Monitorage du choc septique

Dr Laurent Dupic

Journées des pédiatres aux urgences
Jeudi 28 septembre 2017

srlf

Necker

Mortality related to invasive infections, sepsis, and septic shock in critically ill children in Australia and New Zealand, 2002–13: a multicentre retrospective cohort study

Luregn J Schlapbach*, Lahn Straney*, Janet Alexander, Graeme MacLaren, Marino Festa, Andreas Schibler, Anthony Slater, for the ANZICS Paediatric Study Group†

	2002–07			2008–13			Risk		
	Deaths	Patients	Mortality (%, 95% CI)	Deaths	Patients	Mortality (%, 95% CI)	Absolute risk reduction (%)	Relative risk reduction (%)	Adjusted OR
No invasive infection	1036	37 698	2·75% (2·59–2·92)	1092	47 855	2·28% (2·15–2·42)	0·47 (0·25–0·68)	16·97 (9·97–23·96)	0·87 (0·79–0·97)
Invasive infection	132	2717	4·86% (4·08–5·74)	128	3971	3·22% (2·70–3·82)	1·63 (0·66–2·61)	33·65 (17·48–49·82)	0·72 (0·56–0·94)
Sepsis	89	1304	6·83% (5·52–8·33)	70	1543	4·54% (3·55–5·70)	2·29 (0·57–4·01)	33·53 (12·75–54·31)	0·66 (0·47–0·93)
Septic shock	172	894	19·24% (16·70–21·98)	174	1145	15·20% (13·16–17·41)	4·04 (0·73–7·36)	21·01 (5·70–36·33)	0·79 (0·61–1·01)
Sepsis and septic shock	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

OR=odds ratio.

Table 3: Mortality and risk for invasive infections, sepsis, and septic shock for 2002–07 versus 2008–13

Lancet 2015

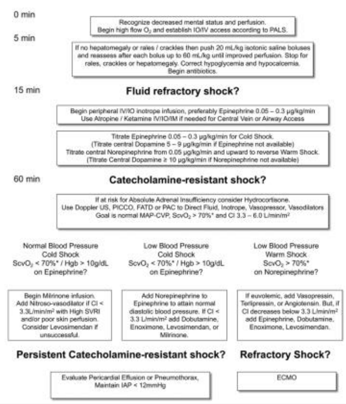
CONFERENCE REPORTS AND EXPERT PANEL

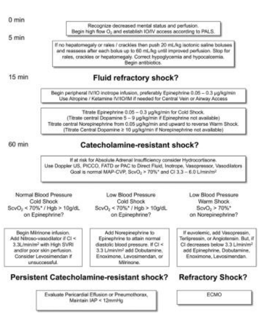
Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Special Article

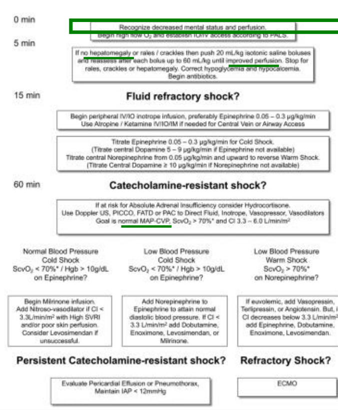
American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

CCM 2017

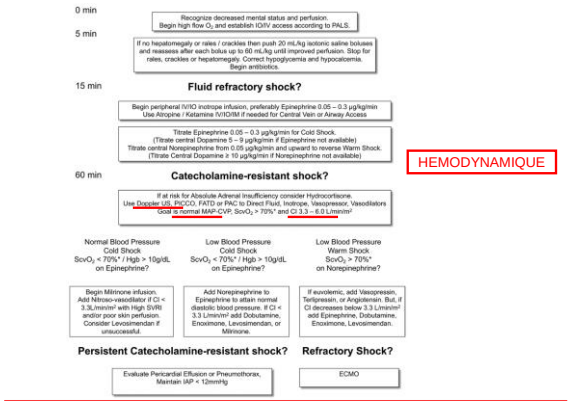




MONITORER ?



