B = place de l'intubation?

QUAND?
- Rarement une priorité initiale!
- Pas clair dans les guidelines…
- Indications possibles:
  - Maladie de base (pneumonie p.ex.)
  - Altération de la conscience
  - Choc résistant au remplissage et/ou à de petites doses de vasopresseur/inotrope

4- Prise en charge du choc septique: première heure

A & B = place de l'intubation?

QUAND?
- Rarement une priorité initiale!
- P…
- In…

AVANTAGES?
- Protection de l'airway
- Optimalisation de l'oxygénation / de la ventilation
- Analgo-sédation → diminution de la consommation en oxygène
- Diminution de la post-charge du VG

4- Prise en charge du choc septique: première heure

A & B = place de l'intubation?

QUAND?
- Rarement une priorité initiale!
- Pas clair dans les guidelines
- Indications possibles:
  - Protection de l'airway
  - Optimalisation de l'oxygénation
  - Analgo-sédation

AVANTAGES?

INCONVENIENTS?
- Instabilité hémodynamique lors de l'analgo-sédation
- Majoration des pressions intrathoraciques → diminution du retour veineux systémique → instabilité si volémie inadéquate
- Augmentation de la post-charge du ventricule droit
- Risque infectieux
- Baro- / Volotraumatisme induit par la ventilation

4- Prise en charge du choc septique: première heure

A & B = place de l'intubation?

QUAND?
- Rarement une priorité initiale!
- Pas clair dans les guidelines
- Indications possibles:
  - Protection de l'airway
  - Optimalisation de l'oxygénation
  - Analgo-sédation

AVANTAGES?

INCONVENIENTS?
- Instabilité hémodynamique lors de l'analgo-sédation
- Majoration des pressions intrathoraciques → diminution du retour veineux systémique → instabilité si volémie inadéquate
- Augmentation de la post-charge du ventricule droit
- Risque infectieux
- Baro- / Volotraumatisme induit par la ventilation

COMMENT?
- Remplissage préalable, inotrope +/- vasopresseur
- Eviter l'étomidate (bloc surrénalien)
- Kétamine
- Fentanyl, Sufentanyl
- Atropine?
- Curare?

4- Prise en charge du choc septique: première heure

C = Circulation

Importance fondamentale de reconnaître la mauvaise circulation!

Comment?

4- Prise en charge du choc septique: première heure

C = Circulation

Importance fondamentale de reconnaître la mauvaise circulation!

Comment?

Fréquence cardiaque, pouls, signes de précharge, PA

Evaluation neurologique (perfusion cérébrale), **diurèse** (perfusion rénale)

4- Prise en charge du choc septique: première heure

C = Circulation

Importance fondamentale de reconnaître la mauvaise circulation!

Comment?

Fréquence cardiaque, pouls, signes de précharge, PA

Evaluation neurologique (perfusion cérébrale), **diurèse** (perfusion rénale)

Age	FC normale (limite sup.)	PAsyst normale (limite inf.)	PAmoy normale (limite inf.)
1 mois	120 (175)	60 (50)	45 (35)
1 an	110 (170)	80 (70)	55 (40)
2 ans	100 (160)	90 + 2 x âge (70 + 2 x âge)	55 + 1.5 x âge (40 + 1.5 x âge)
6 ans	90 (130)	90 + 2 x âge (70 + 2 x âge)	55 + 1.5 x âge (40 + 1.5 x âge)
12 ans	80 (100)	120 (90)	80 (65)

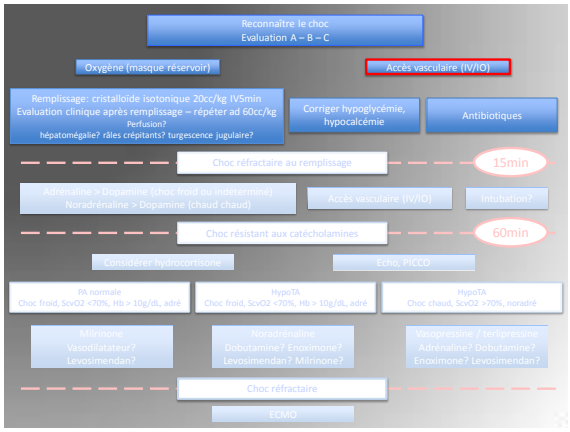
4- Prise en charge du choc septique: première heure

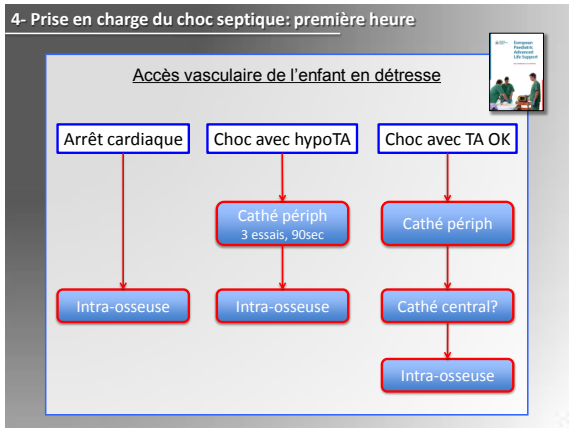
C = Circulation

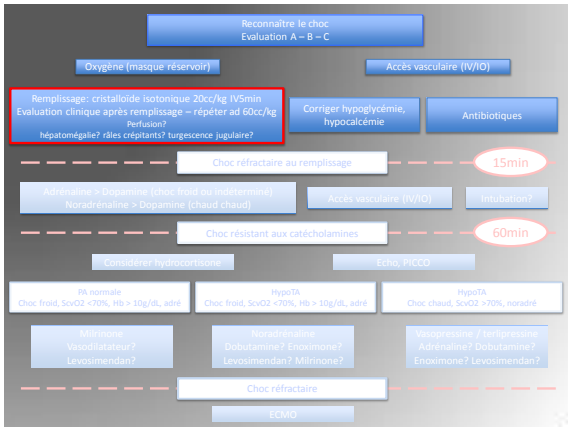
Importance fondamentale de reconnaître la mauvaise circulation!

