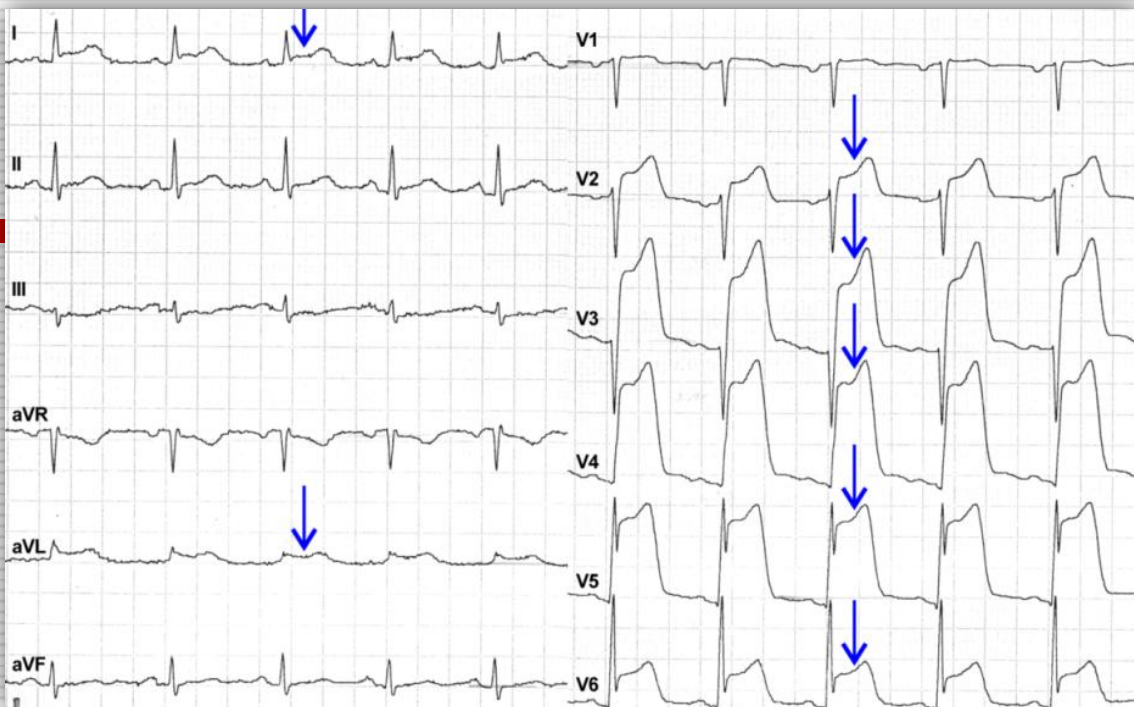
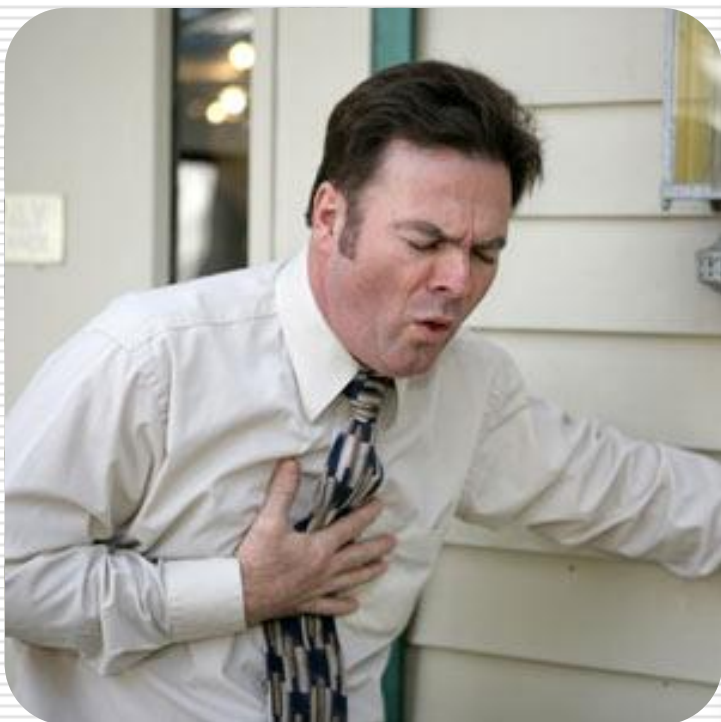

Ultrazvuk během kardiopulmonální resuscitace

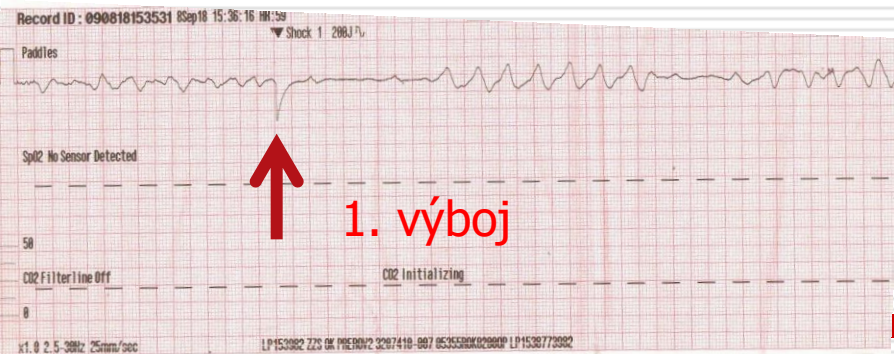
Martin Hutyra

1. interní klinika – kardiologická, Lékařská fakulta Univerzity Palackého a Fakultní nemocnice Olomouc





- Echokardiografie je jednou z nejužitečnějších diagnostických zobrazovacích metod, kterou může lékař v moderních podmínkách emergentní/intenzivní péče využít.
- Tímto vyšetřením získané informace mají zásadní vliv na volbu dalšího managementu péče o nemocné s akutním kardiovaskulárním onemocněním.



1. výboj



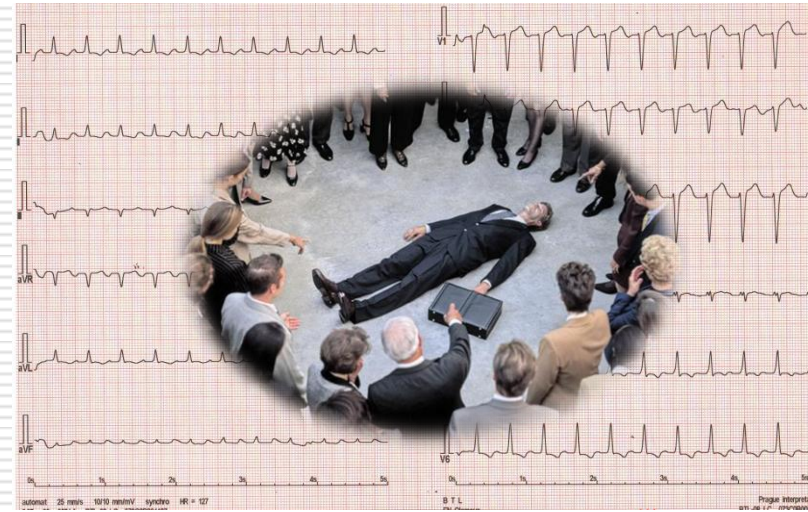
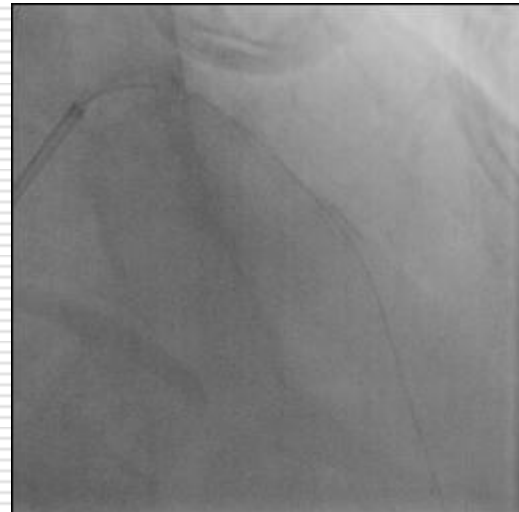
8. výboj



5. výboj

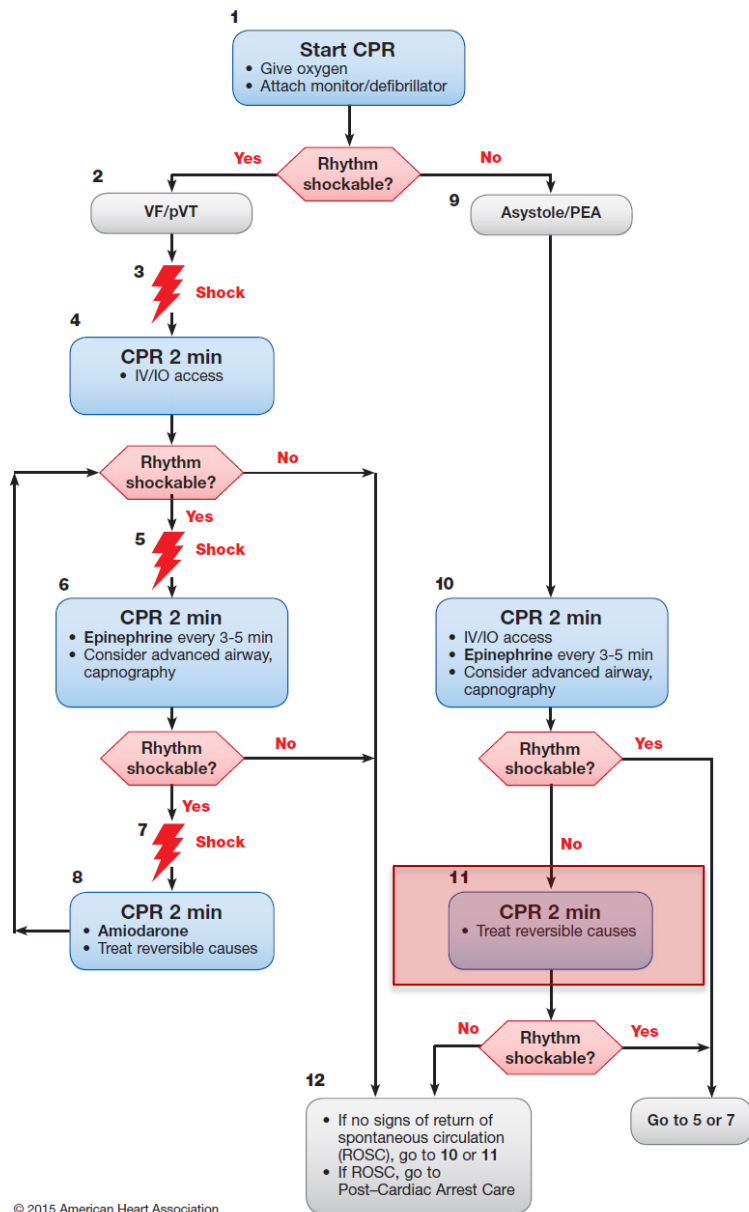
Name:	090818153531	12-Lead 2	HR 147 bpm	Abnormal ECG**Unconfirmed**	ventricular tachycardia
Record ID:	090818153531	08 Sep 18	16:26:29	***MEETS ST ELEVATION MI	• SEPTAL INFARCT - POSSIBLY ACUTE
Patient ID:	PR 0.114s	QRS 0.124s	0.318s/0.478s	CRITERIA ***	• Left ventricular hypertrophy
Incident:	QT/QTc	P-QRS-T Axes	-146° -3° -121°	• Atrial fibrillation with rapid ventricular response with non-sustained	• Inferior/lateral ST-T abnormality may be due to hypertrophy and/or ischemia
Age: 54	Sex: M	aVR			

