



# Hypovolemická zástava oběhu

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1.LF UK v Praze



# Hypovolemická zástava oběhu

- Je obrazem dekompenzovaného hypovolemického šoku
- Na podkladě absolutní nebo relativní hypovolémie
- Nejčastěji – hemoragický šok ( trauma, vnitřní krvácení...)
- Podobné situace: srdeční tamponáda, tenzní hemothorax, tenzní PNO

# Hypovolemická zástava oběhu

- Základní postupy:
  - Diagnostika
  - Radikální terapeutické zákroky ( drenáž, thorakotomie atp.)
  - Zajištění adekvátního žilního přístupu
  - Objemová terapie
  - Katecholaminy, vazopresory



# Hypovolemická zástava oběhu

- Diagnostika:
  - Obtížná, často velmi náročná situace
  - Otázka použití echo – C.A.U.S.E. – Cardiac Arrest Ultrasound Examination
    - Použití v rámci Emergency Department

# Hypovolemická zástava oběhu - TTE

CLINICAL PAPER

## C.A.U.S.E.: Cardiac arrest ultra-sound exam— A better approach to managing patients in primary non-arrhythmogenic cardiac arrest<sup>☆</sup>

Caleb Hernandez<sup>a</sup>, Klaus Shuler<sup>a</sup>, Hashibul Hannan<sup>a</sup>, Chionesu Sonyika<sup>a</sup>,  
Antonios Likourezos<sup>a,\*</sup>, John Marshall<sup>a,b</sup>

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### KEYWORDS

Advanced life support  
(ALS);  
Cardiac arrest;  
Cardiac tamponade;  
Hypovolemia;  
Pulmonary embolism;  
Pulseless electrical  
activity (PEA);  
Tension  
pneumothorax;  
Ultrasound

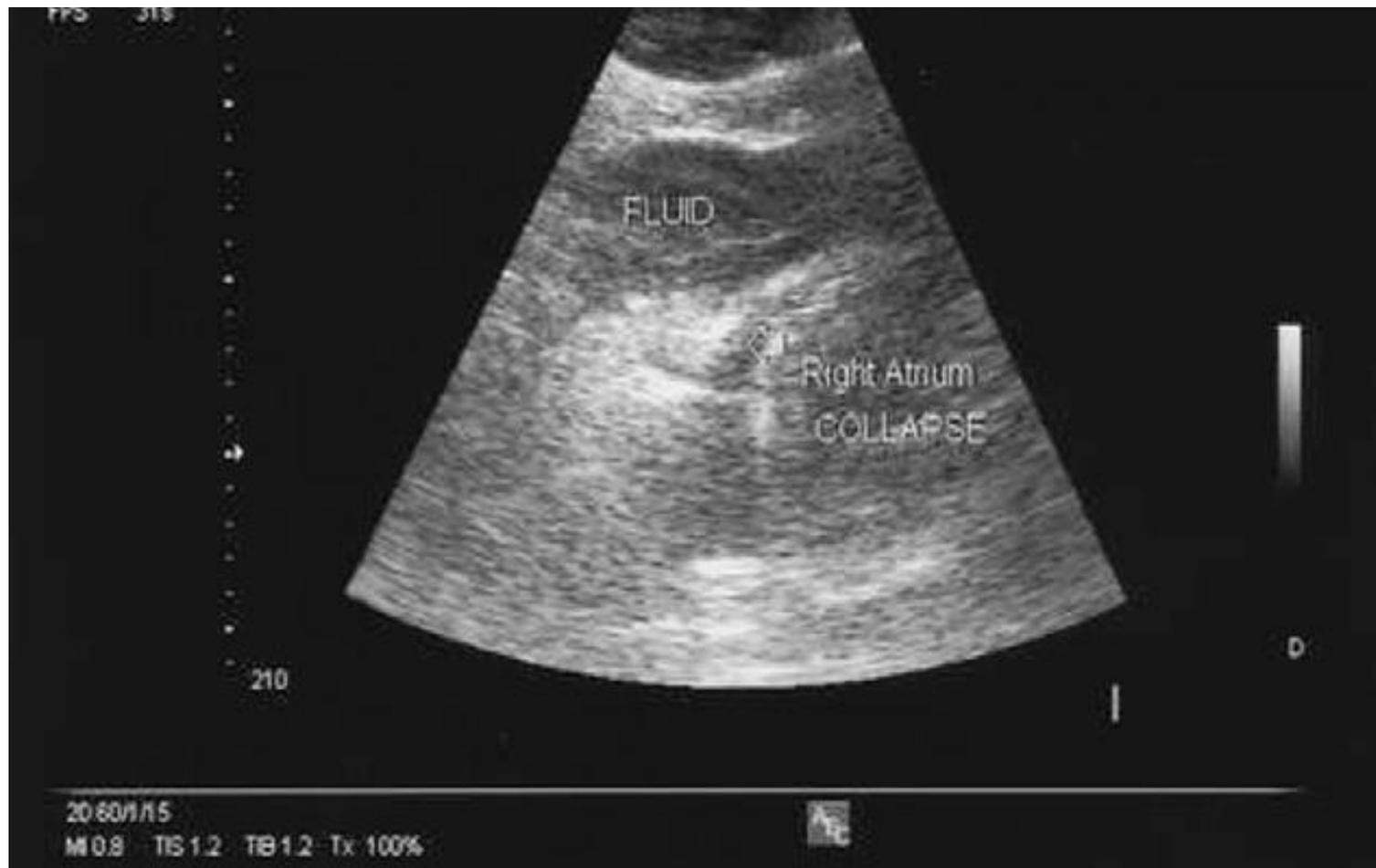
**Summary** Cardiac arrest is a condition frequently encountered by physicians in the hospital setting including the Emergency Department, Intensive Care Unit and medical/surgical wards.