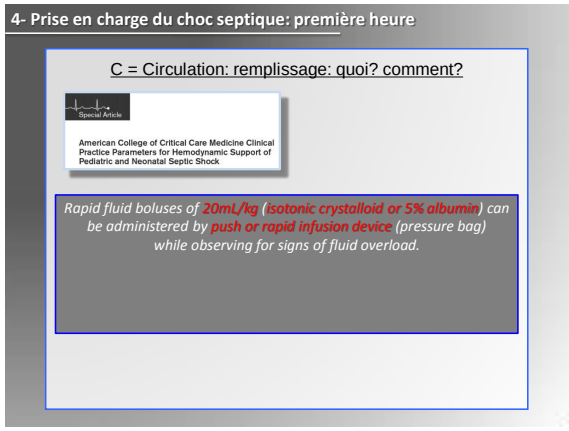
Signes de mauvaise circulation sans signe de précharge augmentée?

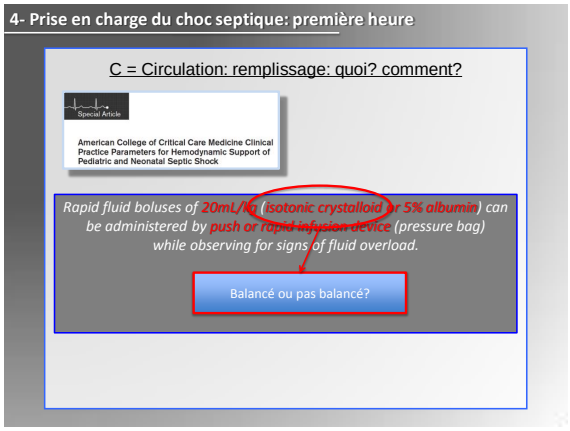
→ REMPLISSAGE


Reconnaître le choc
Evaluation A – B – C
Oxygène (masque réservoir)
Accès vasculaire (IV/IO)
Remplissage: cristalloïde isotonique 20cc/kg IVSmin
Evaluation clinique après remplissage – répéter ad 60cc/kg
Perfusion?
hépatomégalie? râles crépitants? turgescence jugulaire?
Corriger hypoglycémie, hypocalcémie
Antibiotiques
Choc réfractaire au remplissage
15min
Adrénaline > Dopamine (choc froid ou indéterminé)
Noradrénaline > Dopamine (chaud chaud)
Accès vasculaire (IV/IO)
Intubation?
Choc résistant aux catécholamines
60min
Considérer hydrocortisone
Echo, PICCO
PA normale
Choc froid, ScvO2 <70%, Hb > 10g/dL, adré
HypoTA
Choc froid, ScvO2 <70%, Hb > 10g/dL, adré
HypoTA
Choc chaud, ScvO2 >70%, noradré
Milrinone
Vasodilatateur?
Levosimendan?
Noradrénaline
Dobutamine? Enoximone?
Levosimendan? Milrinone?
Vasopressine / terlipressine
Adrénaline? Dobutamine?
Enoximone? Levosimendan?
Choc réfractaire
ECMO


4- Prise en charge du choc septique: première heure
Accès vasculaire de l'enfant en détresse
Arrêt cardiaque
Choc avec hypoTA
Choc avec TA OK
Cathé périph
3 essais, 90sec
Cathé périph
Intra-osseuse
Intra-osseuse
Cathé central?
Intra-osseuse


Reconnaître le choc
Evaluation A – B – C
Oxygène (masque réservoir)
Accès vasculaire (IV/IO)
Remplissage: cristalloïde isotonique 20cc/kg IVSmin
Evaluation clinique après remplissage – répéter ad 60cc/kg
Perfusion?
hépatomégalie? râles crépitants? turgescence jugulaire?
Corriger hypoglycémie, hypocalcémie
Antibiotiques
Choc réfractaire au remplissage
15min
Adrénaline > Dopamine (choc froid ou indéterminé)
Noradrénaline > Dopamine (chaud chaud)
Accès vasculaire (IV/IO)
Intubation?
Choc résistant aux catécholamines
60min
Considérer hydrocortisone
Echo, PICCO
PA normale
Choc froid, ScvO2 <70%, Hb > 10g/dL, adré
HypoTA
Choc froid, ScvO2 <70%, Hb > 10g/dL, adré
HypoTA
Choc chaud, ScvO2 >70%, noradré
Milrinone
Vasodilatateur?
Levosimendan?
Noradrénaline
Dobutamine? Enoximone?
Levosimendan? Milrinone?
Vasopressine / terlipressine
Adrénaline? Dobutamine?
Enoximone? Levosimendan?
Choc réfractaire
ECMO


4- Prise en charge du choc septique: première heure
C = Circulation: remplissage: quoi? comment?
Special Article
American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock
Rapid fluid boluses of 20mL/kg (isotonic crystalloid or 5% albumin) can be administered by push or rapid infusion device (pressure bag) while observing for signs of fluid overload.


4- Prise en charge du choc septique: première heure
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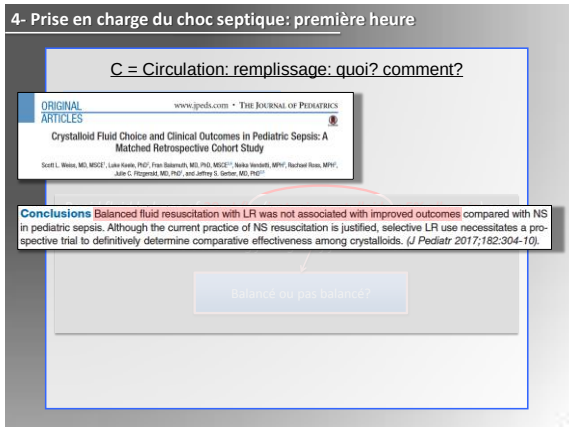
Balancé ou pas balancé?