CLINIQUE



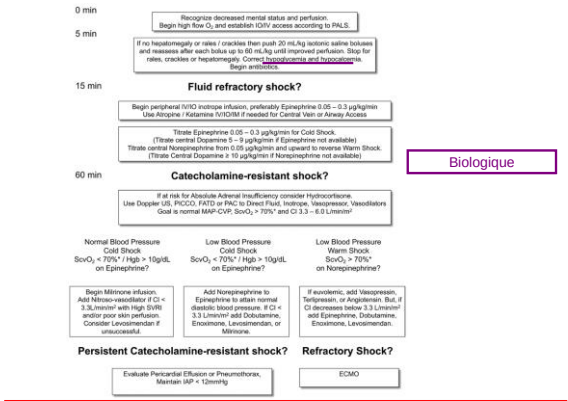
HEMODYNAMIQUE

L Dupic JPU 2017

HEMODYNAMIQUE

METABOLIQUE

L Dupic JPU 2017

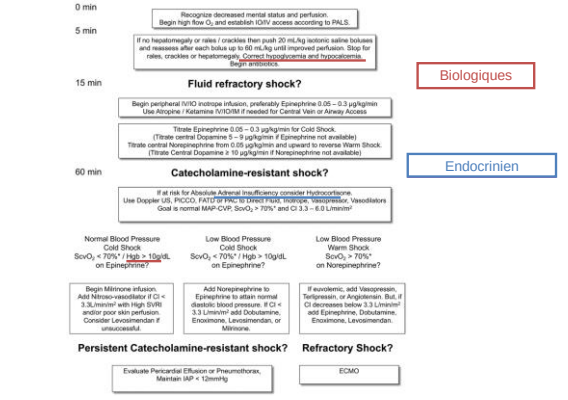


Biologique

L Dupic JPU 2017

Medicamenteuses

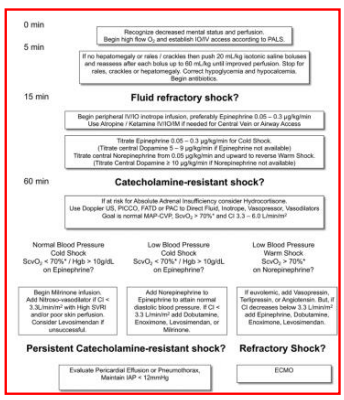
L Dupic JPU 2017



Biologiques

Endocrinien

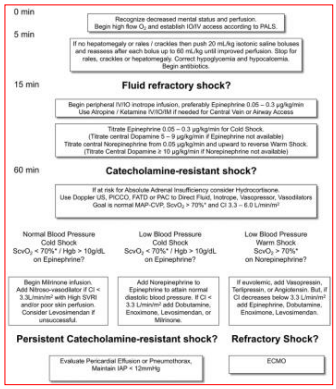
L Dupic JPU 2017



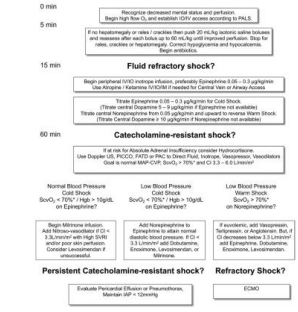
PROTOCOLE

L Dupic JPU 2017

TEMPS



L Dupic JPU 2017

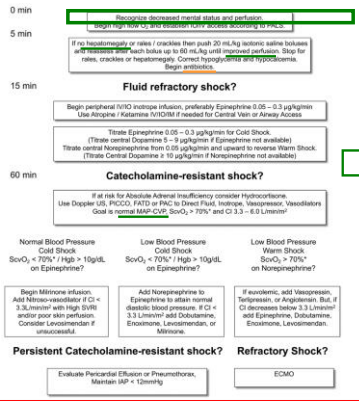


CLINIQUE
HEMODYNAMIQUE
Biologique
Medicamenteux
Endocrinien
Temps
PROTOCOLE

MONITORAGE

L Dupic JPU 2017

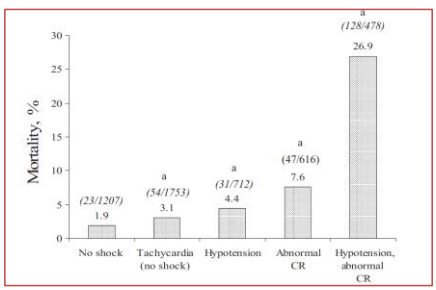
MONITORER CLINIQUE



CLINIQUE

L Dupic JPU 2017

Mortality and Functional Morbidity After Use of PALS/APLS by Community Physicians



L Dupic JPU 2017

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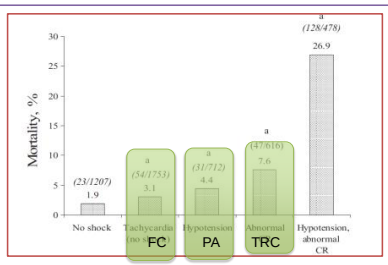

L Dupic JPU 2017

MONITORER CLINIQUE

than 150 beats/min (73). Emergency department therapies should be directed toward restoring normal mental status, threshold HRs, peripheral perfusion (capillary refill < 3 s), palpable distal pulses, and blood pressure for age (10). Carcillo

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

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- Maintain neonatal circulation.
- $Scvo_2$ greater than 70%
- CI greater than 3.3 L/min/m^2
- SVC flow greater than 40 mL/kg/min

CCM 2017

MONITORER CLINIQUE

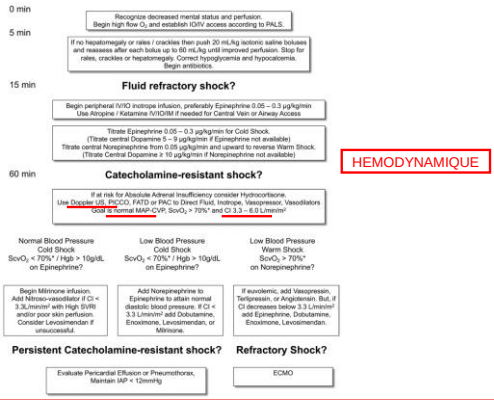
Définir Choc froid ou Choc chaud

Choc froid | Clinique et Monitorage non invasif/invasif e | Choc chaud

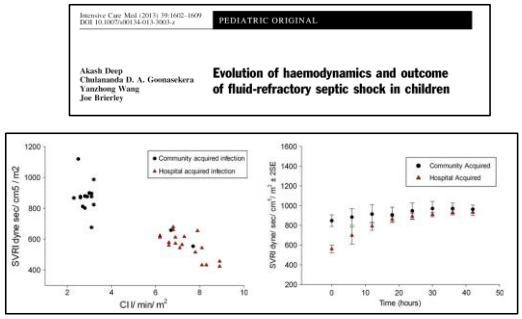
Objectifs
TRC < 2 sec , FC nle
Restoration conscience
Pouls normaux
PA normale
Débit urinaire > 1ml/kg/h
Diminution des lactates