This paper reviews the current literature involving the use of ultrasound in resuscitation and proposes an algorithmic approach for the use of ultrasound during cardiac arrest. At present there is the need for a means of differentiating between various causes of cardiac arrest, which are not a direct result of a primary ventricular arrhythmia. Identifying the cause of pulseless electrical activity or asystole is important as the underlying cause is what guides management in such cases. This approach, incorporating ultrasound to manage cardiac arrest aids in the diagnosis of the most common and easily reversible causes of cardiac arrest not caused by primary ventricular arrhythmia, namely; severe hypovolemia, tension pneumothorax, cardiac tamponade, and massive pulmonary embolus. These four conditions are addressed in this paper using four accepted emergency ultrasound applications to be performed during resuscitation of a cardiac arrest patient with the aim of determining the underlying cause of a cardiac arrest. Identifying the underlying cause of cardiac arrest represents the one of the greatest challenges of managing patients with asystole or PEA and accurate determination has the potential to improve management by guiding therapeutic decisions.

We include several clinical images demonstrating examples of cardiac tamponade, massive pulmonary embolus, and severe hypovolemia secondary to abdominal aortic aneurysm.

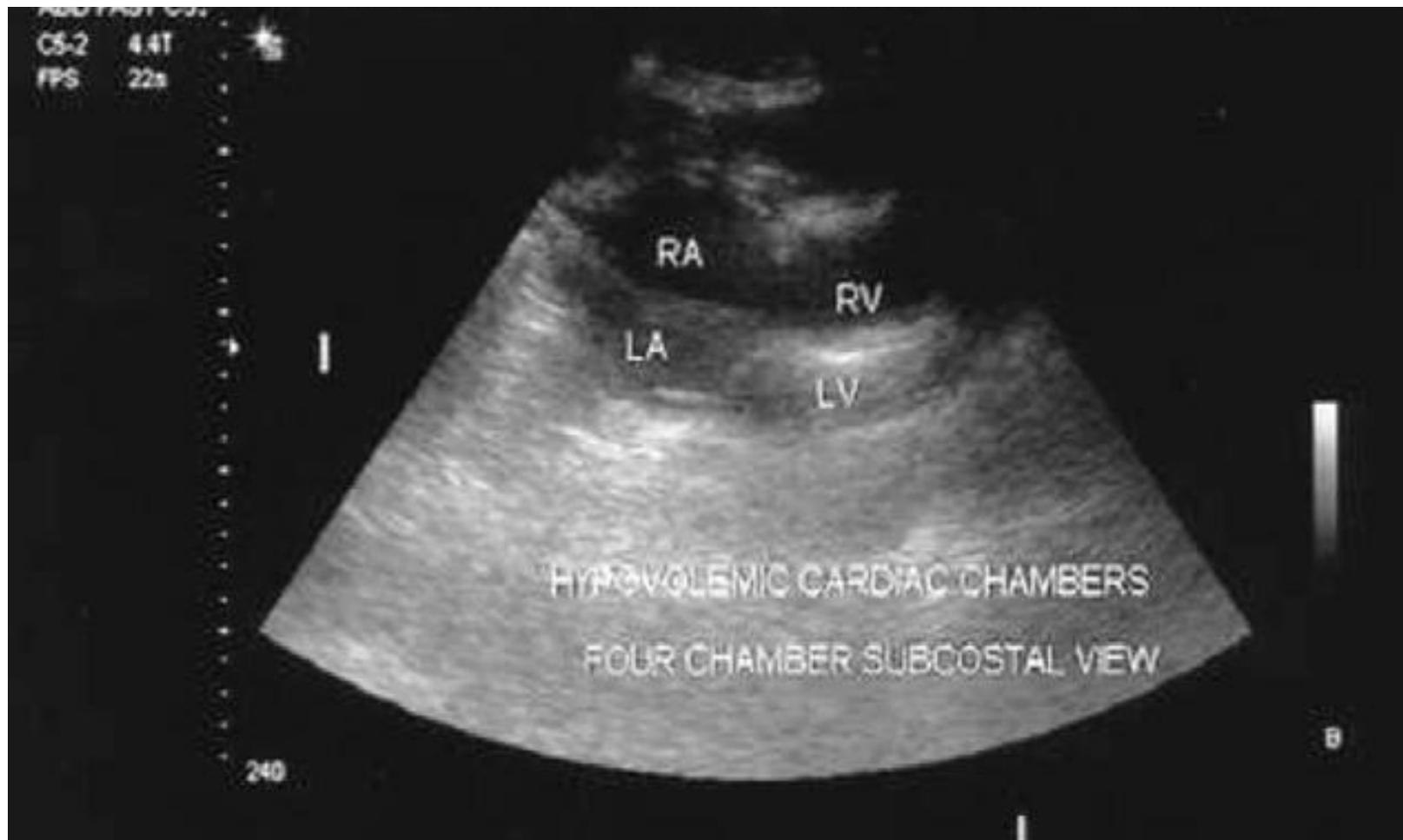
In conclusion, this protocol has the potential to reduce the time required to determine the etiology of a cardiac arrest and thus decrease the time between arrest and appropriate therapy.  
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# Hypovolemická zástava oběhu subxifoidální TTE - tamponáda