4- Prise en charge du choc septique: première heure
C = Circulation: remplissage: quoi? comment?
ORIGINAL ARTICLES
www.jpeds.com • The Journal of Pediatrics
Crystalloid Fluid Choice and Clinical Outcomes in Pediatric Sepsis: A Matched Retrospective Cohort Study
Conclusions Balanced fluid resuscitation with LR was not associated with improved outcomes compared with NS in pediatric sepsis. Although the current practice of NS resuscitation is justified, selective LR use necessitates a prospective trial to definitively determine comparative effectiveness among crystalloids. (J Pediatr 2017;182:304-10).
Balancé ou pas balancé?

4- Prise en charge du choc septique: première heure

C = Circulation: remplissage: quoi? comment?

Resuscitation With Balanced Fluids Is Associated With Improved Survival in Pediatric Severe Sepsis

Elizabeth T. Emrath, MD[1]; James D. Fortenberry, MD, MCCM[1,2]; Curtis Travers, MPH[3]; Courtney E. McCracken, PhD[3]; Kiran B. Hebbar, MD, FCCM[1,2]

Conclusions: In this retrospective analysis carried out by propensity matching, exclusive use of balanced fluids in pediatric severe sepsis patients for the first 72 hours of resuscitation was associated with improved survival, decreased prevalence of acute kidney injury, and shorter duration of vasoactive infusions when compared with exclusive use of unbalanced fluids. (*Crit Care Med* 2017; XX:00–00)

4- Prise en charge du choc septique: première heure

C = Circulation: remplissage: quoi? comment?

Special Article

American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

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Balancé ou pas balancé?

4- Prise en charge du choc septique: première heure

C = Circulation: remplissage: quoi? comment?

Special Article

American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

Rapid fluid boluses of 20mL/kg (isotonic crystalloid or 5% albumin) can be administered by push or rapid infusion device (pressure bag) while observing for signs of fluid overload.
In the absence of these clinical signs, children can require 40-60mL/kg in the first hour.

4- Prise en charge du choc septique: première heure

C = Circulation: remplissage: quoi? comment?

Special Article

American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

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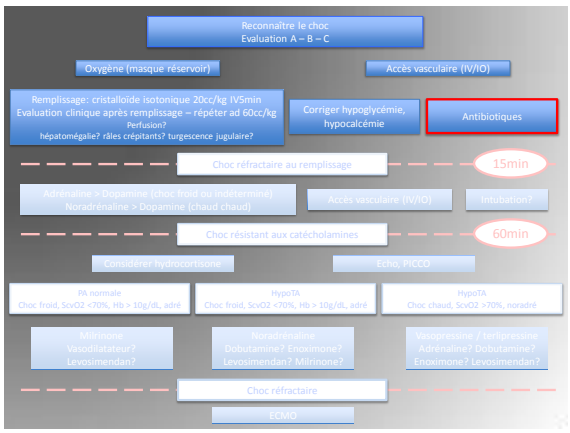
In the absence of these clinical signs, children can require 40-60mL/kg in the first hour.
Fluid can be pushed with the goal of attaining normal perfusion and blood pressure.



4- Prise en charge du choc septique: première heure

Antibiotiques

Special Article

American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

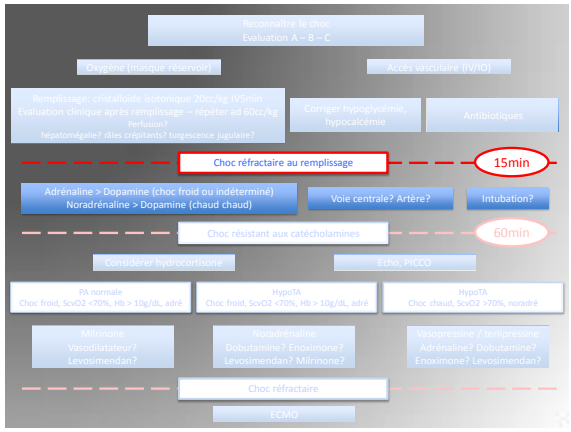
Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012

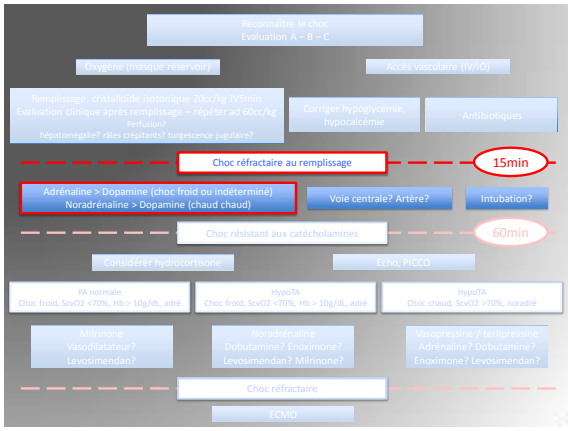
- Antibiothérapie à large spectre au maximum 1 heure après l'identification du choc septique.
- Faire des cultures avant d'administrer les antibiotiques, mais ne pas retarder l'administration de l'antibiotique
- Antibiotique à choisir selon foyer infectieux et épidémiologie locale
- Clindamycine si choc toxique avec hypotension artérielle
- + Contrôle rapide et agressif de la source (fasciite, abcès, empyème,…)

4- Prise en charge du choc septique: première heure

Antibiotiques: exemples de traitement empirique

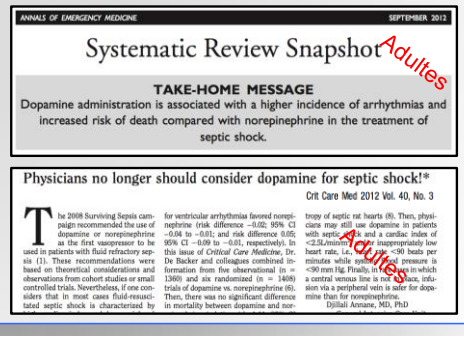
Age	Antibiothérapie
0-1 mois	Ampicilline + Gentamicine Ampicilline + Cefotaxime
1-3 mois	Cefotaxime + Ampicilline (+/- vancomycine si méningite)
> 3 mois	Céphalosporine 3ème génération (+/- vancomycine si méningite)
Immunodéficience	Antibiothérapie à large spectre Piperacillin-Tazobactam + Aminoside
Voie centrale et autre matériel	Ajouter Vancomycine





4- Prise en charge du choc septique: première heure

Vasopresseur / inotrope: quelles molécules?