Age	PAM (mmHfg)
1 jr	> 35
1jr-1 mois	> 45
1 mois-2 ans	> 50
2 – 10 ans	> 60
> 10 ans	>65

MONITORING HEMODYNAMIQUE



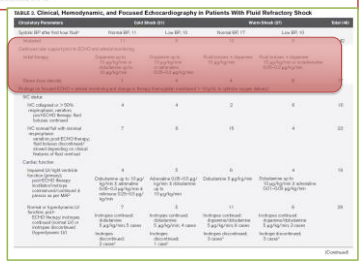
HEMODYNAMIQUE



Int Care Med 2013

Multimodal Monitoring for Hemodynamic Categorization and Management of Pediatric Septic Shock: A Pilot Observational Study*

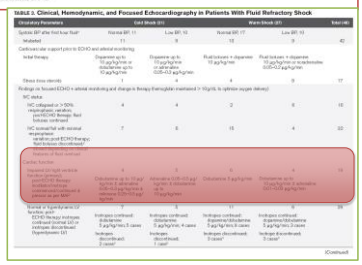
Suchitra Ranjit, MD, FCCM[1]; Gnanam Aram, MD, FNB[2]; Niranjan Kissoon, MBBS, FAAP, FCCM[3]; Mhd Kashif Ali, MD[3]; Rajeshwari Natraj, FNB[2]; Sharad Shresti, MD[2]; Indira Jayakumar, DCH, DNB[2]; Deepika Gandhi, DNB[4]



L Dupic JPU 2107

Multimodal Monitoring for Hemodynamic Categorization and Management of Pediatric Septic Shock: A Pilot Observational Study*

Suchitra Ranjit, MD, FCCM[1]; Gnanam Aram, MD, FNB[2]; Niranjan Kissoon, MBBS, FAAP, FCCM[3]; Mhd Kashif Ali, MD[3]; Rajeshwari Natraj, FNB[2]; Sharad Shresti, MD[2]; Indira Jayakumar, DCH, DNB[2]; Deepika Gandhi, DNB[4]



L Dupic JPU 2107

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

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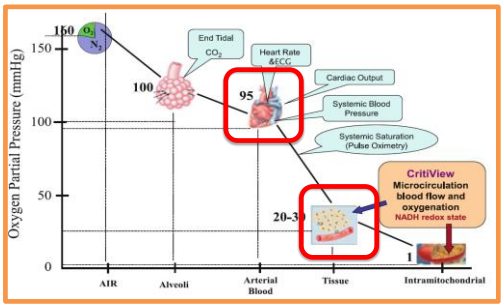
CCM 2017

L Dupic JPU 2017

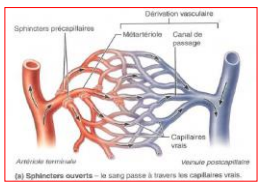


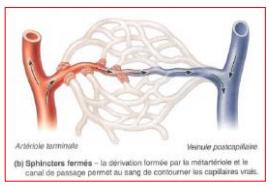
J. Clin. Monit. Comput. Mayevsky 2013

L Dupic SRLF 2017

Microcirculation= réseau artériolaire et capillaire

- Artérioles, capillaires et veinules d'un diamètre de 5 à 200 µm
- Capillaire= de 5 à 9 µm
- Rôle de délivrance de l'oxygène aux tissus, transfert du CO2 vers le sang
- Rôle nutritionnel et élimination des déchets tissulaire
- Interface avec le système lymphatique





L Dupic SRLF 2017

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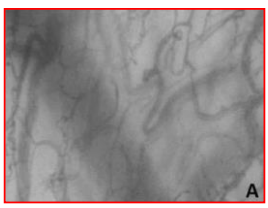


L Dupic JPU 2107

Persistent low microcirculatory vessel density in nonsurvivors of sepsis in pediatric intensive care*

Anke P. C. Top, MD; Can Ince, PhD; Neelke de Meij, MD; Monique van Dijk, PhD; Dick Tibboel, PhD

Table 3. *Microvascular flow index on day 1, 2, and 3*

	Survivors			Nonsurvivors		
MFI	Day 1 (n = 15)	Day 2 (n = 15)	Day 3 (n = 10)	Day 1 (n = 3)	Day 2 (n = 3)	Day 3 (n = 3)
Large	2.13 (0.67–3.00)	2.83* (2.00–3.00)	2.71* (2.13–3.00)	2.75 (1.63–3.00)	2.50 (1.92–3.00)	2.45 (2.40–2.50)
Medium	1.92 (0.08–2.5)	2.62* (1.66–3.00)	2.44 (1.25–3.00)	2.38 (0.75–3.00)	2.00 (1.25–2.33)	1.58 (0.88–2.30)
Small	2.00 (0.33–2.75)	2.63* (2.06–3.00)	2.54 (1.27–3.00)	2.75 (1.00–2.88)	2.17 (2.00–2.33)	1.82 (0.63–2.60)

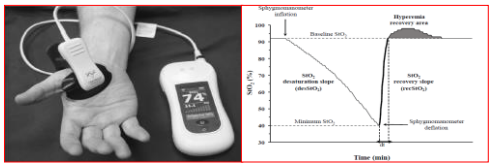
MFI, microvascular flow index.
*Significantly different from day 1 ($p < .05$); †significantly different from survivors on the same day ($p < .05$). Data are presented as median and range.