# Hypovolemická zástava oběhu

## TTE - hypovolémie



# Hypovolemická zástava oběhu

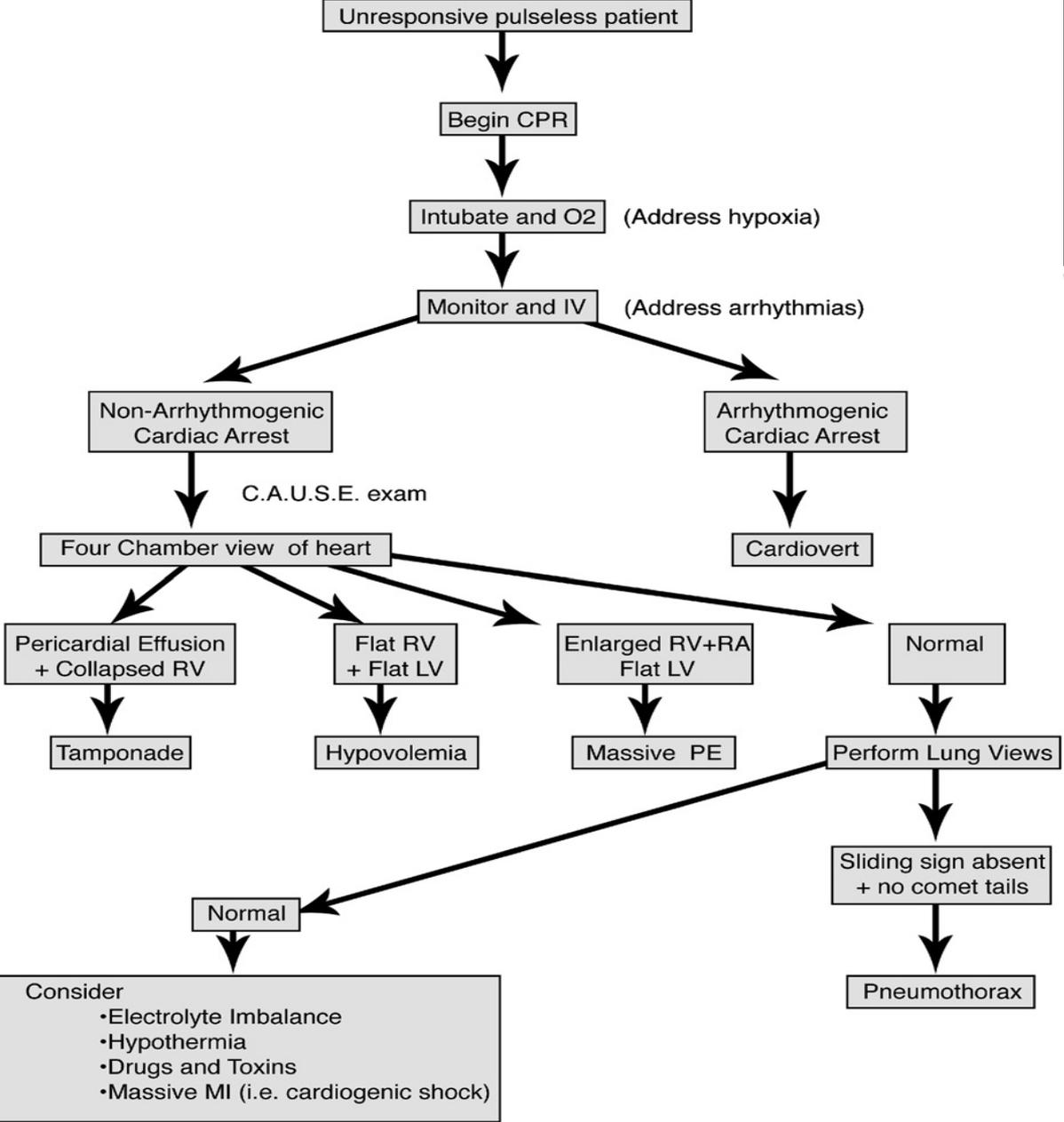
## TTE – sono břišní aorty u předchozího pacienta



# Hypovolemická zástava oběhu

## TTE – susp. plicní embolie





Flow diagram demonstrating use of C.A.U.S.E. protocol in patients with cardiac arrest.