ANNALS OF EMERGENCY MEDICINE — SEPTEMBER 2012

Systematic Review Snapshot

Adultes

TAKE-HOME MESSAGE

Dopamine administration is associated with a higher incidence of arrhythmias and increased risk of death compared with norepinephrine in the treatment of septic shock.

Physicians no longer should consider dopamine for septic shock!*

Crit Care Med 2012 Vol. 40, No. 3

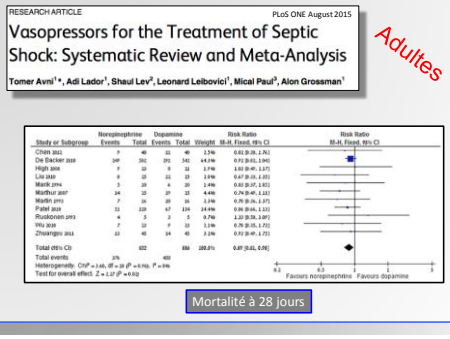
The 2008 Surviving Sepsis campaign recommended the use of dopamine or norepinephrine as the first vasopressor to be used in patients with fluid refractory sepsis (1). These recommendations were based on theoretical considerations and observations from cohort studies or small controlled trials. Nevertheless, if one considers that in most cases fluid-resuscitated septic shock is characterized by ... for ventricular arrhythmias favored norepinephrine (risk difference −0.02; 95% CI −0.04 to −0.01; and risk difference 0.05; 95% CI −0.09 to −0.01, respectively). In this issue of *Critical Care Medicine*, Dr. De Backer and colleagues combined information from five observational (n = 1360) and six randomized (n = 1408) trials of dopamine vs. norepinephrine (6). Then, there was no significant difference in mortality between dopamine and nortropy of septic rat hearts (8). Then, physicians may still use dopamine in patients with septic shock and a cardiac index of <2.5L/min/m² or inappropriately low heart rate, i.e., bradycardia <90 beats per minutes while systolic blood pressure is <90 mm Hg. Finally, in those cases in which a central venous line is not in place, infusion via a peripheral vein is safer for dopamine than for norepinephrine.

Djillali Annane, MD, PhD

Adultes

4- Prise en charge du choc septique: première heure

Vasopresseur / inotrope: quelles molécules?


RESEARCH ARTICLE — PLoS ONE August 2015

Vasopressors for the Treatment of Septic Shock: Systematic Review and Meta-Analysis

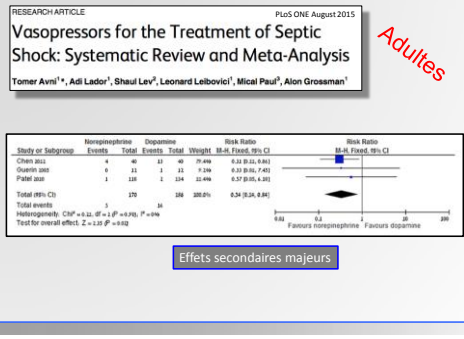
Tomer Avni[1]*, Adi Lador[1], Shaul Lev[2], Leonard Leibovici[1], Mical Paul[3], Alon Grossman[1]

Adultes

Mortalité à 28 jours

4- Prise en charge du choc septique: première heure

Vasopresseur / inotrope: quelles molécules?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Adultes

Effets secondaires majeurs

4- Prise en charge du choc septique: première heure

Vasopresseur / inotrope: quelles molécules?

RESEARCH ARTICLE PLoS ONE August 2015

Vasopressors for the Treatment of Septic Shock: Systematic Review and Meta-Analysis

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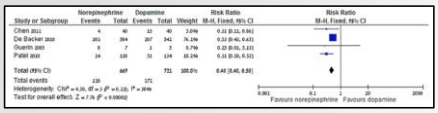
Adultes



Arythmies

4- Prise en charge du choc septique: première heure

Vasopresseur / inotrope: quelles molécules?

Special Article

American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

	Inotrope	Vasodilatateur	Vasoconstricteur
Adrénaline	0.05-0.3µg/kg/min	0.05-0.3µg/kg/min	>0.3µg/kg/min
Dobutamine	1-20µg/kg/min	1-20µg/kg/min	NON
Dopamine	5-10µg/kg/min	5-10µg/kg/min	>10µg/kg/min
Milrinone	0.4-0.8µg/kg/min	0.4-0.8µg/kg/min	NON
Noradrénaline	+/-	NON	++
Vasopressine / terlipressine	NON	NON	+++

4- Prise en charge du choc septique: première heure

Vasopresseur / inotrope: quelles molécules?

Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012

- « Choc froid »: dopamine
- « Choc chaud »: noradrénaline
- « Choc froid »:
  - Adrénaline en seconde intention
  - Dobutamine en 3ème intention

MAIS…

4- Prise en charge du choc septique: première heure

Vasopresseur / inotrope: quelles molécules?

Crit Care Med. 1998 Sep;24(9):1580-90.

Anterior pituitary function during critical illness and dopamine treatment.

Van den Berghe G[1], de Zegher F.

Author information

Abstract

OBJECTIVE: To summarize the available data on anterior pituitary function in critical illness and to focus on the endocrine effects of **dopamine** infusion. The analogy with anterior pituitary function in the elderly is highlighted, and the potential importance of these observations for recovery from critical illness is discussed.

DATA SOURCES: Computerized search of published research and reference list review.

CONCLUSIONS: The **dopamine**-induced or aggravated pituitary dysfunction in critical illness warrants caution with prolonged infusion of this catecholamine as a so-called supportive agent, particularly in early life. The potential of combined hormonal therapy to improve the metabolic and immune status of the critically ill patient deserves thorough investigation.