L Dupic JPU 2107

Evaluation par méthode NIRS (Near Infrared Spectroscopy)

Tests d'occlusion artérielle

- Mesure de la saturation tissulaire en oxygène StO2(cerveau, rein, muscle)
- Lumière de proche infrarouge (680–800 nm)
- Absorption différente entre Hb-O2 et DesO2-Hb
- Analyse des Microvaisseaux de manière indifférenciée
- StO2 musculaire moyenne = 87 ± 6 %
- Evaluation au niveau des muscles l'éminence thénar



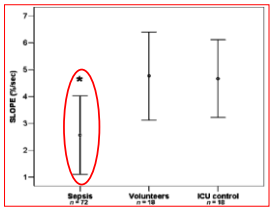
L Dupic SRLF 2017

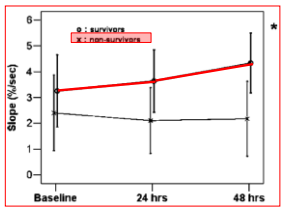
Intensive Care Med (2007) 33:1549–1556
DOI 10.1007/s00134-007-0739-3

ORIGINAL

The prognostic value of muscle StO_2 in septic patients

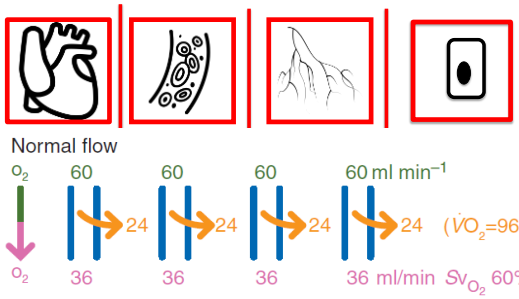
Jacques Creteur
Tiziana Carollo
Giulia Soldati
Gustavo Buchele
Daniel De Backer
Jean-Louis Vincent





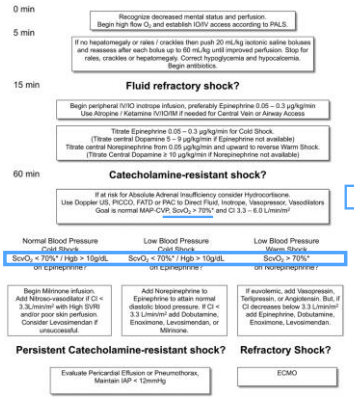
L Dupic JPU 2107

COUPLAGE HEMODYNAMIQUE



L Dupic JPU 2107

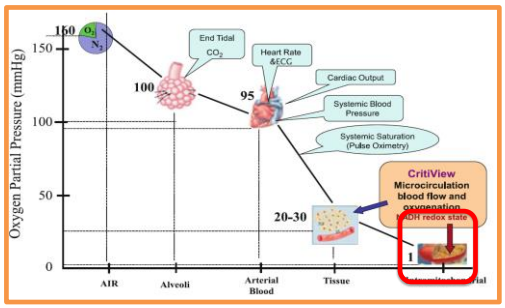
MONITORING METABOLIQUE



HEMODYNAMIQUE

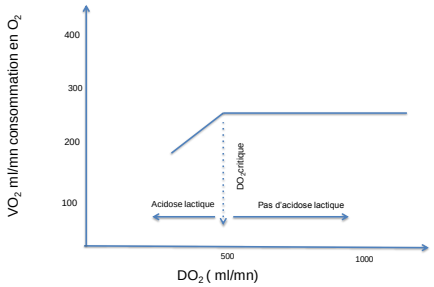
METABOLIQUE

L Dupic JPU 2017



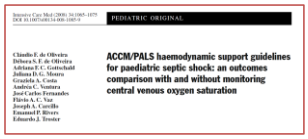
J. Clin. Monit. Comput. Mayevsky 2013

DO_2/VO_2

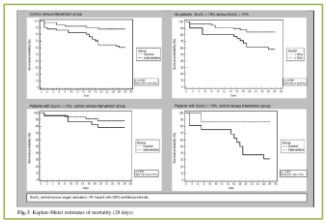


SvO_2

- La SvO_2 permet une approche globale des déterminants essentiels de l'oxygénation tissulaire, à savoir:
  - Le taux d'hémoglobine
  - L'oxygénation artérielle mesurée par la SaO_2
  - Le débit cardiaque
  - La consommation en oxygène, ou VO_2
- Elle est un témoin du rapport entre apport et consommation d'oxygène.


PEDIATRIC ORIGINAL

ACCM/PALS haemodynamic support guidelines for paediatric septic shock: an outcomes comparison with and without monitoring central venous oxygen saturation



Int Care Med 2008

Early Goal-Directed Therapy in Pediatric Septic Shock: Comparison of Outcomes "With" and "Without" Intermittent Superior Venacaval Oxygen Saturation Monitoring: A Prospective Cohort Study*

Sankar, Jhuma MD1; Sankar, M. Jeeva DM2; Suresh, C. P. MD1; Dubey, Nandkishore K. MD1; Singh, Archana MD1

Measurements an25 patients . 125 children were enrolled in the study–63 in the ScvO2 group and 57 in the no ScvO2 group. Baseline characteristics including the organ dysfunction and mortality risk scores were comparable between the groups.
Children in the ScvO2 group had significantly lower in-hospital mortality (33.3% vs 54%; relative risk, 0.61; 95% CI, 0.4, 0.93; number needed to treat, 5; 95% CI, 3, 27).

Conclusion:
Early goal-directed therapy using intermittent ScvO2 monitoring seemed to reduce the mortality rates and improved organ dysfunction in children with septic shock as compared with those without such monitoring.