LP153982 ZTS OK PRE30V2 3207410-007 05353530K02000P LP1530773982



Mimonemocniční oběhová zástava

- **Incidence:** 38 případů na 100 000 obyvatel/rok
USA: 300.000/1 rok OHCA, 78% transport na ER, 8% dimise
 - defibrilovatelné rytmy - cca 45 %
(cca 60-65 % - degenerace v nedefibrilovatelný rytmus)
- **Akutní infarkt myokardu**
 - zodpovědný za **40-60 % případů OHCA**
 - fibrilace komor - nejčastěji v prvních hodinách IM
- **Prognóza**
 - ROSC - cca 50 % pacientů
 - propuštění z nemocnice:
 - 2 - 15 % pacientů - celkově
 - 20 % pacientů - defibrilovatelné rytmy
 - **faktory asociované se zvýšeným přežíváním:**
defibrilovatelný rytmus, bystander KPR, ROSC při KPR



© 2015 American Heart Association

CPR Quality

- Push hard (at least 2 inches [5 cm]) and fast (100-120/min) and allow complete chest recoil.
- Minimize interruptions in compressions.
- Avoid excessive ventilation.
- Rotate compressor every 2 minutes, or sooner if fatigued.
- If no advanced airway, 30:2 compression-ventilation ratio.
- Quantitative waveform capnography
 - If PETCO₂ <10 mm Hg, attempt to improve CPR quality.
- Intra-arterial pressure
 - If relaxation phase (diastolic) pressure <20 mm Hg, attempt to improve CPR quality.

Shock Energy for Defibrillation

- **Biphasic:** Manufacturer recommendation (eg, initial dose of 120-200 J); if unknown, use maximum available. Second and subsequent doses should be equivalent, and higher doses may be considered.
- **Monophasic:** 360 J

Drug Therapy

- **Epinephrine IV/IO dose:** 1 mg every 3-5 minutes
- **Amiodarone IV/IO dose:** First dose: 300 mg bolus. Second dose: 150 mg.

Advanced Airway

- Endotracheal intubation or supraglottic advanced airway
- Waveform capnography or capnometry to confirm and monitor ET tube placement
- Once advanced airway in place, give 1 breath every 6 seconds (10 breaths/min) with continuous chest compressions

Return of Spontaneous Circulation (ROSC)

- Pulse and blood pressure
- Abrupt sustained increase in PETCO₂ (typically >40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

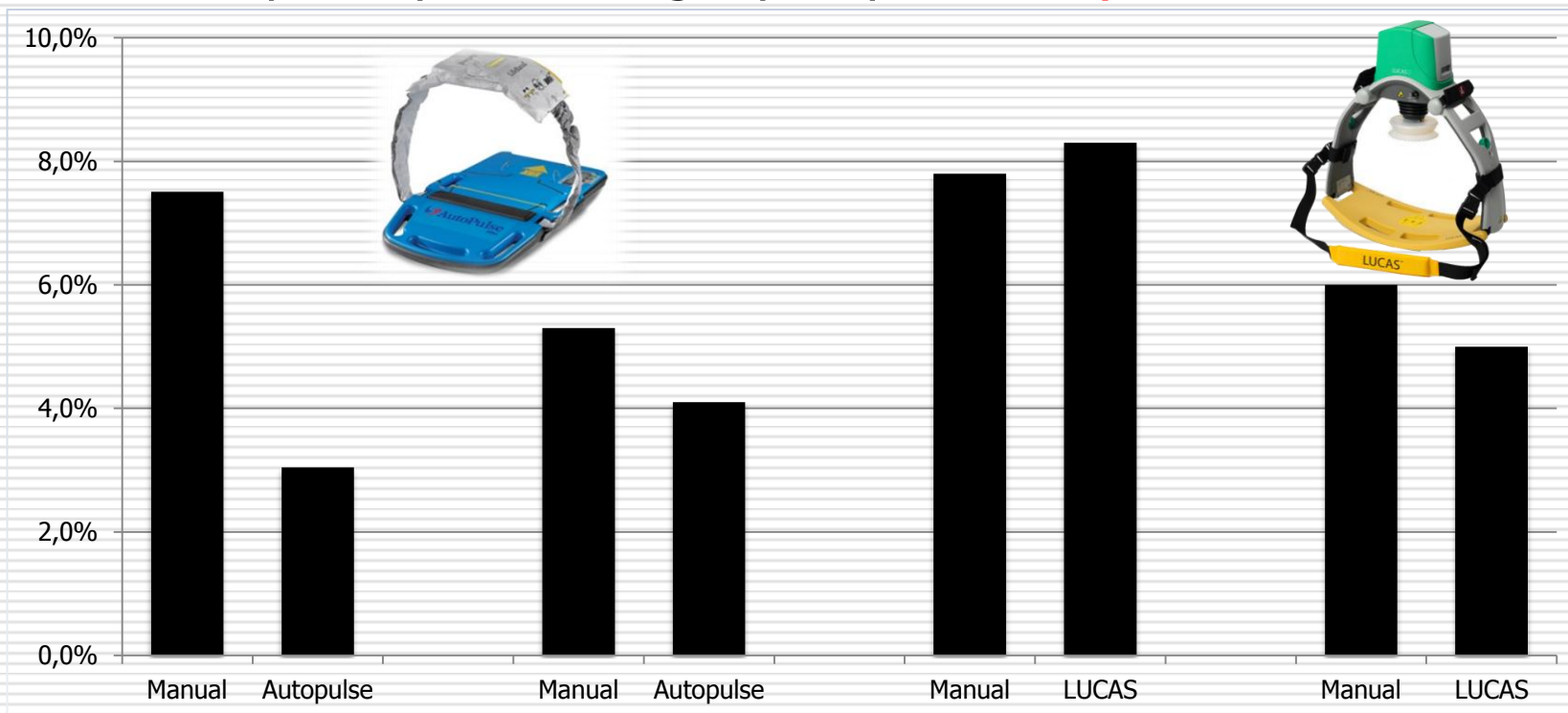
Reversible Causes

- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary



Mechanická vs. manuální KPR

Přežívání s příznivým neurologickým výsledkem (mRS ≤ 3 nebo CPC 1-2)



Hallstrom
JAMA 2006

Wik
Resus 2014

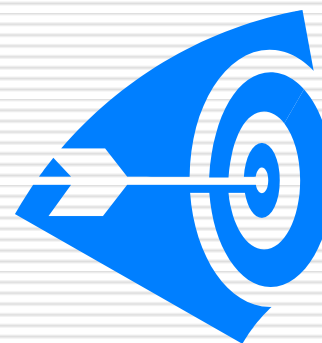
Rubertsson
JAMA 2014

Perkins
Lancet 2015

Jakou informací očekáváme?

□ Prognostickou

- Stanovení reálné kontraktility myokardu komor
- Zobrazení polohy endotracheální kanyly



□ Diagnostickou

- Odhalení potenciálně reverzibilních kauzálních příčin oběhové zástavy (hypovolémie, pneumotorax, plicní embolie, srdeční tamponáda, srdeční infarkt a komplikace)



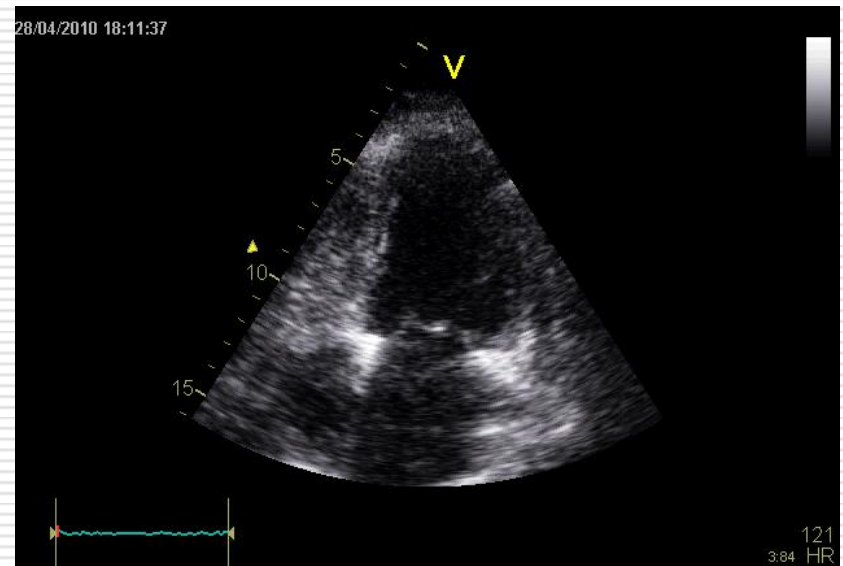
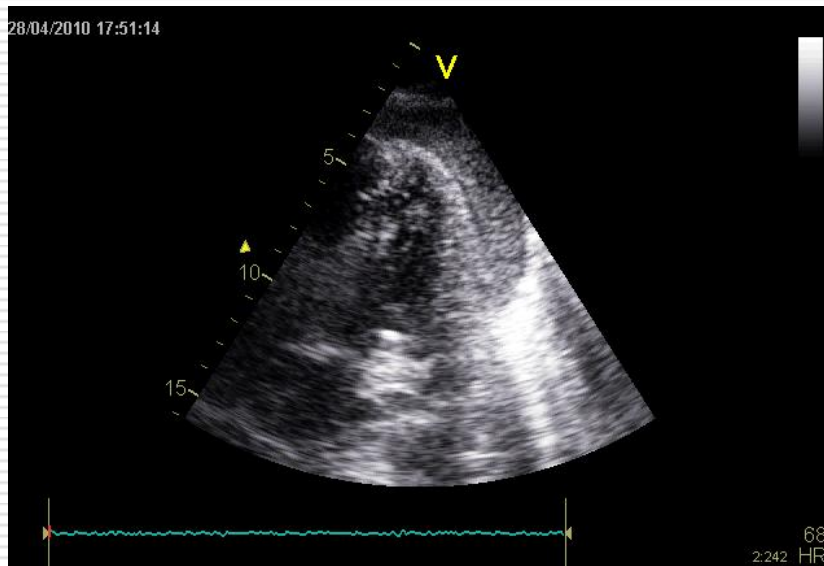
Využití ultrazvuku při KPR