DATA SYNTHESIS: The different pituitary axes are important determinants of normal anabolism and immune function. Continuously increased serum cortisol concentrations, insulin resistance, blunted prolactin release, and attenuated pulsatility of growth hormone and luteinizing hormone secretory patterns, as well as multiple anomalies in the thyroid axis, characterize the endocrine profile of prolonged critical illness. **Dopamine**, a natural catecholamine with hypophysiotropic properties, which has been used for more than two decades as an inotropic and vasoactive drug in intensive care, suppresses the circulating concentrations of all anterior pituitary-dependent hormones, except for cortisol. Available evidence suggests that the major effect of **dopamine** administration on the endocrine system is unlikely to be beneficial for the threatened metabolic and immunologic homeostasis of the severely ill patient. This pattern of hypopituitarism induced by chronic, severe illness and exogenous **dopamine** administration is reminiscent of the hormonal profiles obtained in experimental models of chronic stress, suggesting that endogenous **dopamine** may play a role in the endocrine and metabolic response to critical illness.

CONCLUSIONS: The **dopamine**-induced or aggravated pituitary dysfunction in critical illness warrants caution with prolonged infusion of this catecholamine as a so-called supportive agent, particularly in early life. The potential of combined hormonal therapy to improve the metabolic and immune status of the critically ill patient deserves thorough investigation.

4- Prise en charge du choc septique: première heure

Vasopresseur / inotrope: quelles molécules?

Epinephrine in pediatric septic shock: Does the algorithm speak what the recommendations say?

Crit Care Med 2010 Vol. 38, No. 4

mentioned as the next-line drug if cold shock is resistant to dopamine (1). In our opinion, epinephrine should be the first-line drug, and the algorithm should stress that it is appropria inotrope by peripheral

The author replies:

I completely agree with the summation by Jain and Bansal (1). If I were to choose one drug to use as an inotrope, it would definitely be epinephrine for the reasons eloquently described in the doctor's Letter to the Editor concerning our article (2). Epinephrine can be adminis-

4- Prise en charge du choc septique: première heure

Noradrénaline en 1ère ligne chez l'enfant?

ACTA PÆDIATRICA

REGULAR ARTICLE

Noradrenaline use for septic shock in children: doses, routes of administration and complications

Table 2 Administration modalities of the main vasoactive agents

	n (%)	1st-line n (%)	2nd-line n (%)	3rd-line n (%)	PR* n (%)	Maximum dose (µg/kg/min) Mean (±SD)	Duration (hours) Median (IQR)
Dopamine	95 (66)	80 (56)	14 (10)	1 (1)	62 (65)	16.5 (±5)	6 (4-14)
Noradrenaline	144 (100)	31 (22)	58 (40)	55 (38)	27 (19)	2.5 (±2.2)	33 (10-64)
Dobutamine	123 (85)	41 (28)	66 (46)	16 (11)	57 (46)	18.4 (±5)	55 (19-87)

IQR, interquartile range.
*PR, peripheral route including peripheral venous or intra-osseous route.

4- Prise en charge du choc septique: première heure

Noradrénaline en 1ère ligne chez l'enfant?

ACTA PÆDIATRICA

REGULAR ARTICLE

Noradrenaline use for septic shock in children: doses, routes of admi

Conclusions

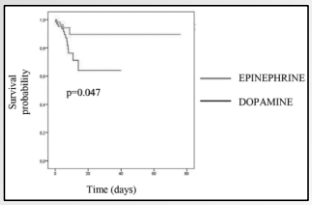
« Comme chez l'adulte, la noradrénaline pourrait être utilisée comme agent vasopresseur de 1ère intention avec ou sans dobutamine chez les enfants avec choc septique. Cependant, les données actuelles sont insuffisantes et des études prospectives sont requises pour déterminer la place réelle de la noradrénaline chez l'enfant en choc septique »

4- Prise en charge du choc septique: première heure

Adrénaline en 1ère ligne chez l'enfant?

Double-Blind Prospective Randomized Controlled Trial of Dopamine Versus Epinephrine as First-Line Vasoactive Drugs in Pediatric Septic Shock

Crit Care Med 2015; 43:2292-2302



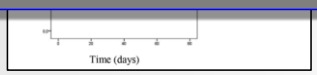
4- Prise en charge du choc septique: première heure

Adrénaline en 1ère ligne chez l'enfant?

Double-Blind Prospective Randomized Controlled Trial of Dopamine Versus Epinephrine as First-Line Vasoactive Drugs in Pediatric Septic Shock

Conclusions

« L'usage de dopamine dans cette population est associé à un risque accru de décès et d'infection. L'administration précoce d'adrénaline est sécuritaire et associée avec une survie accrue par rapport à la dopamine. Les limites de notre étude doivent être prises en considération lors de l'interprétation de nos résultats »



4- Prise en charge du choc septique: première heure

Adrénaline en 1ère ligne chez l'enfant?

Double-Blind Randomized Clinical Trial Comparing Dopamine and Epinephrine in Pediatric Fluid-Refractory Hypotensive Septic Shock*

Pediatr Crit Care Med 2016; 17:e502–e512

Outcome Measures	Epinephrine (n = 29)	Dopamine (n = 31)	Risk Ratio (95% CI)	p
Primary outcome—at end of 1 hr				
Resolution of shock*	12 (41.4%)	4 (12.9%)	3.2 (1.16–8.82)	0.019
Shock unresolved*	17	27		
Hypotensive cold shock	13	11		
Normotensive cold shock	4	16		
Heart rate normal for age*	15 (51.7)	16(51.7)	1.00 (0.59–1.7)	1.000
Blood pressure for age within normal range*	16(55.2)	20 (64.5)	0.82 (0.49–1.38)	0.599
Capillary filling time ≥ 2 s*	12 (41.4)	4 (12.9)	1.94 (1.22–3.1)	**0.019**
Urine output ≥ 1 mL/Kg/hr*	18 (62.1)	26 (83.9)	0.59 (0.37–0.97)	0.08

4- Prise en charge du choc septique: première heure

Adrénaline en 1ère ligne chez l'enfant?