PCCM 2014

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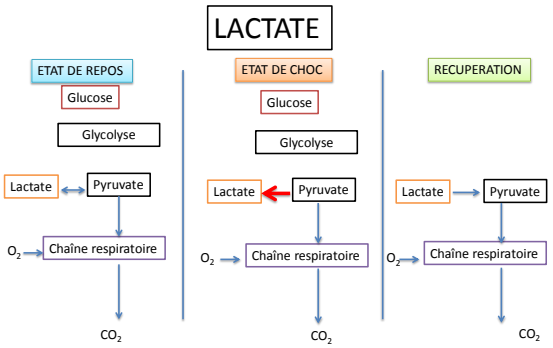
CCM 2017

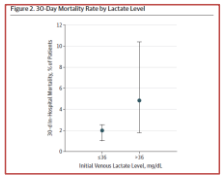


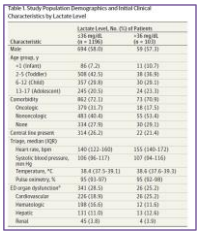
Baker J. Annals of intensive care 2013

JAMA Pediatrics | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Association Between Early Lactate Levels and 30-Day Mortality in Clinically Suspected Sepsis in Children

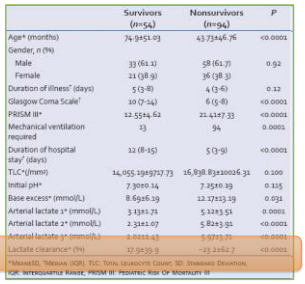
Halden F. Scott, MD; Lina Brou, MPH; Sara J. Deakyne, MPH; Allison Kempe, MD, MPH; Diane L. Fairclough, DrPH; Lalit Bajaj, MD, MPH





Lactate clearance as the predictor of outcome in pediatric septic shock

Richa Choudhary, Sadasivan Sitaraman, and Anita Choudhary

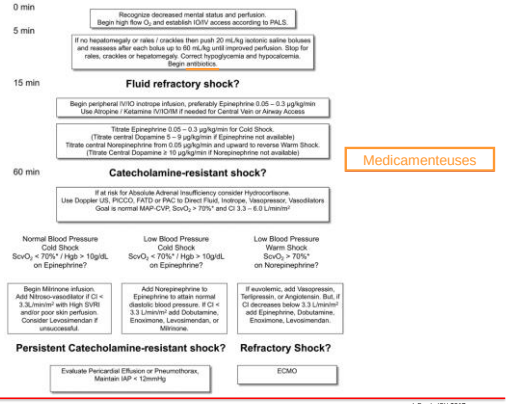


	Survivors (n=54)	Nonsurvivors (n=94)	P
Age* (months)	74.9±51.03	43.73±46.76	<0.0001
Gender, n (%)			
Male	33 (61.1)	58 (61.7)	0.92
Female	21 (38.9)	36 (38.3)	
Duration of illness* (days)	5 (3-8)	4 (3-6)	0.12
Glasgow Coma Scale*	10 (7-14)	6 (5-8)	<0.0001
PRISM III*	12.55±4.62	21.41±7.33	<0.0001
Mechanical ventilation required	13	94	0.0001
Duration of hospital stay* (days)	12 (8-15)	5 (3-9)	<0.0001
TLC*(/mm3)	14,055.19±5717.73	16,838.83±10026.31	0.100
Initial pH*	7.30±0.14	7.25±0.19	0.115
Base excess* (mmol/L)	8.69±6.19	12.37±13.19	0.031
Arterial lactate 1* (mmol/L)	3.13±1.71	5.32±3.51	0.0001
Arterial lactate 2* (mmol/L)	2.31±1.07	5.82±3.91	<0.0001
Arterial lactate 3* (mmol/L)	2.02±1.43	5.97±3.71	<0.0001
Lactate clearance* (%)	17.9±39.9	−23.2±62.7	<0.0001

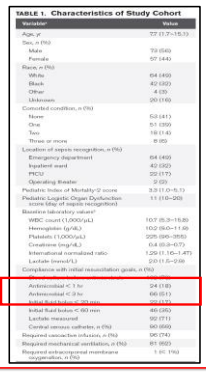
*Mean±SD, †Median (IQR). TLC: Total Leukocyte Count, SD: Standard Deviation, IQR: Interquartile Range, PRISM III: Pediatric Risk Of Mortality III

J Emerg Trauma Shock 2017;10:55-9

MONITORING ANTIBIOTHERAPIE



Medicamenteuses



Delayed Antimicrobial Therapy Increases Mortality and Organ Dysfunction Duration in Pediatric Sepsis*

Scott L. Weiss, MD[1]; Julie C. Fitzgerald, MD, PhD[2]; Fran Balamuth, MD, PhD[3]; Elizabeth R. Alpern, MD, MSCE[4]; Jane Lavelle, MD[5]; Marianne Chilutti, MS[5]; Robert Grundmeier, MD[4,5]; Vinay M. Nadkarni, MD, MS[2]; Neal J. Thomas, MD, MSc[2]

Ped Crit Care Med 2014

DOSAGE ANTIBIOTIQUES

Therapeutic drug monitoring of β-lactams in critically ill patients: proof of concept

Jason A. Roberts[a,b,c,*], Marta Ulldemolins[a,d], Michael S. Roberts[e,f], Brett McWhinney[g], Jacobus Ungerer[g], David L. Paterson[h,i], Jeffrey Lipman[a,c]

Etude prospective
236 patients sur 11 mois
11 β-lactamines
Dosage 2 fois la 1ère semaine
Cmax >10 CMI

Posologie maintenue 26 %
Posologie augmentée 51 %
Posologie diminuée 23 %

12 % d' échec clinique de traitement
Mais
Pas de relation entre
PD targets et outcomes cliniques