- ❑ **Diagnostické aspekty** - identifikace potenciálně reverzibilních příčin oběhové zástavy a vliv na volbu/změnu terapie
- ❑ **Prognostické aspekty** - predikce výsledku a eventuální futility kardiopulmonální resuscitace
- ❑ **Praktické aspekty** - taktika provedení ultrazvukového vyšetření srdce (protokoly vyšetření, projekce, interference s resuscitací, časová náročnost), hrudníku/plic, břicha a cév během kardiopulmonální resuscitace
- ❑ **Podpora terapie** - guiding perikardiální/pleurální punkce, kontrola pozice endotracheální kanyly, podpora kanylace centrální žíly (pokud je to nutné)

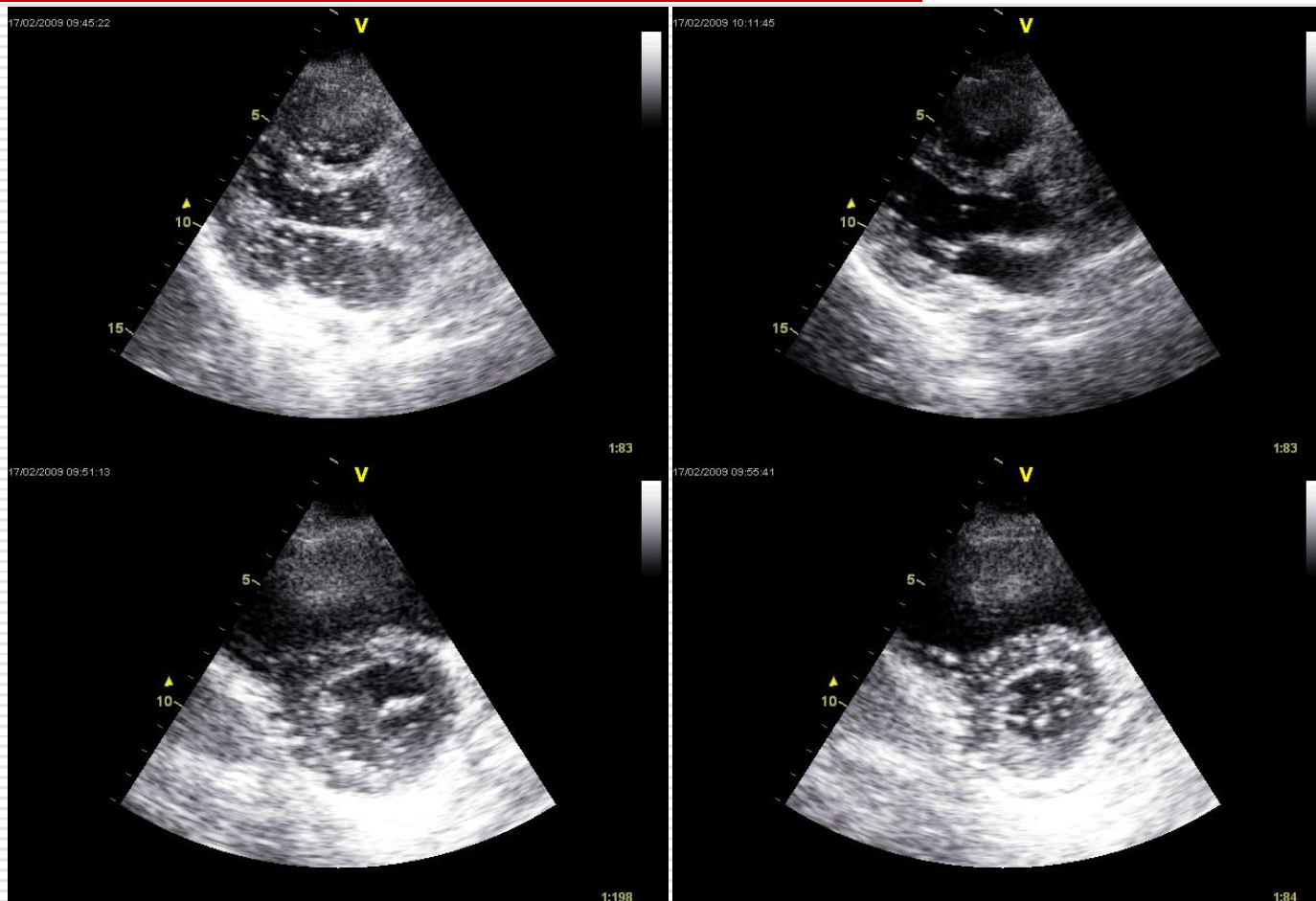


Diagnostické aspekty – identifikace potenciálně reverzibilních příčin oběhové zástavy a vliv na volbu/změnu terapie