# Hypovolemická zástava oběhu - outcome

TRAUMATIC CARDIAC ARREST RESEARCH REPORT

## Traumatic Cardiac Arrest: Who Are the Survivors?

**David Lockey, FRCA, FIMC,  
RCS(Ed)**

From the London Helicopter Emergency Medical Service, Royal London Hospital, London, United Kingdom.

**Kate Crewdson, MB, BS, BSc  
Gareth Davies, FFAEM, FRCP**

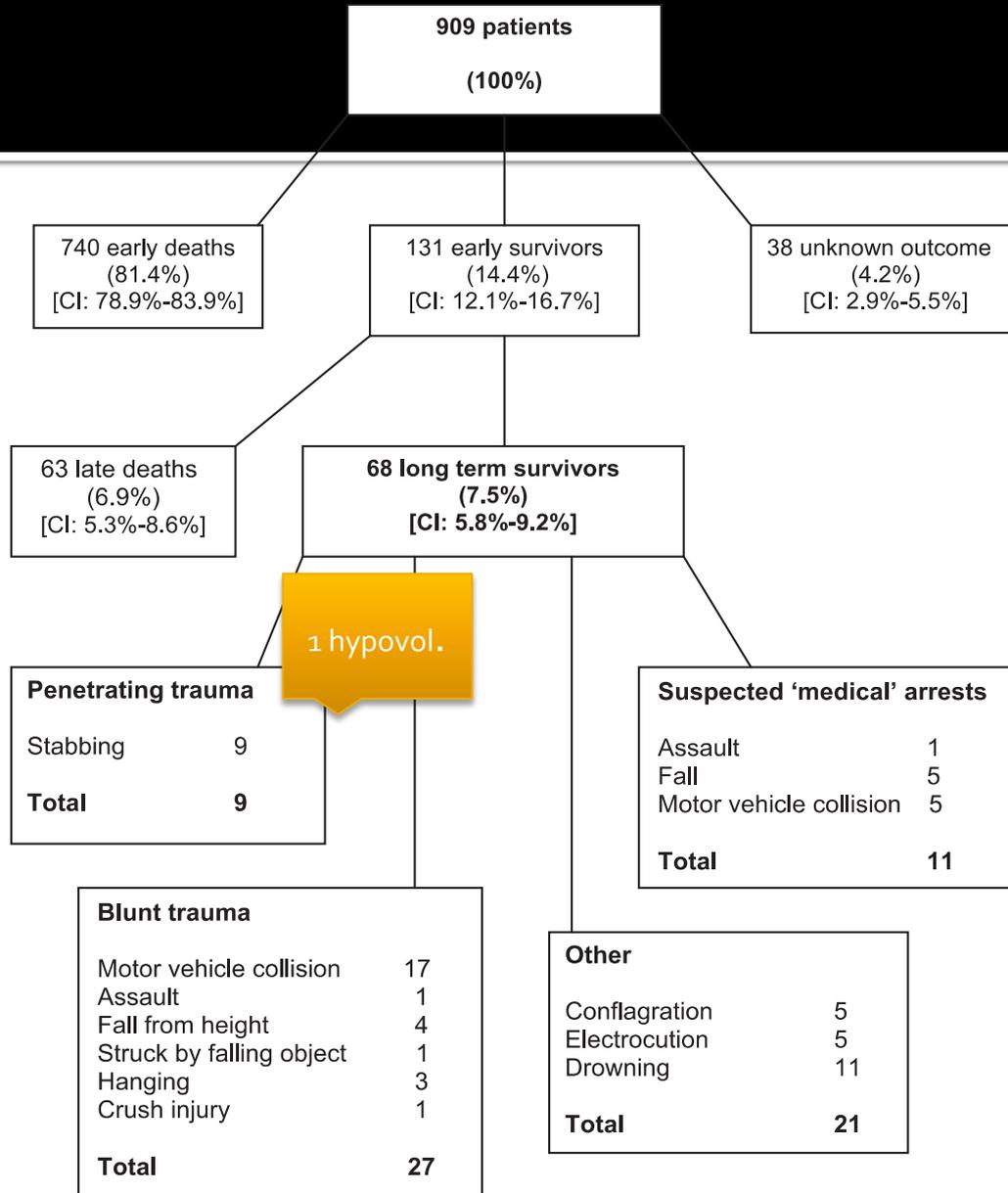
**Study objective:** Survival from traumatic cardiac arrest is poor, and some consider resuscitation of this patient group futile. This study identified survival rates and characteristics of the survivors in a physician-led out-of-hospital trauma service. The results are discussed in relation to recent resuscitation guidelines.