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Pediatr Crit Care Med 2016; 17:e502–e512

Outcome Measures	Epinephrine (n = 29)	Dopamine (n = 31)	Risk Ratio (95% CI)	p
Sequential Organ Failure Assessment scores*				
Day 1	8 (3–12)	11 (9–12)	–	0.096
Day 2	10 (2–13)	12 (8–13)	–	0.132
Day 3	8 (2–13)	12 (6–14)	–	**0.050**
Organ failure–free days among survivors	24 (23–26)	20 (18.5–24)	–	**0.022**

4- Prise en charge du choc septique: première heure

Adrénaline en 1ère ligne chez l'enfant?

Double-Blind Randomized Clinical Trial Comparing Dopamine and Epinephrine in Pediatric Fluid-Refractory Hypotensive Septic Shock*

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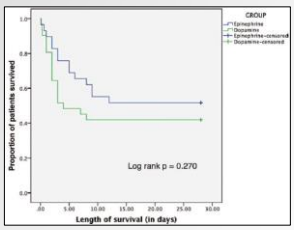


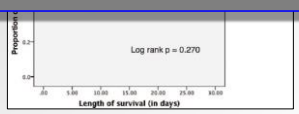
4- Prise en charge du choc septique: première heure

Adrénaline en 1ère ligne chez l'enfant?

Double-Blind Randomized Clinical Trial Comparing Dopamine and Epinephrine in Pediatric Fluid-Refractory Hypotensive Septic Shock*

Conclusions

« Notre étude montre que l'adrénaline, utilisée comme agent vaso-actif de première ligne, permet une résolution du choc froid réfractaire au remplissage plus précocément que la dopamine, et que l'usage de l'adrénaline est sécuritaire. »



4- Prise en charge du choc septique: première heure

Donc que fait-on?

American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

Choc froid → Adrénaline 0.05-0.3µg/kg/min (Dopamine 5-9µg/kg/min si adrénaline non disponible)

Choc chaud → Noradrénaline ≥0.05µg/kg/min (Dopamine ≥10µg/kg/min si noradrénaline non disponible)

4- Prise en charge du choc septique: première heure

Donc que fait-on?

American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

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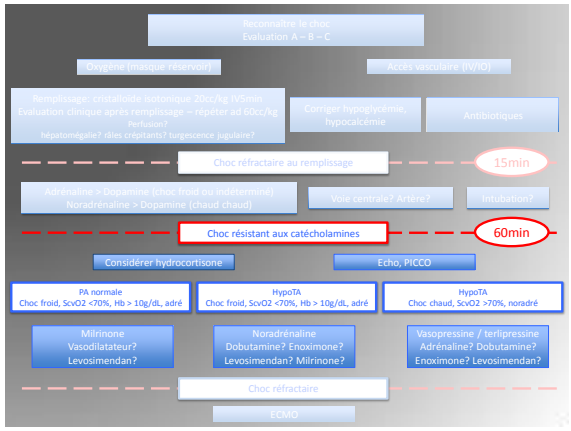
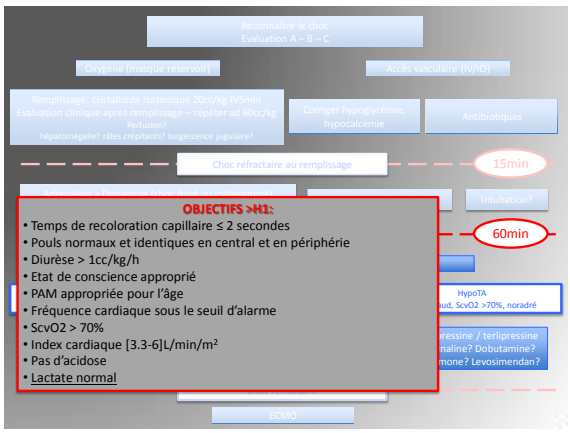
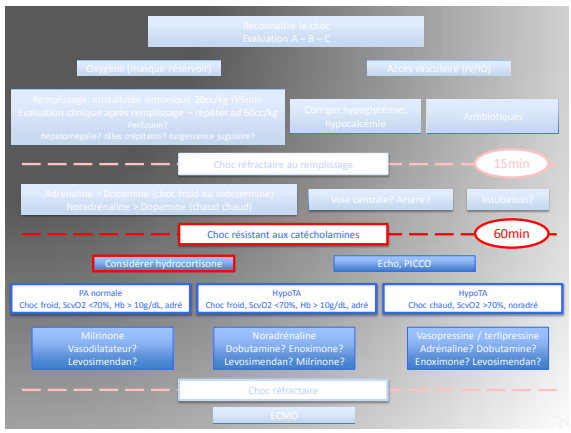
Choc chaud → Noradrénaline ≥0.05µg/kg/min (Dopamine ≥10µg/kg/min si noradrénaline non disponible)

1mg/50mL: (Poids/3)cc/h = 0.1µg/kg/min
Exemple: 9kg: 3cc/h=0.1µg/kg/min

50mg/50mL: (Poids/3)cc/h = 5µg/kg/min
Exemple: 9kg: 3cc/h = 5µg/kg/min







4- Prise en charge du choc septique: hydrocortisone?

Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012

We suggest hydrocortisone therapy in children with fluid-refractory, catecholamine-resistant shock and suspected or proven absolute adrenal insufficency

4- Prise en charge du choc septique: hydrocortisone?

Special Article

American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

- ***No gold standard*** *has been established for the diagnosis of adrenal insufficency in critical illness*
- *Patients at risk of absolute adrenal insufficiency include*
  - ✓ *Children with* ***purpura fulminans***
  - ✓ *Children who* ***previously*** *received* ***steroid therapies*** *for chronic illness*
  - ✓ *Children with* ***pituitary*** *or* ***adrenal abnormalities***
- *The pediatric literature* ***lacks large RCTs*** *evaluating the benefit of corticosteroids specifically in septic shock, and a pediatric meta-analysis evaluating the role of corticosteroids in shock did not demonstrate benefit*
- ***Hydrocortisone 100mg/m²/day*** *(max 200mg/day)*

4- Prise en charge du choc septique: hydrocortisone?