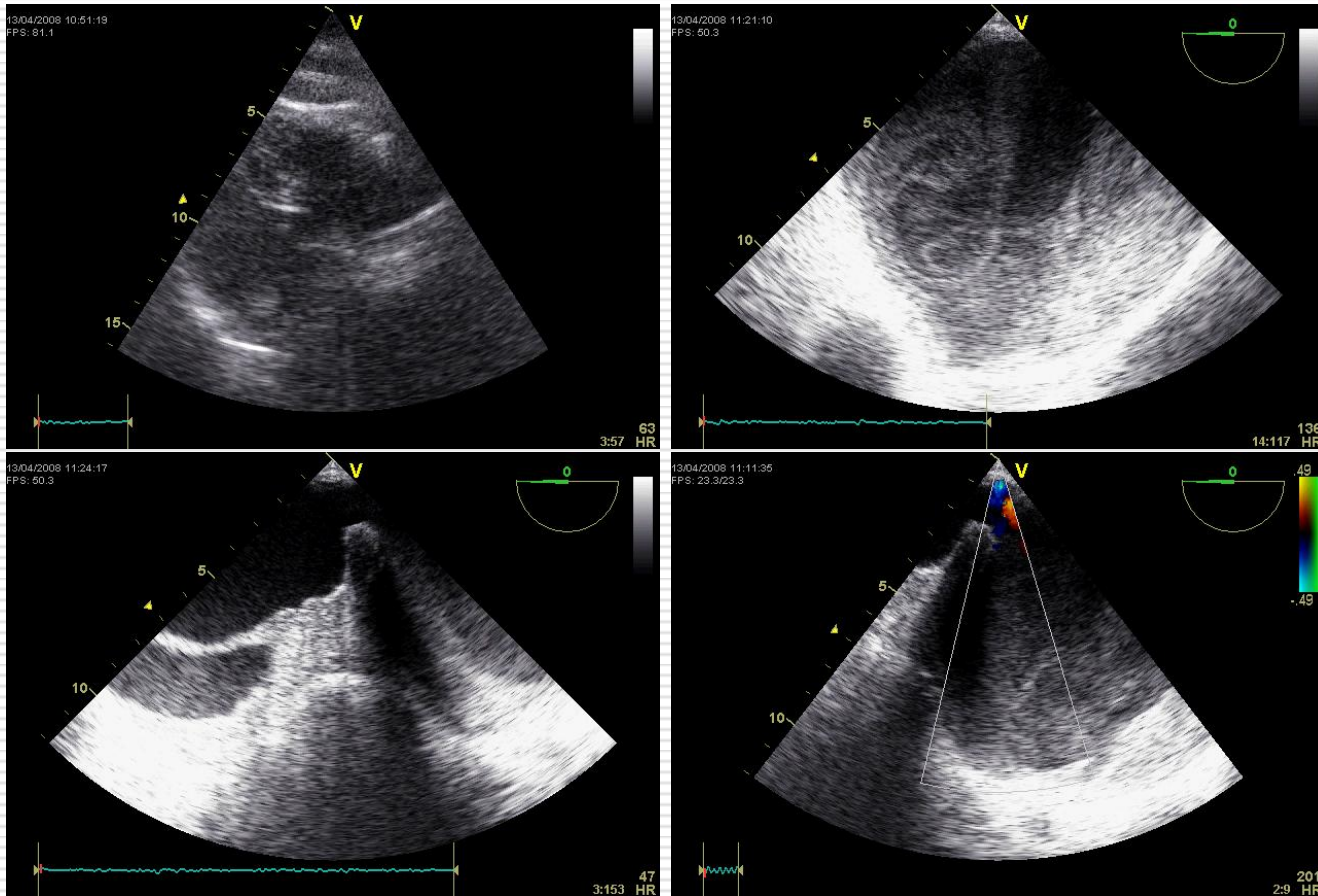
Srdeční tamponáda



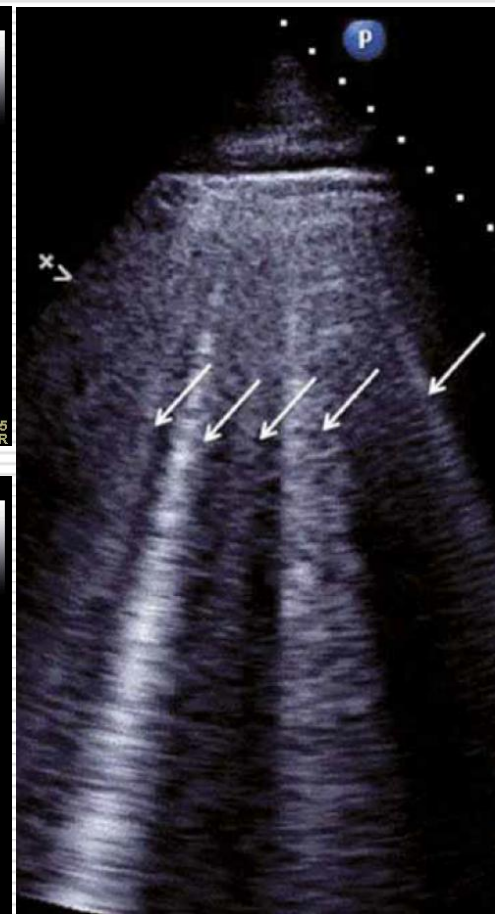
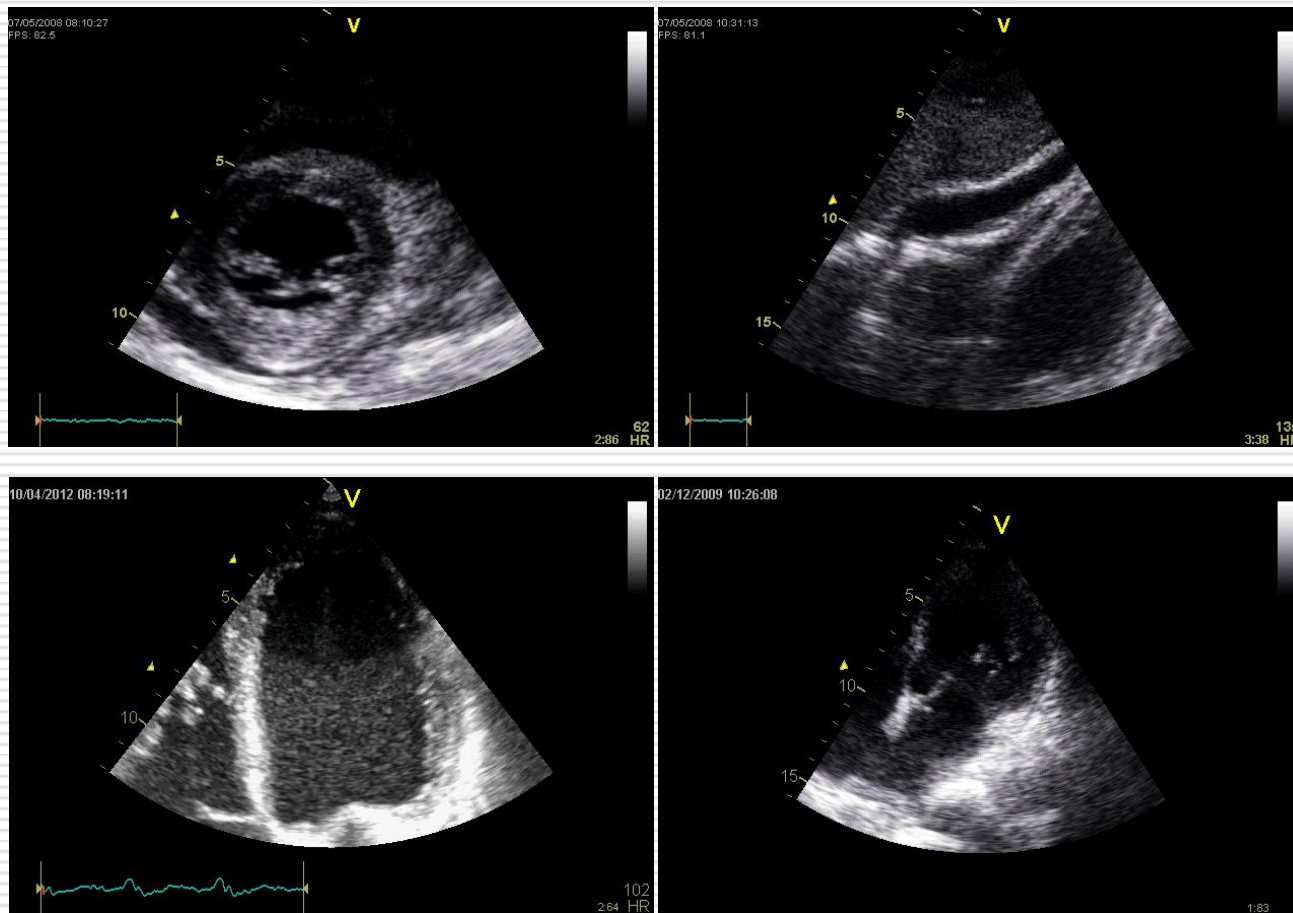
Plicní embolie



Hypovolémie/hemoragie

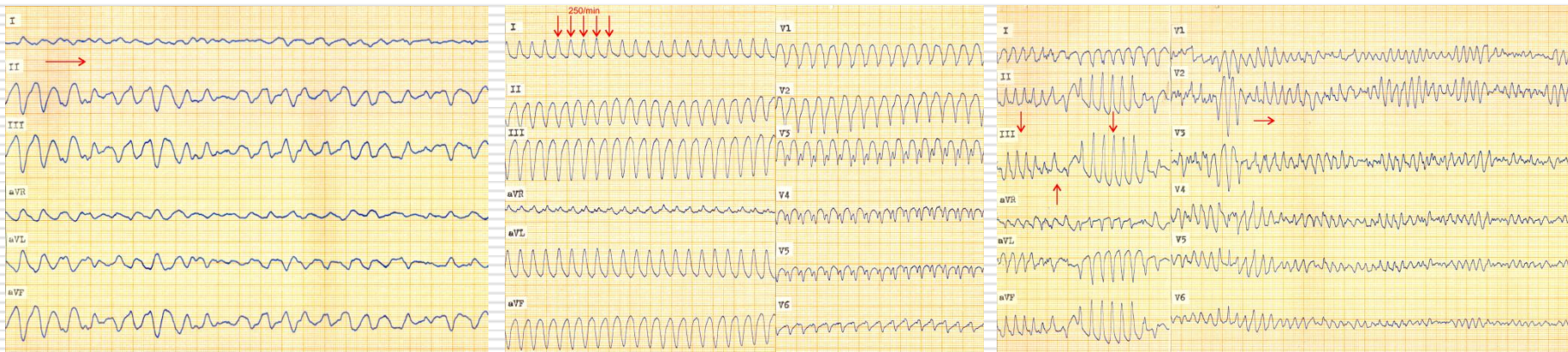


Srdeční selhání

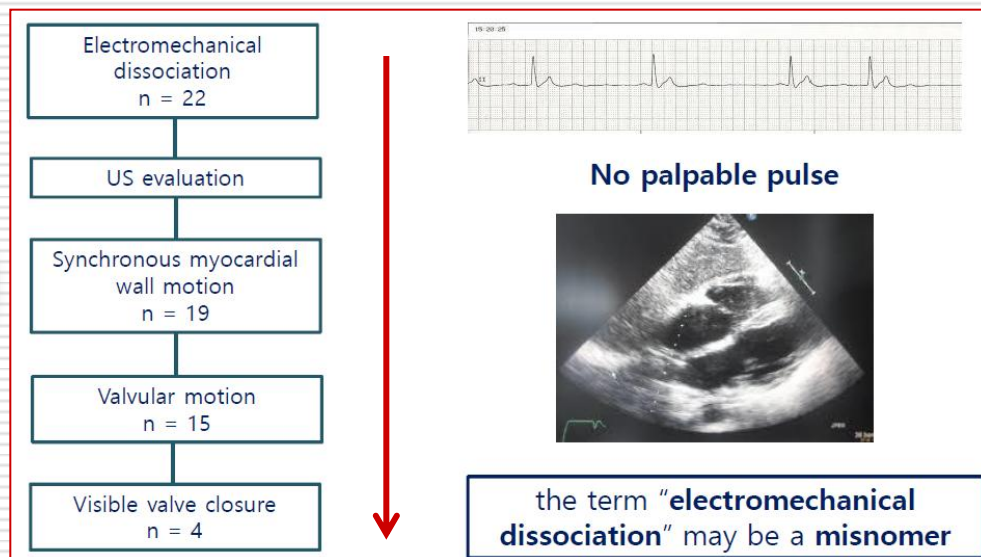




Prognostické aspekty - predikce výsledku a eventuální futility kardiopulmonální resuscitace



Oběhová zástava – asystolie, PEA, maligní arytmie

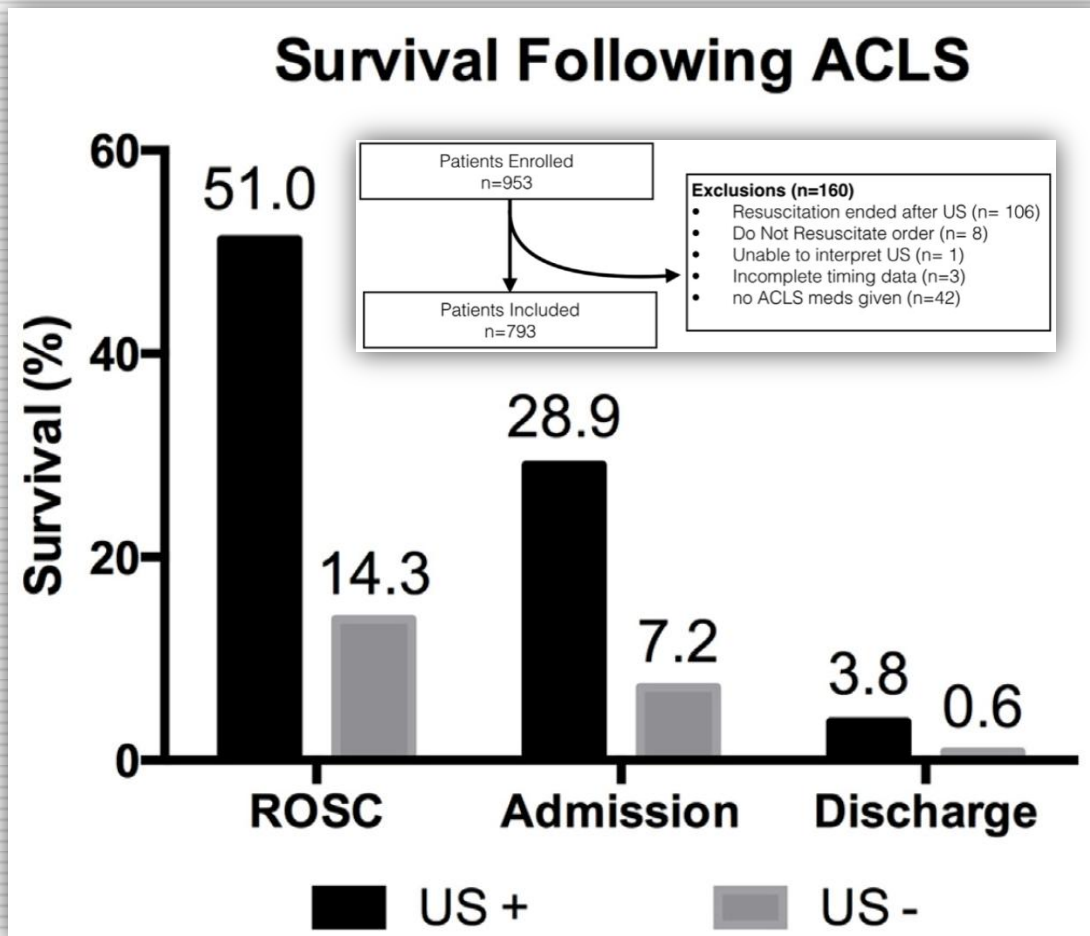


Prognóza

Clinical paper

Emergency department point-of-care ultrasound in out-of-hospital and in-ED cardiac arrest[☆]