**Methods:** A 10-year retrospective database review was conducted to identify trauma patients receiving out-of-hospital cardiopulmonary resuscitation. The primary outcome measure was survival to hospital discharge.

**Results:** Nine hundred nine patients had out-of-hospital cardiopulmonary resuscitation. Sixty-eight (7.5% [95% confidence interval 5.8% to 9.2%]) patients survived to hospital discharge. Six patients had isolated head injuries and 6 had cervical spine trauma. Eight underwent on-scene thoracotomy for penetrating chest trauma. Six patients recovered after decompression of tension pneumothorax. Thirty patients sustained asphyxial or hypoxic insults. Eleven patients appeared to have had “medical” cardiac arrests that occurred before and was usually the cause of their trauma. One patient survived hypovolemic cardiac arrest. Thirteen survivors breached recently published guidelines.

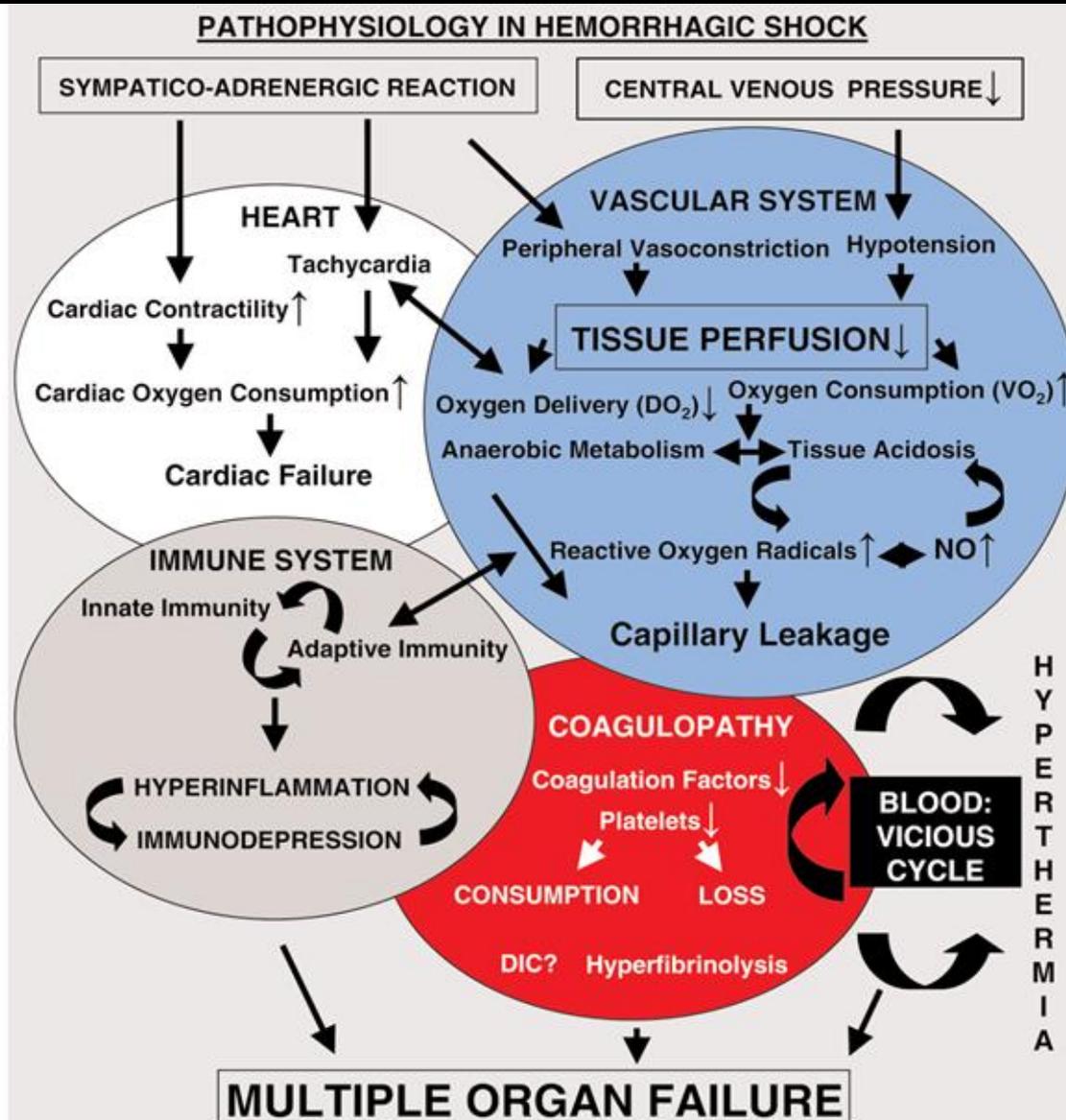
**Conclusion:** The survival rates described are poor but comparable with (or better than) published survival rates for out-of-hospital cardiac arrest of any cause. Patients who arrest after hypoxic insults and those who undergo out-of-hospital thoracotomy after penetrating trauma have a higher chance of survival. Patients with hypovolemia as the primary cause of arrest rarely survive. Adherence to recently published guidelines may result in withholding resuscitation in a small number of patients who have a chance of survival. [Ann Emerg Med. 2006;48:240-244.]