Feature Articles

(Pediatr Crit Care Med 2017; 18:503–512)

A Randomized Controlled Trial of Corticosteroids in Pediatric Septic Shock: A Pilot Feasibility Study*

- *(…) corticosteroids when hemodynamic instability persists despite aggressive fluid and vasopressor administration; however,* ***there is no clear evidence to support this practice***
- *There is currently* ***no consensus*** *on the indications, target population, or dose for the use of adjunctive corticosteroids in pediatric septic shock*

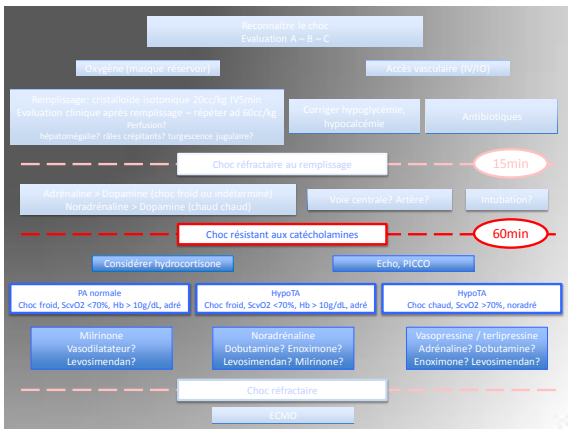
4- Prise en charge du choc septique: hydrocortisone?

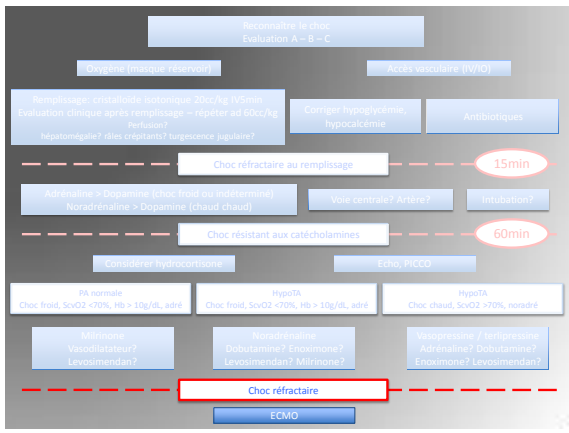
Feature Articles

(Pediatr Crit Care Med 2017; 18:503–512)

A Randomized Controlled Trial of Corticosteroids in Pediatric Septic Shock: A Pilot Feasibility Study*

- *We demonstrated that* ***enrollment*** *of patients into a trial of corticosteroids in pediatric septic shock was* ***potentially feasible***
- ***However, the lack of equipoise*** *among critical care physicians as evidenced by the frequent overall use of corticosteroids remains the most significant impediment to the recruitment of otherwise eligible patients*





4- Prise en charge du choc septique de l'enfant: choc réfractaire?

PEDIATRIC ORIGINAL

Refractory septic shock in children: a European Society of Paediatric and Neonatal Intensive Care definition

Intensive Care Med (2016) 42:1948–1957

- Computed SSS calculated as follows, (cSSS) = $1.001^{\text{VIS in mcg/kg min}} + 1.1^{\text{arterial lactate in mmol/L}} + 18$ (in the presence of myocardial dysfunction).
- Bedside SSS (bSSS) based on 5 points with coefficient ranked and rounded to have a user-friendly score:
- VIS > 200 mcg/kg min = 1 point
- Arterial lactate >8 mmol/L or its increase of 1 mmol/L after 6 h of care = 1 point
- Myocardial dysfunction as defined above = 3 points.

4- Prise en charge du choc septique de l'enfant: choc réfractaire?

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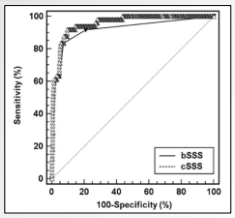

4- Prise en charge du choc septique de l'enfant: choc réfractaire?

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	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Likelihood ratio
Bedside septic shock score (bSSS)					
≥1	91.8	78.9	36.3	98.7	4.4
≥2	83.7	92.8	60.3	97.8	11.6
≥3	63.3	95.2	63.3	95.2	13.2
≥4	59.2	98.1	80.6	94.8	31.7
Computed septic shock score (cSSS)					
≥2.5	98	71.7	31.2	99.6	3.5
≥3.5	89.8	90.4	55	98.5	9.4
≥5.0	81.6	94.7	66.7	97.5	15.3
≥21	57.1	98.7	84.8	94.6	42.9

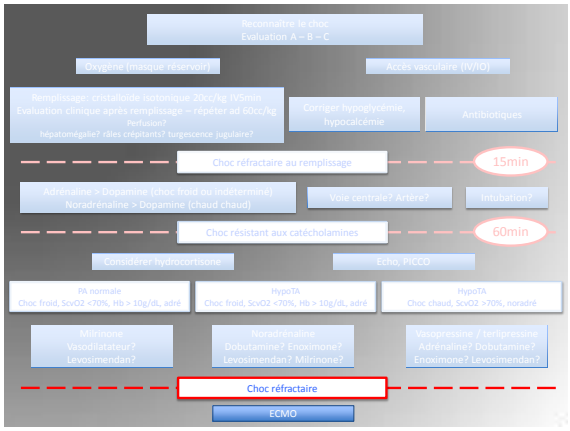
4- Prise en charge du choc septique de l'enfant: choc réfractaire?

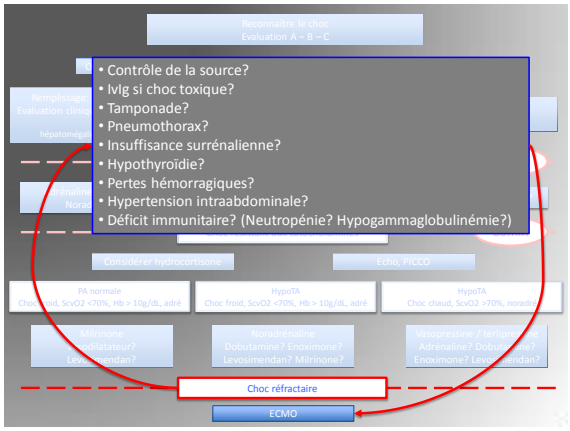
PEDIATRIC ORIGINAL

Refractory septic shock in children: a European Society of Paediatric and Neonatal Intensive Care definition

Intensive Care Med (2016) 42:1948–1957

- *We have **defined refractory septic shock** in children as the association of high blood lactate with vaso-inotrope doses associated with myocardial dysfunction.*
- *This definition is based on **two septic shock scores** showing excellent discriminative power in a multicentre validation population.*
- *The **RSS Computed Score** is a powerful and potentially useful tool to compare patients in future interventional randomized multicenter studies.*
- *The **RSS Bedside Score** is easy to calculate and may assist in determining patients who would be suitable for inclusion in clinical trials of rescue therapies.*





4- Prise en charge du choc septique: immunoglobulines?