Romolo Gaspari^{a,*}, Anthony Weekes^b, Srikar Adhikari^c, Vicki E. Noble^d



	Odds ratio (95% CI)	p Value	
ROSC			
Gender (F vs M)	1.6 (1.1–2.3)	0.010	AUC = 0.803 (0.769–0.837)
Rhythm during initial US (PEA vs asystole)	2.8 (1.8–4.3)	<0.0001	
Cardiac activity (Yes vs No)	3.0 (2.0–4.5)	<0.0001	
Length of resuscitation	1.02 (1.01–1.03)	<0.0001	
Epi per min	0.16 (0.018–1.47)	0.10	
Survival to hospital admission			
Gender (F vs M)	1.8 (1.2–2.8)	0.007	AUC = 0.762 (0.710–0.813)
Bystander (Yes vs No)	1.6 (1.0–2.4)	0.042	
Rhythm during initial US (PEA vs Asystole)	2.1 (1.2–3.6)	0.011	
Cardiac activity (Yes vs No)	3.6 (2.2–5.9)	<0.0001	
Shockable rhythm (LS vs CS)	2.9 (1.4–5.9)	0.006	
Shockable rhythm (NS vs CS)	1.7 (0.97–3.1)	0.96	
Epi per min	0.12 (0.013–1.23)	0.075	
Survival to hospital discharge			
Bystander (Yes vs No)	2.6 (0.84–8.3)	0.096	AUC = 0.825 (0.739–0.912)
Presenting rhythm (PEA vs Asystole)	1.8 (0.34–9.3)	0.64	
Presenting rhythm (VF/VT vs asystole)	5.5 (1.03–30.0)	0.022	
Cardiac activity (Yes vs No)	5.7 (1.5–21.9)	0.011	

Characteristic of subjects	All patients (n = 793)	
Demographics		
Age, mean (SD), years	64.2 ± 17.4	
Male—n (%)	492 (62.0)	
Details of cardiac arrest		
Bystander witnessed—no. (%)	334 (42.1)	
Bystander CPR—no. (%)	268 (33.8)	
Out of hospital arrest—no. (%)	680 (85.8)	
	Absence of cardiac activity on initial US (n = 530)	Comparison between US activity groups
Presence of cardiac activity on initial US (n = 263)		
66.1 ± 16.1	63.2 ± 18.0	p = ns
151 (57.4)	341 (64.3)	p = ns
141 (53.6)	193 (36.4)	p < 0.001
105 (39.9)	163 (30.8)	p = 0.02
197 (74.9)	483 (91.1)	p < 0.001

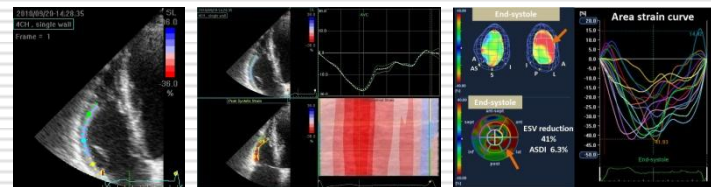
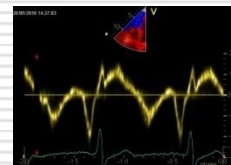
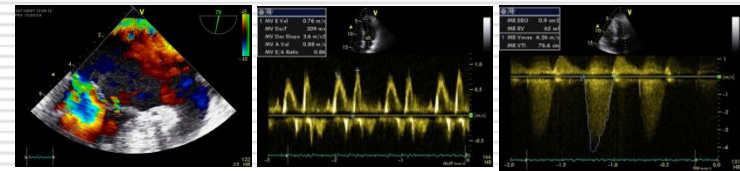
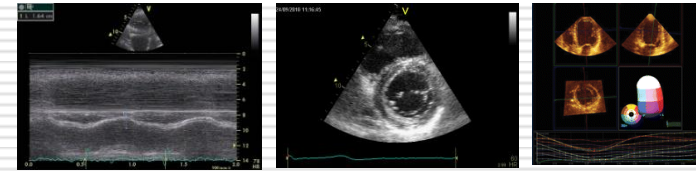


Praktické aspekty - taktika provedení ultrazvukového vyšetření srdce (protokoly vyšetření, projekce, interference s resuscitací, časová náročnost), hrudníku/plic, břicha a cév během kardiopulmonální resuscitace

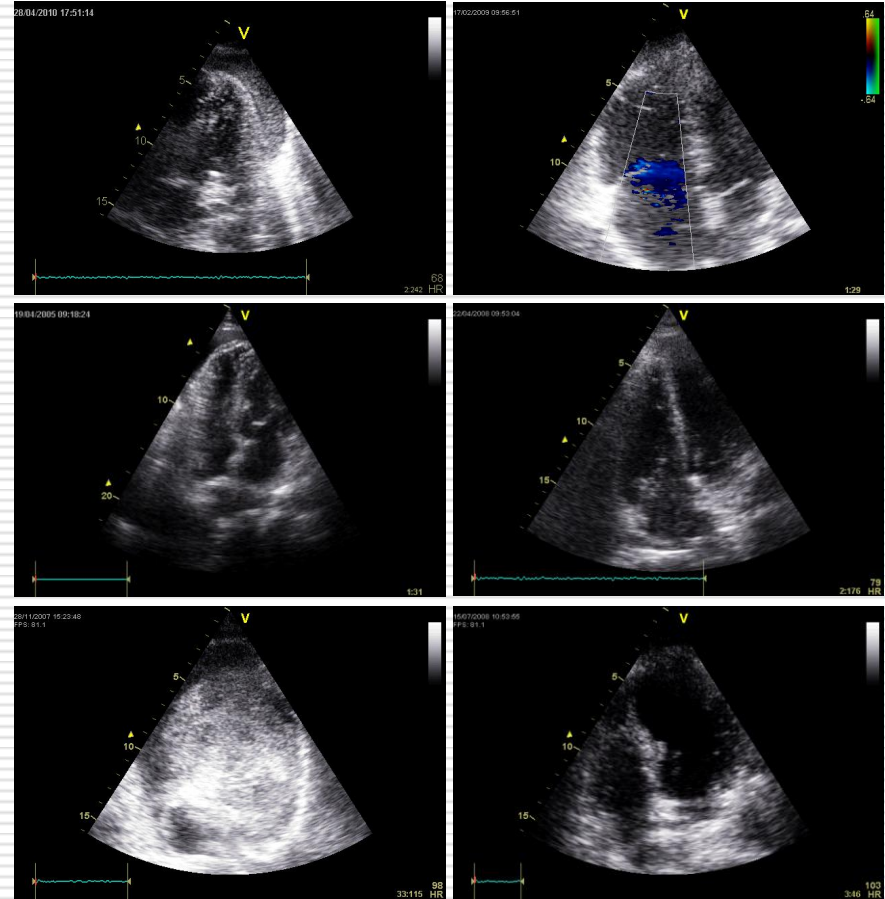
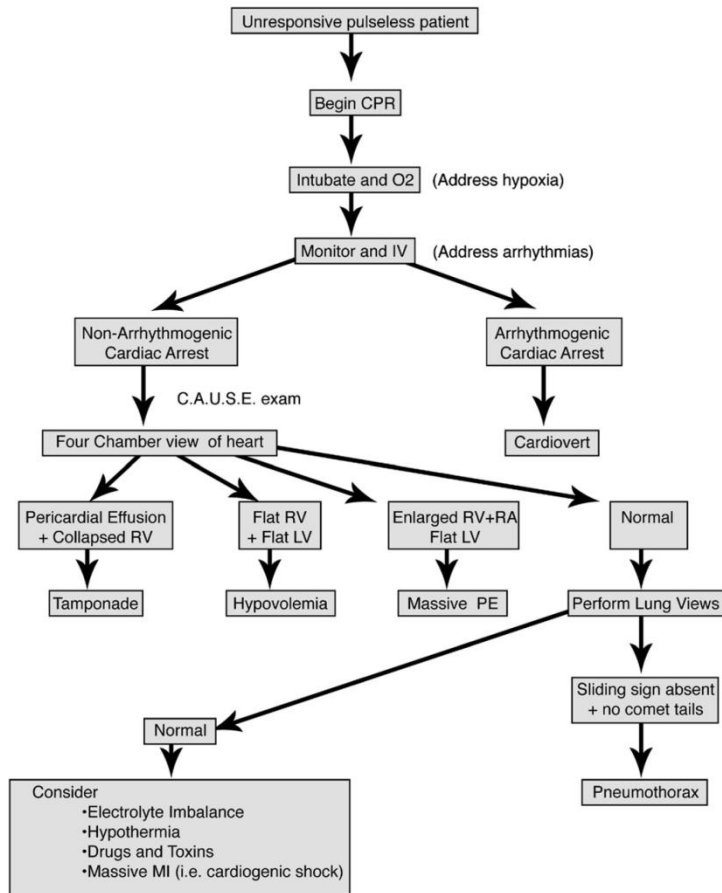


Echokardiografie/UZ

- **MM/2DE/RT 3DE**
- **CEE**
- **Doppler (CFM, PWD, CWD)**
- **Tissue Doppler imaging**
- **2D/3D strain**

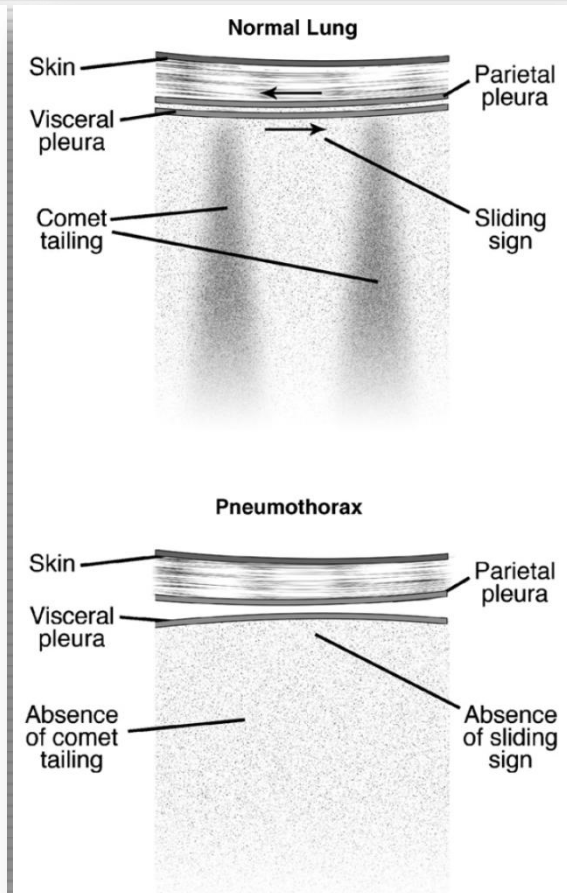
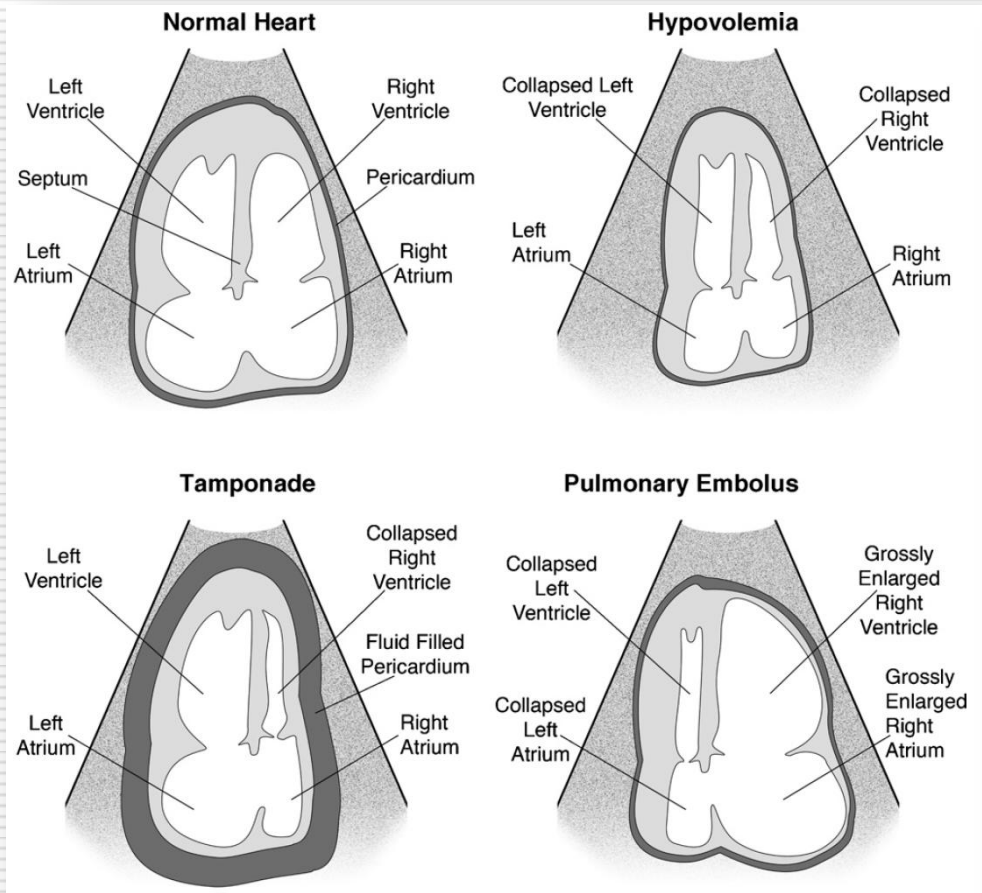