# Hypovolemická zástava oběhu - outcome



**Figure.** Outcome of traumatic cardiac arrest and mechanism of injury for survivors.

# Hemoragický šok



# Hemoragický šok

Research

Open Access

## Management of bleeding following major trauma: a European guideline

Donat R Spahn<sup>1</sup>, Vladimír Cerný<sup>2</sup>, Timothy J Coats<sup>3</sup>, Jacques Duranteau<sup>4</sup>, Enrique Fernández-Mondéjar<sup>5</sup>, Giovanni Gordini<sup>6</sup>, Philip F Stahel<sup>7</sup>, Beverley J Hunt<sup>8</sup>, Radko Komadina<sup>9</sup>, Edmund Neugebauer<sup>10</sup>, Yves Ozier<sup>11</sup>, Louis Riddez<sup>12</sup>, Arthur Schultz<sup>13</sup>, Jean-Louis Vincent<sup>14</sup> and Rolf Rossaint<sup>15</sup>

- Minimalizace časového prostojie mezi poraněním a chirurgickou kontrolou krvácení
- Stabilizace poranění pánve následně angiografická embolizace nebo chirurgická kontrola krvácení
- CT, sono a další u neidentifikovaného zdroje krvácení
- laktát, BE – monitorace závažnosti šoku
- Volná tekutina v břiše a hemodynamická nestabilita – chirurgická revize

Critical Care 2007

# Časná resuscitace velké krevní ztráty

- Objemové náhrady:
  - Není konsenzus jaké používat
  - Krystaloidy – nutné velké množství – cave! kumulativní pozitivní bilance
  - Koloidy – albumin, želatina, FFP, HAES
  - Isotonické roztoky vs. hypertonické
  - Trauma – arginine vasopressin ?

# Hemoragický šok – vasopressin?

- Dlouhodobý koncept masivní časné objemové resuscitace
- Ukazuje se, že nemusí jít o nejefektivnější postup: komplikace:
  - MOF
  - ALI
  - Hypotermie
  - Tkáňový edém
  - Imunosuprese
  - Další krevní ztráty



# Hemoragický šok – vasopressin?

- časná velko-objemová resuscitace
  - Delší hospitalizace
  - Větší počet UPV
  - Větší počet nosokomiálních infekcí
  - Vyšší mortalita

# Hemoragický šok – vasopressin?

- arginin vasopressin (AVP)
  - Přirozená odpověď organismu na pokles TK (art. baroreceptory)
  - Ztráta cirkulujícího objemu – endogenní uvolnění vasopressinu a katecholaminů
  - 10-20% zásob AVP – uvolněno ihned v časně fázi šoku
  - Další pokles zásob AVP je dramatický

Tato fakta vedou ke konceptu časného podávání AVP

# Hemoragický šok – vasopressin?

- arginin vasopressin (AVP)
  - Při normálním pH je cévní odpověď na katecholaminy podobná jako na AVP
  - Při acidóze dochází snížené senzitivě cév na  $\text{Ca}^{++}$
  - To vede ke snížené cévní reaktivitě
  - Noradrenalin a adrenalin nejsou efektivní
  - Vasopressin používá několik mechanismů k udržení cévního tonu
  - Jako hlavní efekt se jeví udržení hladiny  $\text{Ca}^{++}$  v cytosolu
  - Mimo jiné také vliv na NO

# Hemoragický šok

Safari Soubor Úpravy Zobrazení Historie Záložky Okno Nápověda (100%) Thu 6:20 PM Tomas Kotulak

Developing alternative strategies for th... [Curr Opin Crit Care. 2008] - PubMed - NCBI

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Curr Opin Crit Care, 2008 Jun;14(3):247-53.

## Developing alternative strategies for the treatment of traumatic haemorrhagic shock.

Lienhart HG, Lindner KH, Wenzel V.  
Department of Anesthesiology and Critical Care Medicine, Innsbruck Medical University, Innsbruck, Austria.

### Abstract

**PURPOSE OF REVIEW:** The optimal strategy of stabilizing haemodynamic function in uncontrolled traumatic haemorrhagic shock states is unclear. Although fluid replacement is established in controlled haemorrhagic shock, its use in uncontrolled haemorrhagic shock is controversial, because it may worsen bleeding.