Int j Agent Antimicrobia Agent 2010

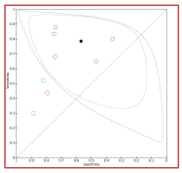
L Dupic JPU 2107

MONITORING BIOLOGIQUE

L Dupic JPU 2107

Accuracy of serum procalcitonin for the diagnosis of sepsis in neonates and children with systemic inflammatory syndrome: a meta-analysis

Giuseppe Pontrelli[1,*], Franco De Crescenzo[1,2], Roberto Buzzetti[3], Alessandro Jenkner[1,3], Sara Balduzzi[4], Francesca Calò Carducci[5], Donato Amodio[5], Maia De Luca[5], Sara Chiurchiù[5], Elin Haf Davies[6], Giorgia Capponi[1], Alessandra Simonetti[1,2], Elena Ferretti[1], Valeria Di Franco[1,2], Virginia Raso[1], Martina Della Corte[1], Luca Gramatica[1], Marco Ciabattini[7], Susanna Livadiotti[7] and Paolo Rossi[1,3]



Conclusions: PCT shows a moderate accuracy for the diagnosis of sepsis in neonates with suspected sepsis at the cut-off of 2.0-2.5 ng/mL. More studies with high methodological quality are warranted, particularly in neonates, studies considering EOS and LOS separately are needed to improve specificity.

L Dupic JPU 2107

Accuracy of a real-time continuous glucose monitoring system in children with septic shock: A pilot study
Sumant Prabhudesai, Amruta Kanjani,1 Isha Bhagat,2 Karnam G. Ravikumar,3 and Bala Ramachandran3

:
Results:
Nineteen children were included, and 235 pairs of BG-CGMS readings were obtained. BG and CGMS had a correlation coefficient of 0.61 ($P < 0.001$) and a median relative absolute difference of 17.29%.

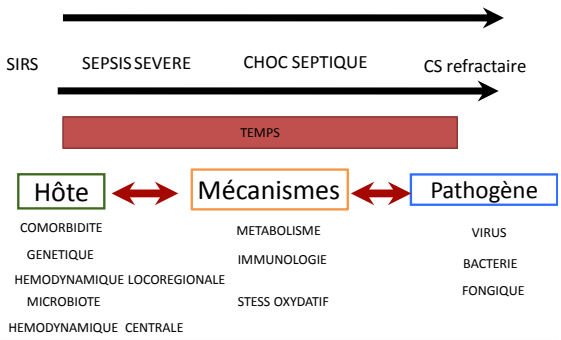
Conclusion:
CGMS provides a fairly, accurate estimate of BG in children with septic shock. It is unaffected by a variety of clinical variables. The accuracy over extremes of blood sugar may be a concern. We recommend larger studies to evaluate its use for the early detection of hypoglycemia and hyperglycemia.

I JCC 2016

L Dupic JPU 2017

MONITORING IMMUNOLOGIQUE

L Dupic JPU 2107



L Dupic JPU 2017

SHORT COMMUNICATION

Assessment of cellular immune parameters in paediatric toxic shock syndrome: a report of five cases

Olivier Dauwalder[1,2,3], Fabienne Venet[4], Etienne Javouhey[5], Cédric Badiou[1,2], Yves Gillet[6], Caroline Guignant[4], Céline Plainvert[7,8,9,10], Jerome Etienne[1,2,3], Claire Poyart[7,8,9,10], François Vandenesch[1,2,3], Gerard Lina[1,2,3] & Guillaume Monneret[4]

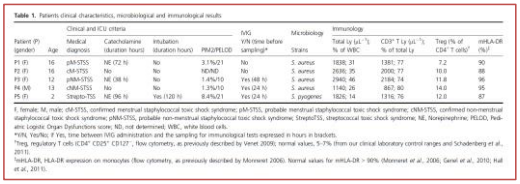


Table 1. Patients clinical characteristics, microbiological and immunological results

Patient (P) (gender)	Age	Clinical and ICU criteria: Medical diagnosis	Catecholamine (duration hours)	Intubation (duration hours)	IVIG: PIM2/PELOD	IVIG: Y/N (time before sampling)[a]	Microbiology: Strains	Immunology: Total Ly (µL⁻¹): % of WBC	Immunology: CD3⁺ T Ly (µL⁻¹): % of total Ly	Immunology: Treg (% of CD4⁺ T cells)[b]	Immunology: mHLA-DR (%)[c]
P1 (F)	16	pM-STSS	NE (72 h)	No	3.1%/21	No	*S. aureus*	1838; 31	1381; 77	7.2	90
P2 (F)	16	cM-STSS	No	No	ND/ND	No	*S. aureus*	2636; 35	2090; 77	10.0	88
P3 (F)	12	pMM-STSS	NE (38 h)	No	1.4%/10	Yes (48 h)	*S. aureus*	2940; 46	2184; 74	11.8	96
P4 (M)	13	cMM-STSS	No	No	1.3%/10	Yes (24 h)	*S. aureus*	1140; 26	867; 80	14.0	95
P5 (F)	2	Strepto-TSS	NE (96 h)	Yes (120 h)	8.4%/21	Yes (24 h)	*S. pyogenes*	1826; 14	1316; 76	12.0	87

F, female; M, male; cM-STSS, confirmed menstrual staphylococcal toxic shock syndrome; pM-STSS, probable menstrual staphylococcal toxic shock syndrome; cMM-STSS, confirmed non-menstrual staphylococcal toxic shock syndrome; pMM-STSS, probable non-menstrual staphylococcal toxic shock syndrome; Strepto-TSS, streptococcal toxic shock syndrome; NE, Norepinephrine; PELOD, Pediatric Logistic Organ Dysfunctions score; ND, not determined; WBC, white blood cells.