CAUSE - Cardiac Arrest Ultra-Sound Exam - A better approach to managing patients in primary non-arrhythmogenic cardiac arrest

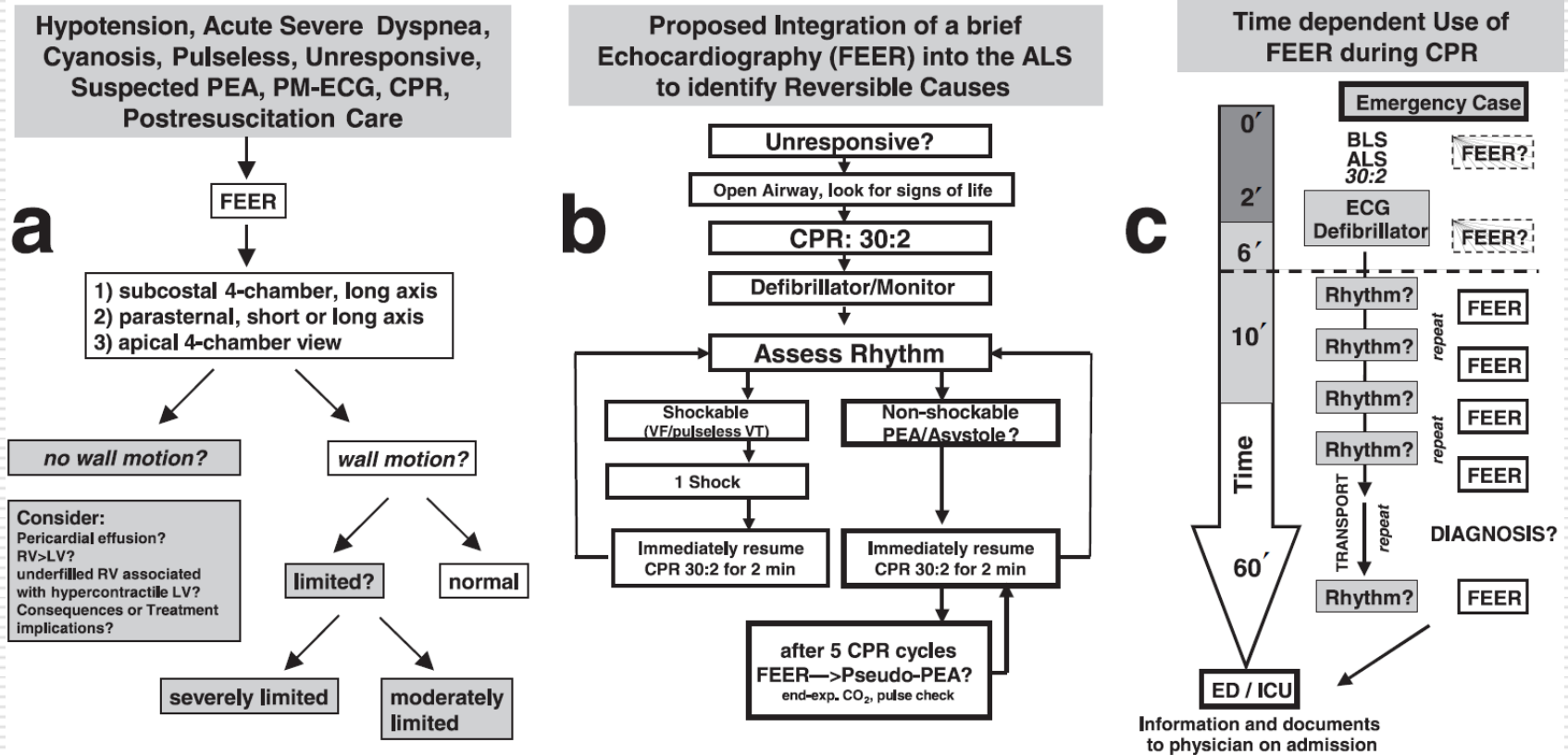


C.A.U.S.E.: Cardiac arrest ultra-sound exam— A better approach to managing patients in primary non-arrhythmogenic cardiac arrest☆

Caleb Hernandez^a, Klaus Shuler^a, Hashibul Hannan^a, Chionesu Sonyika^a,
Antonios Likourezos^{a,*}, John Marshall^{a,b}



FEER - Focused Echocardiographic Evaluation in Resuscitation management



Focused echocardiographic evaluation in resuscitation management: Concept of an advanced life support–conformed algorithm

Raoul Breitzkreutz, MD; Felix Walcher, MD, PhD; Florian H. Seeger, MD

High-quality CPR, preparation, team information

1) *Perform* immediate and accurate BLS and ACLS according to AHA/ERC/ILCOR guidelines, at least five cycles of chest compression/ventilation

2) *Tell* the CPR team: “I am preparing an echocardiogram”

3) *Prepare* portable ultrasound (let prepare) and *test* it

4) *Accommodate* situation (e.g., best position of patient and doctor, removal of clothes), be ready to start

Execution, obtaining the echocardiogram

5) *Tell* CPR Team to count down 10 secs and to undertake a pulse check simultaneously

6) *Command*: “Interrupt at the end of this cycle for echocardiography”

7) *Put* the probe gently onto the patients subxiphoidal region during chest compressions

8) *Perform* a subcostal (long axis) echocardiogram as quickly as possible. If you cannot identify the heart after 3 secs, stop the interruption and repeat again five cycles later and/or with the parasternal approach.

Resuming CPR

9) *Command* after 9 secs at the latest: “Continue CPR” and control it

Interpretation and consequences

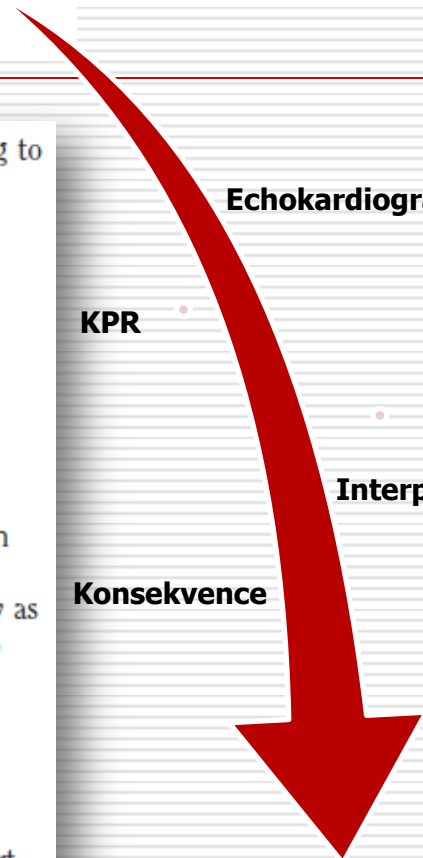
10) *Communicate* (after continuation of chest compressions only) the findings to the CPR team (e.g. wall motion, heart is squeezing, cardiac stand still, (massive) pericardial effusion, no conclusive finding, suspected pulmonary artery embolism, hypovolemia) and *explain* consequences and follow-up procedure

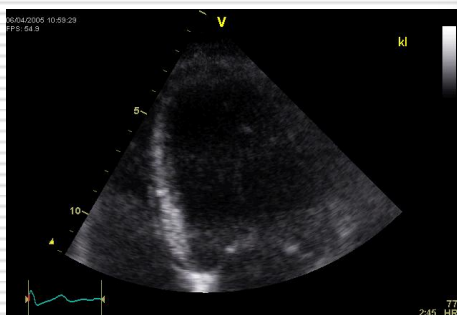
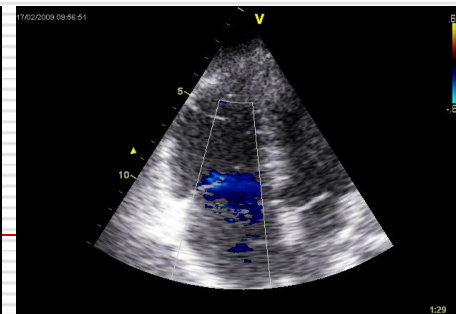
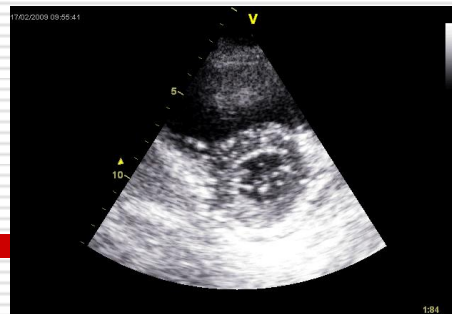
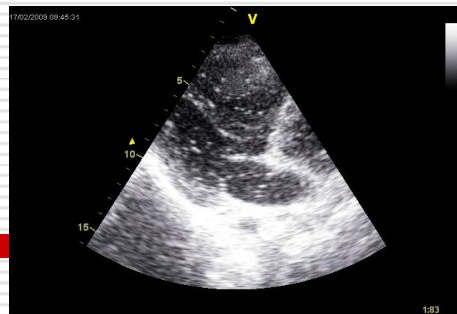
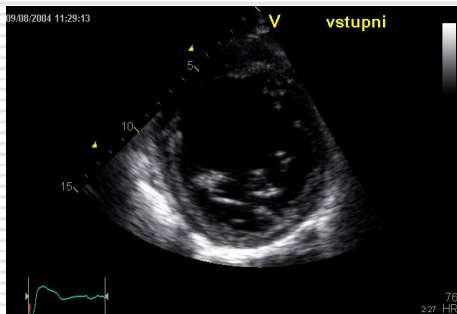
Echokardiografie