**RECENT FINDINGS:** In the refractory phase of severe haemorrhagic shock, arginine vasopressin has been shown to be beneficial in selected cases due to an increase in arterial blood pressure, shift of blood away from a subdiaphragmatic bleeding site towards the heart and brain, and decrease in fluid resuscitation requirements. Especially in patients with severe traumatic brain injury, rapid stabilization of cardiocirculatory function is essential to ensure adequate brain perfusion and thus to prevent neurological damage and to improve outcome. In addition, despite wide distribution of highly developed and professional emergency medical systems in western industrialized countries, survival chances of patients with uncontrolled traumatic haemorrhagic shock in the prehospital setting are still poor.

**SUMMARY:** A multicenter, randomized, controlled, international clinical trial is being initiated to assess the effects of arginine vasopressin (10 IU) vs. saline placebo in prehospital traumatic haemorrhagic shock patients, not responding to standard shock treatment, being managed by helicopter emergency medical services [vasopressin in traumatic haemorrhagic shock (VITRIS.at) study].

PMID: 18467882 [PubMed - indexed for MEDLINE]

+ Publication Types, MeSH Terms, Substances

+ LinkOut - more resources

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**Review** Preventing cardiac arrest during hemorrhagic shock with va: [Crit Care Med. 2008]  
[Vasopressin for therapy of persistent traumatic hemorrhagic shock: The VII] [Anaesthesist. 2007]

**Review** Arginine vasopressin: a promising rescue drug i [Best Pract Res Clin Anaesthesi...]

Arginine vasopressin, but not epinephrine, improves survival in uncont [Crit Care Med. 2003]

Treatment of uncontrolled hemorrhagic shock after liver trauma: fatal effe [Anesth Analg. 2004]

See reviews...  
See all...

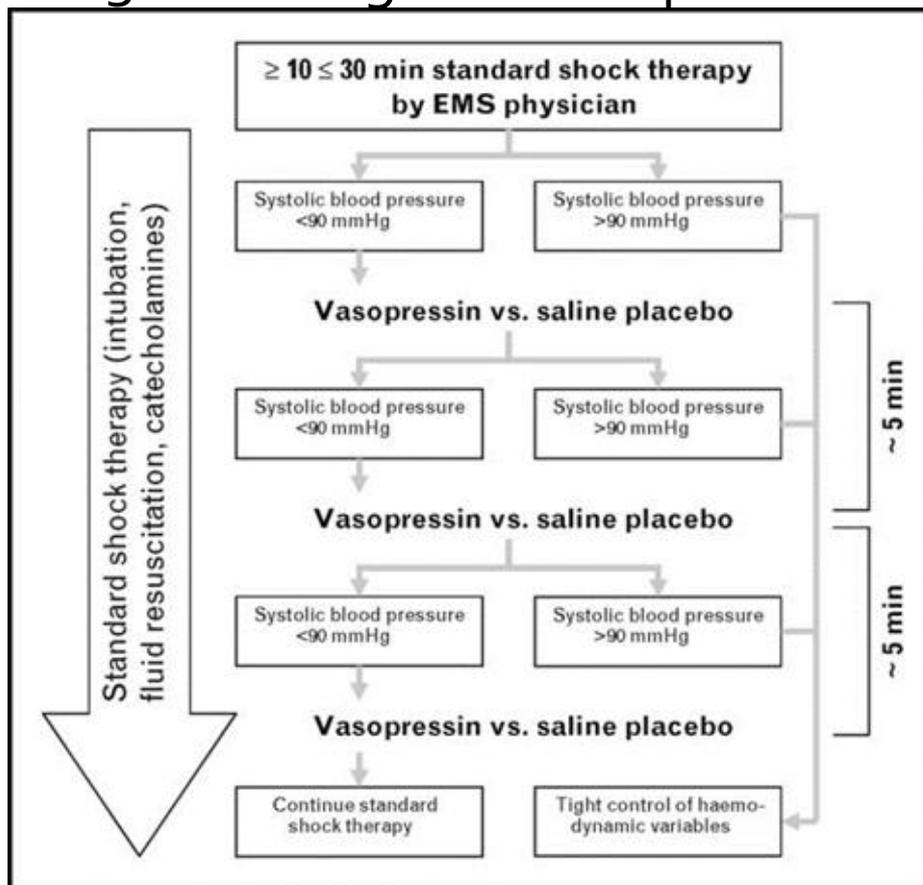
### Cited by 1 PubMed Central article

Aptamer based surface enhanced Raman scattering detection ( [Biosens Bioelectron. 2010]

### Related information



- Studie zkoumá arginine vasopressin vs. placebo u traumatického hemoragického šoku
- Až 3x10 IU arginine vasopressin



Developing alternative strategies for the treatment of traumatic haemorrhagic shock.