[a]Y/N, Yes/No; if Yes, time between IVIG administration and the sampling for immunological tests expressed in hours in brackets.

[b]Treg, regulatory T cells (CD4⁺ CD25⁺ CD127⁻; flow cytometry, as previously described by Venet 2009); normal values, 5–7% (from our clinical laboratory control ranges and Schadenberg et al., 2011).

[c]mHLA-DR, HLA-DR expression on monocytes (flow cytometry, as previously described by Monneret 2006). Normal values for mHLA-DR > 90% (Monneret *et al.*, 2006; Genel *et al.*, 2010; Hall *et al.*, 2011).

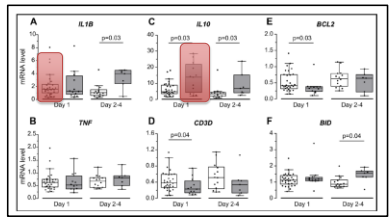
FEMS 2012

L Dupic JPU 2107

RESEARCH ARTICLE

Evaluation of mRNA Biomarkers to Identify Risk of Hospital Acquired Infections in Children Admitted to Paediatric Intensive Care Unit

Estelle Peronnet[1¤], Kha Nguyen[1¤], Elisabeth Cerrato[1], Rathi Guhadasan[2], Fabienne Venet[1,4], Julien Textoris[1,4], Alexandre Pachot[1], Guillaume Monneret[1,4]*, Enitan Deiphine Carrol[2]*



PLOSE one 2016

L Dupic JPU 2107

MONITORING PROTOCOLE

L Dupic JPU 2107

RESEARCH Open Access

Management of children with sepsis and septic shock: a survey among pediatric intensivists of the Réseau Mère-Enfant de la Francophonie

Miriam Santschi[1*], Francis Leclerc[2] and members of the Réseau Mère-Enfant de la Francophonie

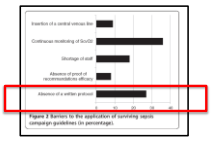


Figure 2 Barriers to the application of surviving sepsis campaign guidelines (in percentage).

Table 2 Investigations to determine sepsis severity and parameters used to follow clinical response to fluid resuscitation

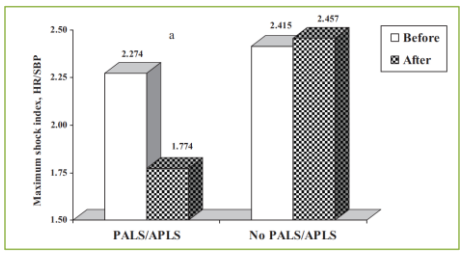
Investigations used to determine sepsis severity n(%)	
Serum lactate	11 (92%)
Arterial or venous blood gas	11 (92%)
Central venous saturation ($ScvO_2$)	9 (75%)
Echocardiography	8 (67%)
Chest X-Ray	7 (58%)
Complete Blood count	7 (58%)
C reactive protein	4 (33%)
Coagulation tests	3 (25%)
Sedimentation rate	1 (8%)
Other	2 (17%)
Parameters used to follow response to fluid resuscitation n(%)	
Physical exam and vital signs	11 (92%)
Urine output	11 (92%)
Central Venous Pressure Monitoring	6 (50%)
Echocardiography	5 (42%)
Central Venous Saturation ($ScvO_2$)	2 (17%)
Continuous monitoring of CO	1 (8%)
NIRS	1 (8%)
Swan Ganz	0
Other	2 (17%)

(*) cardiac output, NIRS near-infrared spectroscopy

Ann Int Care Med 2013

L Dupic JPU 2107

Mortality and Functional Morbidity After Use of PALS/APLS by Community Physicians



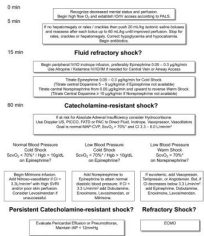
Pediatrics 2009

L Dupic JPU 2107

CONCLUSION

CLINIQUE

HEMODYNAMIQUE



Biologique

Medicamenteux

PROTOCOLE

Temps

L Dupic JPU 2017

CONCLUSION

MONITORAGE CHOC SEPTIQUE

CLINIQUE

MONITORING HEMODYNAMIQUE MULTIMODAL

Clairance lactate

Dosage des antibiotiques

TEMPS

MERCI DE VOTRE ATTENTION

?

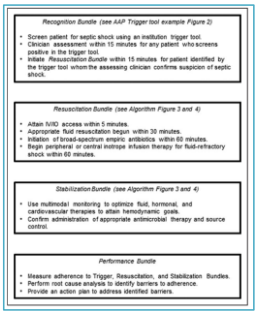
laurent.dupic@aphp.fr

SIRS → SEPSIS SEVERE → CHOC SEPTIQUE → CS refractaire

TEMPS

Hôte	Mécanismes	Pathogène
COMORBIDITE	METABOLISME	VIRUS
GENETIQUE	IMMUNOLOGIE	BACTERIE
HEMODYNAMIQUE LOCOREGIONALE		FONGIQUE
MICROBIOTE	STESS OXYDATIF	
HEMODYNAMIQUE CENTRALE		

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



Recognition Bundle (see AAP Trigger tool example Figure 2)

- Screen patient for septic shock using an institution trigger tool.
- Clinician assessment within 15 minutes for any patient who screens positive in the trigger tool.
- Initiate *Resuscitation Bundle* within 15 minutes for patient identified by the trigger tool whom the assessing clinician confirms suspicion of septic shock.