KPR

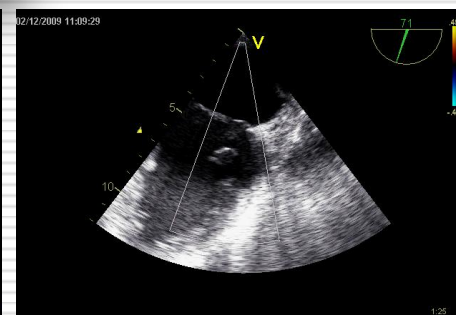
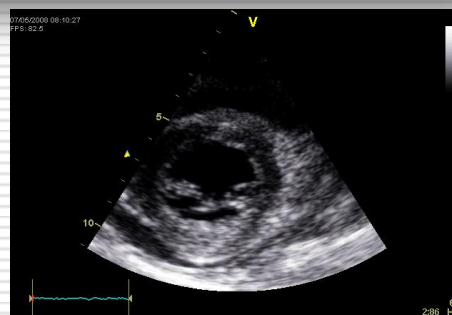
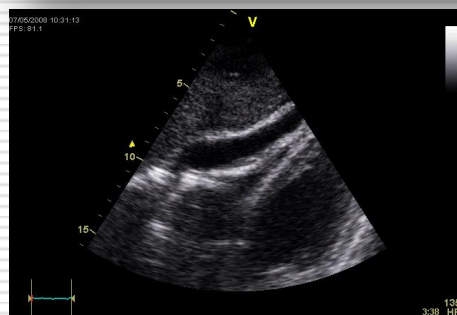
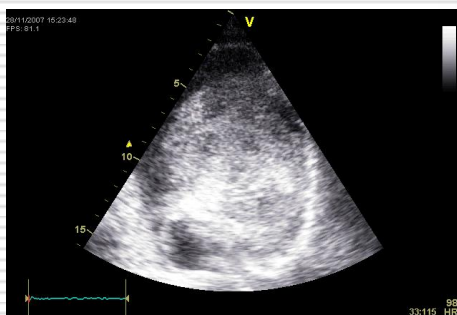
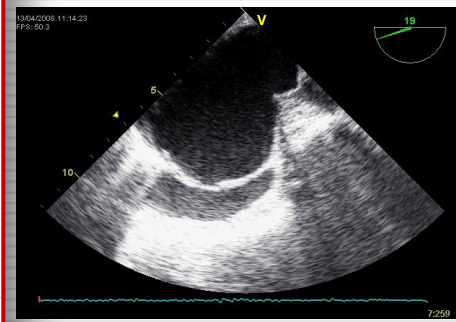
Interpretace

Konsekvence

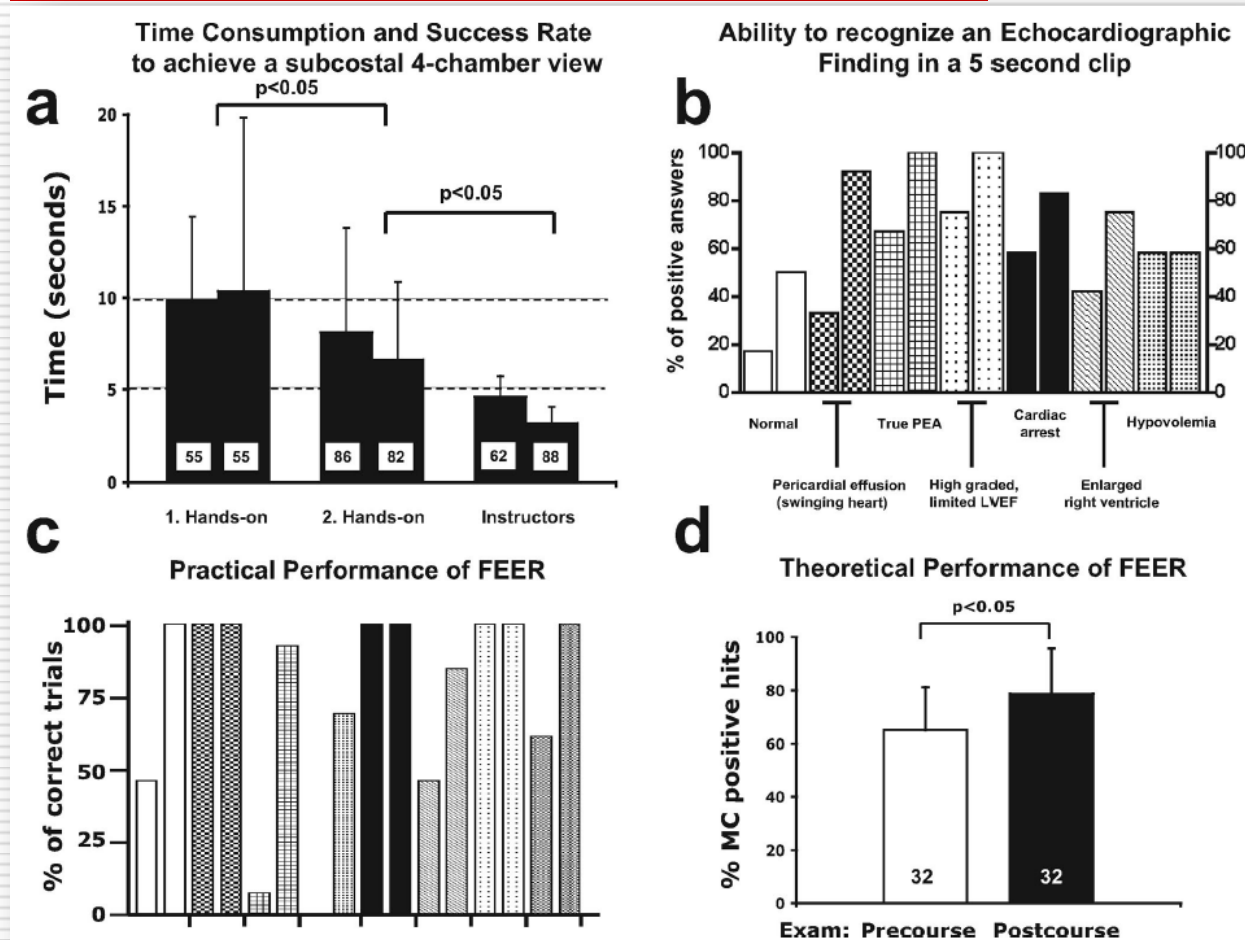




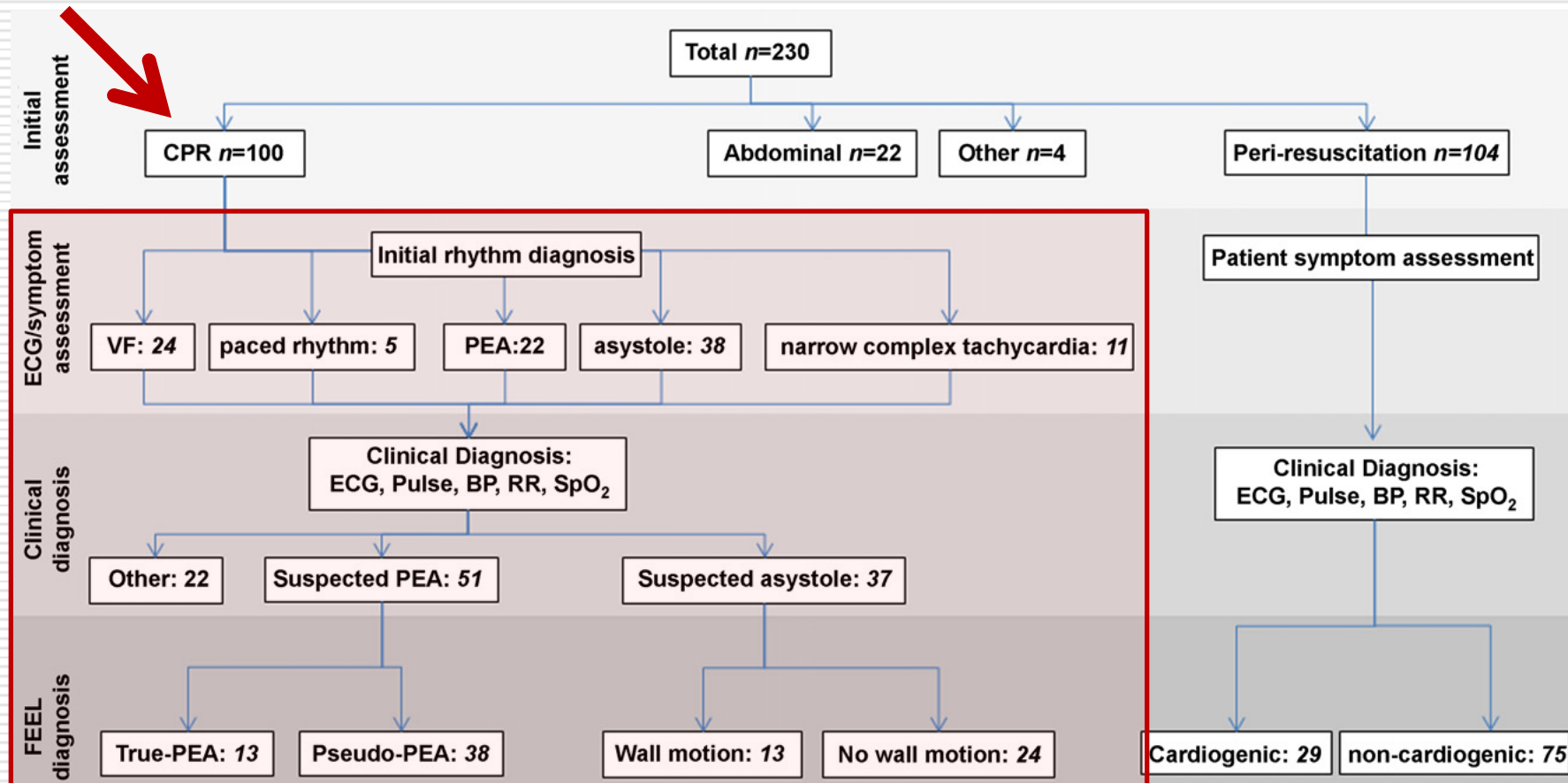
Possible Echocardiographic Findings	(Qualitative) Diagnoses
Wall movement	Circulation present
No wall movement in asystole, pulselessness, PEA, other rhythms	Proven cardiac standstill
Limited pump function	Myocardial insufficiency
Severely limited	
Moderately limited	
Wall motion, pulselessness, regular rhythm	Pseudo-PEA
No wall motion, pulselessness, regular rhythm	True PEA
Hypercontractile ventricular walls, underfilled right ventricle and atrium, hypotension, tachycardia, "kissing" trabecular muscles	Hypovolemia
Enlarged right ventricular cavum, "D-sign"	Suspected pulmonary artery embolism
Pericardial effusion (small or massive) and pericardial tamponade	Pericardial effusion (small or massive), with or without functional relevance, tamponade
No conclusive finding	No diagnosis