CONFERENCE REPORTS AND EXPERT PANEL

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Adultes

We suggest against the use of IV immunoglobulins in patients with sepsis or septic shock

Cochrane Library

Cochrane Database of Systematic Reviews

Intravenous immunoglobulin for treating sepsis, severe sepsis and septic shock (Review)

Alejandría MM, Lansang MAD, Dans LF, Mantaring III JB

- Adultes: pas de bénéfice dans les études avec faible risque de biais
- Nouveau-nés: IvIg ne réduisent pas la mortalité
- Ivig enrichies en IgM: évidence insuffisante

4- Prise en charge du choc septique: immunoglobulines?

Choc toxique?

Intravenous Immunoglobulin G Therapy in Streptococcal Toxic Shock Syndrome: A European Randomized, Double-Blind, Placebo-Controlled Trial

Clinical Infectious Diseases 2003; 37:333–40

Adultes

End point	All included patients: IVIG group (n = 10)	All included patients: Placebo group (n = 11)	Patients with GAS only: IVIG group (n = 8)	Patients with GAS only: Placebo group (n = 10)
Primary: mortality day 28, no. (%) of patients	1 (10)	4 (36)	1 (12.5)	3 (30)
Secondary				
Time to resolution of shock,[a] h				
Mean	88	122	100	122
Median (range)	96 (2–159)	108 (47–294)	108 (2–159)	108 (47–294)
Time to no further progression of NF/cellulitis, h				
Mean	68[b]	36[c]	69[c]	36[c]
Median (range)	20 (2–168)[b]	24 (19–72)[c]	20 (2–168)[c]	24 (19–72)[c]
Mortality day 180, no. (%) of patients	2 (20)	4 (36)	1 (12.5)	3 (30)

4- Prise en charge du choc septique: immunoglobulines?

Choc toxique?

Clinical Efficacy of Polyspecific Intravenous Immunoglobulin Therapy in Patients With Streptococcal Toxic Shock Syndrome: A Comparative Observational Study

Clinical Infectious Diseases 2014;59(6):851–7

Adultes

Table 2. Predictors Expected to Influence Survival in Streptococcal Toxic Shock Syndrome Patients: Crude and Adjusted Results

	Simple Logistic Regression (Crude Results)		Multiple Logistic Regression (Adjusted Results)[a]	
Variable	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
SAPS	1.05 (1.0–1.1)	.007	1.1 (1.0–1.1)	.007
Clindamycin	7.5 (2.0–27.3)	.002	8.6 (1.8–40.4)	.007
IVIG	6.7 (1.7–25.7)	.006	5.6 (1.2–26.9)	.030
Surgery	4.4 (1.4–13.9)	.012	. . .	. . .

4- Prise en charge du choc septique: immunoglobulines?

Choc toxique?

EDITORIAL COMMENTARY

Assessing the Impact of Intravenous Immunoglobulin in the Management of Streptococcal Toxic Shock Syndrome: A Noble but Difficult Quest

Clinical Infectious Diseases 2003; 43:137–9

Donc, la question difficile de savoir si les IvIg sont bénéfiques pour les adultes ou pour les enfants avec choc toxique streptococcique reste non résolue

4- Prise en charge du choc septique: immunoglobulines?

Choc toxique?

EDITORIAL COMMENTARY

Assessing the Impact of Intravenous Immunoglobulin in the Management of Streptococcal Toxic Shock Syndrome: A Noble but Difficult Quest

Donc les IvIg n'ont pas de place pour la prise en charge du sepsis sévère / choc septique aux urgences, même en cas de choc toxique

streptococcique réfractaire à plusieurs de de traitement agressif ou en présence d'un foyer non drainable ou d'une oligurie persistante avec œdème pulmonaire »

4- Prise en charge du choc septique: immunoglobulines?

Choc toxique?

ClinicalTrials.gov

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Efficacy of IntraVenous ImmunoGlobulins in Toxic Shock Syndromes: a Paediatric Pilot Study (IVIG)

This study is currently recruiting participants. (see Contacts and Locations)

Verified March 2016 by Hospices Civils de Lyon

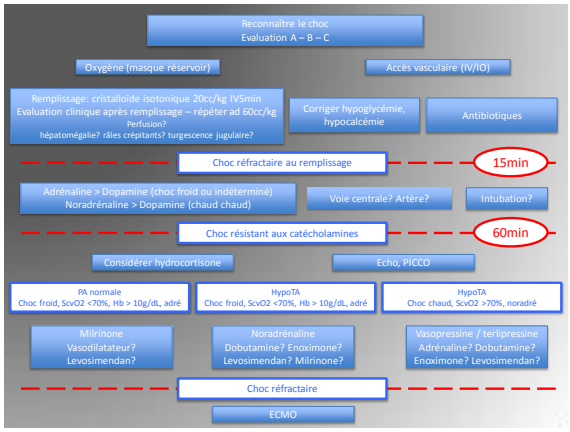
Sponsor:
Hospices Civils de Lyon

Information provided by (Responsible Party):
Hospices Civils de Lyon

ClinicalTrials.gov Identifier:
NCT02219165

First received: August 6, 2014
Last updated: March 15, 2016
Last verified: March 2016
History of Changes

Full Text View | Tabular View | No Study Results Posted | Disclaimer | How to Read a Study Record



6- Conclusions

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