Resuscitation Bundle (see Algorithm Figure 3 and 4)

- Attain IV/IO access within 5 minutes.
- Appropriate fluid resuscitation begun within 30 minutes.
- Initiation of broad-spectrum empiric antibiotics within 60 minutes.
- Begin peripheral or central inotrope infusion therapy for fluid-refractory shock within 60 minutes.

Stabilization Bundle (see Algorithm Figure 3 and 4)

- Use multimodal monitoring to optimize fluid, hormonal, and cardiovascular therapies to attain hemodynamic goals.
- Confirm administration of appropriate antimicrobial therapy and source control.

Performance Bundle

- Measure adherence to Trigger, Resuscitation, and Stabilization Bundles.
- Perform root cause analysis to identify barriers to adherence.
- Provide an action plan to address identified barriers.

CCM 2017

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

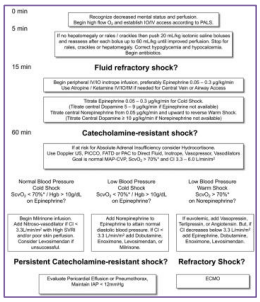
Therapeutic Endpoints (Level 1C)

- Capillary refill less than or equal to 2 seconds, normal pulses with no differential between peripheral and central pulses, warm extremities, urine output greater than 1 mL/kg/hr, normal mental status, and normal blood pressure for age
- greater than 95% Sao_2
- less than 5% difference in preductal and postductal Sao_2
- $Scvo_2$ greater than 70%
- Absence of right-to-left shunting, tricuspid regurgitation, or right ventricular failure on echocardiographic analysis.
- Normal glucose and ionized calcium concentrations
- SVC flow greater than 40 mL/kg/min
- CI greater than 3.3 L/min/m^2
- Normal INR
- Normal anion gap, and lactate Fluid overload less than 10%

CCM 2017

L Dupic JPU 2017

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



CCM 2017

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

Monitoring (Level 1C)

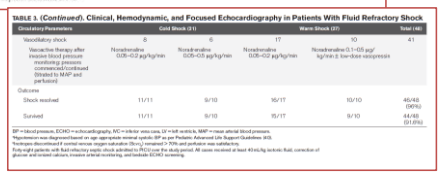
- Pulse oximetry
- Arterial pH Continuous ECG
- Continuous intra-arterial blood pressure
- Temperature
- Glucose and calcium concentration
- Ins and outs, urine output
- CVP/oxygen saturation
- CO
- SVC flow
- INR
- Anion gap and lactate

CCM 2017

L Dupic JPU 2017

Multimodal Monitoring for Hemodynamic Categorization and Management of Pediatric Septic Shock: A Pilot Observational Study*

Suchitra Ranjit, MD, FCCM[1]; Gnanam Aram, MD, FNB[2]; Niranjan Kissoon, MBBS, FAAP, FCCM[3]; Mhd Kashif Ali, MD[3]; Rajeshwari Natraj, FNB[1]; Sharad Shresti, MD[1]; Indira Jayakumar, DCH, DNB[1]; Deepika Gandhi, DNB[4]



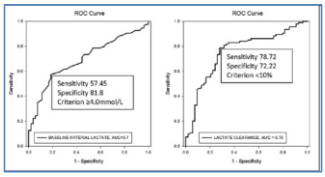
L Dupic JPU 2017

Lactate clearance as the predictor of outcome in pediatric septic shock

Richa Choudhary, Sadasivan Sitaraman, and Anita Choudhary

Variable	Sensitivity	Specificity	PPV	NPV	OR	95% CI
Lactate ≥ (24 mmol/L)*	57	82	84	51	5.4	2.453-12.059
Lactate ≥ (24 mmol/L)	62	87	89	56	10.8	4.434-26.326
Lactate ≥ (24 mmol/L)	67	92	94	61	25.4	8.409-76.736

*At cut-off point of lactate as obtained by ROC curve. OR Of Blood Lactate At The Levels Above The Cut-off Point. CI: Confidence Interval, PPV: Positive Predictive Value, NPV: Negative Predictive Value, OR: Odds Ratio



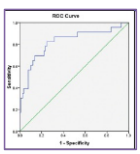
J Emerg Trauma Shock 2017;10:55-9

L Dupic JPU 2107

Validation of lactate clearance at 6 h for mortality prediction in critically ill children

Rajeev Kumar and Nirmal Kumar

Lactate clearance test	Mortality		
	Died (n=23)	Survived (n=117)	Total
≤16.435 (n=48)	19	29	48
>16.435 (n=92)	4	88	92
Total	23	117	140
Sensitivity		82.6%	
Specificity		75.2%	
Positive predictive value		39.6%	
Negative predictive value		95.7%	



Indian J Crit Care Med. 2016 Oct; 20(10): 570–574.

L Dupic JPU 2107

Multimodal monitoring for hemodynamic categorization and management of pediatric septic shock: a pilot observational study*.
Ranjit S1, Aram G, Kissoon N, Ali MK, Natraj R, Shresti S, Jayakumar I, Ga

CONCLUSION:

Bedside echocardiography provided crucial information leading to the recognition of septic myocardial dysfunction and uncorrected hypovolemia that was not apparent on clinical assessment. With invasive blood pressure monitoring, echocardiography affords a simple noninvasive tool to determine the cause of low cardiac output and the physiological basis for adjustment of therapy in patients who remain in shock despite 40 mL/kg fluid.

PCCM 2014