Lienhart, Hannes; Lindner, Karl; Wenzel, Volker

Current Opinion in Critical Care. 14(3):247-253, June 2008.

DOI: 10.1097/MCC.0b013e3282fce62a

# Časná resuscitace velké krevní ztráty - monitoring

monitoring?

- IABP, CVP
- SG
- TEE, TTE
- Nesmí zpozdit transport a chirurgické řešení u traumatu
- Časný flow monitoring: LIDCO, PICCO, VIGILEO
- Biochemie- BE, laktát, htk, Hb, SvO<sub>2</sub>

# Časná resuscitace velké krevní ztráty - monitoring

Futier et al. *Critical Care* 2010, **14**:R193  
<http://ccforum.com/content/14/5/R193>



RESEARCH

Open Access

## Central venous O<sub>2</sub> saturation and venous-to-arterial CO<sub>2</sub> difference as complementary tools for goal-directed therapy during high-risk surgery

Emmanuel Futier<sup>1\*</sup>, Emmanuel Robin<sup>2</sup>, Matthieu Jabaudon<sup>1</sup>, Renaud Guerin<sup>1</sup>, Antoine Petit<sup>1</sup>, Jean-Etienne Bazin<sup>1</sup>, Jean-Michel Constantin<sup>1</sup>, Benoit Vallet<sup>2</sup>

**Conclusions:** ScvO<sub>2</sub> reflects important changes in O<sub>2</sub> delivery in relation to O<sub>2</sub> needs during the perioperative period. A P(cv-a)CO<sub>2</sub> < 5 mmHg might serve as a complementary target to ScvO<sub>2</sub> during GDT to identify persistent inadequacy of the circulatory response in face of metabolic requirements when an ScvO<sub>2</sub> ≥71% is achieved.

# Časná resuscitace velké krevní ztráty – objemová terapie

## objemová resuscitace

- krystaloidy vs. koloidy ..... záleží na zvyklostech
- opakované objemové výzvy – hodnocení na základě odpovědi nebo známek přetížení
- ev. hodnocení dle TTE, TEE
- Isotonické roztoky, iso-onkotické
- Cave HAES : VISEP, CRICO,
- Krevní deriváty: FFP, PRBC, cryoprecipitát, - cave warfarin
  - anamnéza

# Časná resuscitace velké krevní ztráty – objemová terapie

- adekvátní intravaskulární náplň je nefroprotektivní
- nejsou data doporučující míru intravaskulární expanze (CVP)
- Pozitivní kumulativní bilance spojena s vyšší mortalitou u chirurgických nemocných !
- vs. „permisivní“ hypotenze před vyřešením zdroje

# Časná resuscitace velké krevní ztráty – objemová terapie

- Hydroxyetylškroby
- Krevní deriváty
- Hypertonické roztoky (small -volume resuscitation)
- Hemoglobin- based oxygen carriers
- Otázka použití PRBC v přednemocniční péči O Rh-

# Hemoglobin based Oxygen Carriers

- semisyntetické nebo syntetické přípravky s hemoglobinem jsou nazývány Hemoglobin based Oxygen Carriers (HBOC)

Critical Care Vol 12 No 4 Angele *et al.*

Table 1

## Artificial oxygen carriers

Category	Product	Type	MW (Daltons)	Phase of testing
Perfluorocarbons	Oxygent™	Perfluorooctylbromide	450 to 500	Up to clinical phase III, discontinued
Hemoglobin-based oxygen carrier	HemAssist™	Diaspirin-crosslinked hemoglobin (human)	65,000	Up to clinical phase III, discontinued
	Hemopure™	Polymerized bovine hemoglobin (bovine)	250,000	Up to clinical phase III
	Polyheme™	Pyridoxylated glutaraldehyde-polymerized hemoglobin (human)	150,000	Up to clinical phase III
	Hemospan™	Maleimide-activated polyethylene-glycol-modified hemoglobin (human)	95,000	Up to clinical phase II, phase III planned
Hemoglobin vesicles	Oxygenix™	Hemoglobin containing liposomes (OXY-0301)	Unpublished	Experimental, up to phase I

Presented are the physiochemical characteristics and state of clinical research on artificial oxygen carrier. The manufacturers are as follows: Oxygent™, Alliance Pharmaceutical Corp., San Diego, CA, USA; HemAssist™, Baxter Healthcare, Round Lake, IL, USA; Hemopure™, Biopure Corp., Cambridge, MA, USA; Polyheme™, Northfield Lab Inc., Evanston, IL, USA; Hemospan™, Sangart Inc., San Diego, CA, USA; and Oxygenix™, Oxygenix Co. Ltd., Tokyo, Japan.

# Závěr:

Otázky:

Poměr FFP/PRBC ( 1:1,5)

HES – bezpečnost

Hypertonické roztoky

Koloidy vs. Krystaloidy

AVP

Permisivní hypotenze vs. Pressure support

# Hemorrhagic shock - not only on scene also on theatre 😊