FEER – vliv tréningu na praktické a teoretické dovednosti



FEEL - Focused Echocardiographic Evaluation in Life support and peri-resuscitation of emergency patients



FEEL - diagnóza/prognóza, management

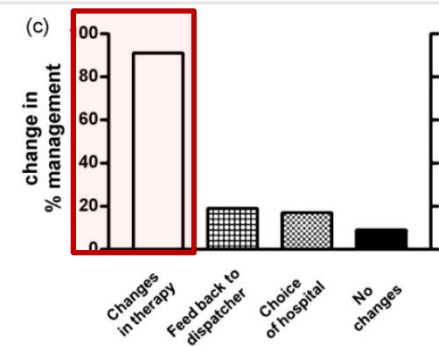
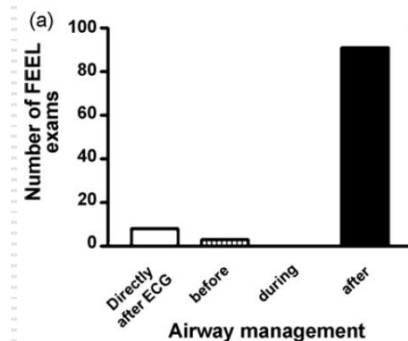
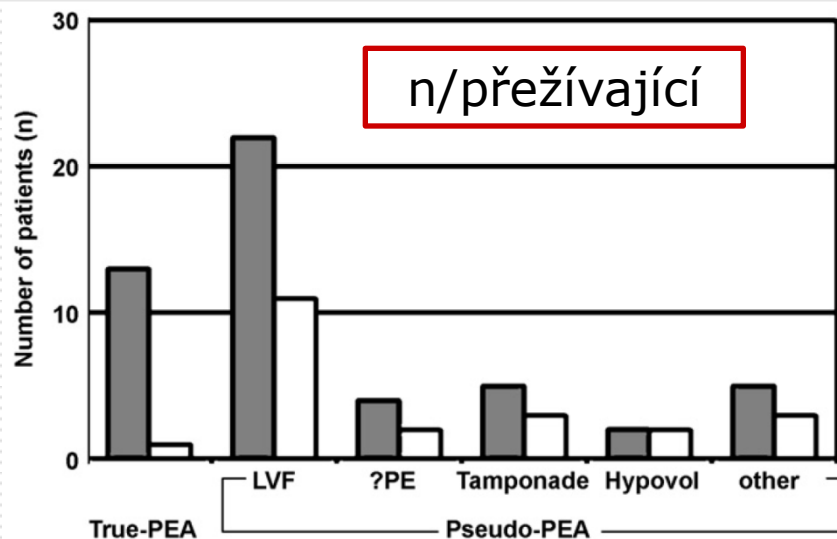


Clinical paper

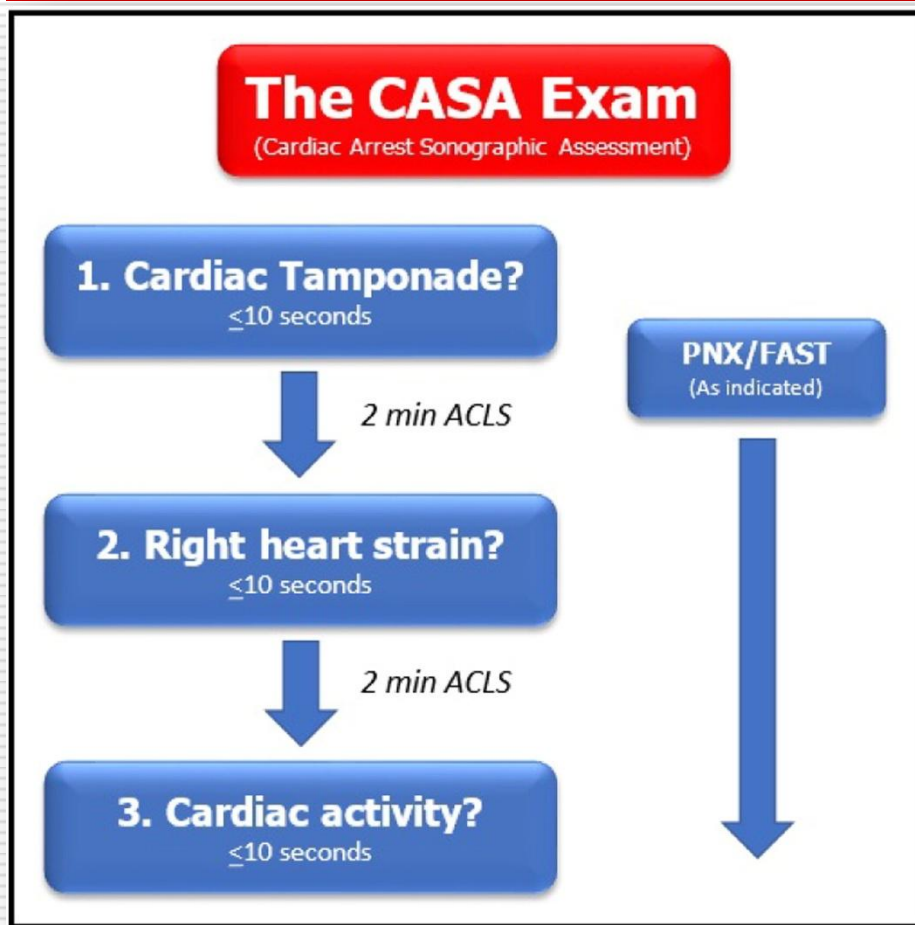
Focused echocardiographic evaluation in life support and peri-resuscitation of emergency patients: A prospective trial^{☆,☆☆}

Raoul Breitzkreutz^{a,*,☆☆}, Susanna Price^b, Holger V. Steiger^c, Florian H. Seeger^d, Hendrik Ilper^e, Hanns Ackermann^f, Marcus Rudolph^g, Shahana Uddin^h, Markus A. Weigandⁱ, Edgar Müller^j, Felix Walcher^k, from the Emergency Ultrasound Working Group of the Johann Wolfgang Goethe-University Hospital, Frankfurt am Main^l

Pre-FEEL diagnosis	Post-FEEL diagnosis	Survived to admission	Died on scene
Suspected PEA (n = 51)	-	22 (43%)	29 (57%)
	Pseudo-PEA (n = 38) (wall motion present) True-PEA (n = 13) (no wall motion present)	21/38 (55%) 1/13 (8%)	17/38 (45%) 12/13 (92%)
Suspected asystole (n = 37)	-	13/37 (35%)	24/37 (65%)
	Wall motion present (n = 13) No wall motion present (n = 24)	9/37 (24%) 4/37 (11%)	4/37 (11%) 20/37 (54%)
Pooled suspected PEA and asystole (n = 88)	-	35/88 (40%)	53/88 (60%)
	Wall motion present	30 (34%)	21 (24%)
	No wall motion present	5 (6%)	32 (36%)



CASA - Cardiac Arrest Sonographic Assessment exam



Perikardiální výpotek vedoucí k **srdeční tamponádě** je příčinou zástavy oběhu u 4-15% případů KPR. Pacienti po evakuaci tamponády přežívají signifikantně více než ostatní s PEA (15.4% vs. 1.3%)

Plicní embolie je příčinou zástavy oběhu u 4-7.6% případů KPR. Pacienti po úspěšném zaléčení PE přežívají signifikantně více než ostatní s PEA (6.7% vs. 1.3%)

Pacienti s PEA a obrazem „**stojícího srdce**“ přežívají signifikantně méně než s pseudo-PEA (0-0.6%)

American Journal of Emergency Medicine 36 (2018) 715–732

Gaspari R, et al. Emergency department point-of-care ultrasound in out-of-hospital and in-ED cardiac arrest. Resuscitation Dec 2016;109:33–9.

Tayal VS. Emergency echocardiography to detect pericardial effusion in patients in PEA and near-PEA states. Resuscitation 2003 Dec;59(3):315–8.

Breitkreutz R, et al. Focused echocardiographic evaluation in life support and peri-resuscitation of emergency patients: a prospective trial.

Resuscitation Nov 2010;81(11):1527–33.

Vliv POCUS na prodloužení doby přerušení KPR

Clinical paper

Ultrasound use during cardiopulmonary resuscitation is associated with delays in chest compressions[☆]

Maite A. Huis in 't Veld^a, Michael G. Allison^b, David S. Bostick^a, Kiondra R. Fisher^c, Olga G. Goloubeva^d, Michael D. Witting^e, Michael E. Winters^{e,*}

^a E-Department of Emergency Medicine, University of Maryland Medical Center, Baltimore, MD, United States

^b Critical Care Medicine, Saint Agnes Hospital, Baltimore, MD, United States

^c University of Maryland School of Medicine, Baltimore, MD, United States

^d Department of Epidemiology & Public Health, University of Maryland School of Medicine, Baltimore, MD, United States

^e Department of Emergency Medicine, University of Maryland School of Medicine, Baltimore, MD, United States

Použití POCUS během resuscitace při oběhové zástavě bylo spojeno s **prodloužením doby trvání pulsních kontrol** o 8,4 s, což způsobilo **přerušeni provádění komprese hrudníku** na téměř dvojnásobnou dobu trvání než 10 s doporučenou současnými guidelines (2015). Je extrémně důležité **věnovat pozornost délce přerušeni KPR** při použití ultrazvuku během resuscitace.

Mean duration of pulse checks, calculated by treating each pulse check as an independent observation.

Type of pulse check	Mean duration in seconds	95% CI
Without POCUS	13	12–15
With POCUS	21	18–24

- *Single center studie*
- *23 pacientů, 123 kontrol pulzací*
- *Nezávislé hodnocení měřením času z videozáznamů KPR*

US-C/A/B

Od 1/2016-3/2017 bylo zařazeno 177 pacientů se zástavou oběhu, u kterých byl aplikován US-CAB.

Doba trvání protokolu byla **(C)** 9.0 ± 1.4 , **(A)** 7.5 ± 1.5 a **(B)** 16.0 ± 1.9 s.

Srdeční mechanická aktivita byla zjištěna ve 47 případech (26,6%), s vyšším výskytem ROSC (95,7% vs. 21,5%, $p < 0,0001$) a přežití do hospitalizace (25,5% vs. 10%, $p < 0.01$).

UZ průkaz mechanické srdeční aktivity po 10 minutách KPR

vykazoval 100% citlivost, specifitu, pozitivní a negativní prediktivní hodnotu pro ROSC.

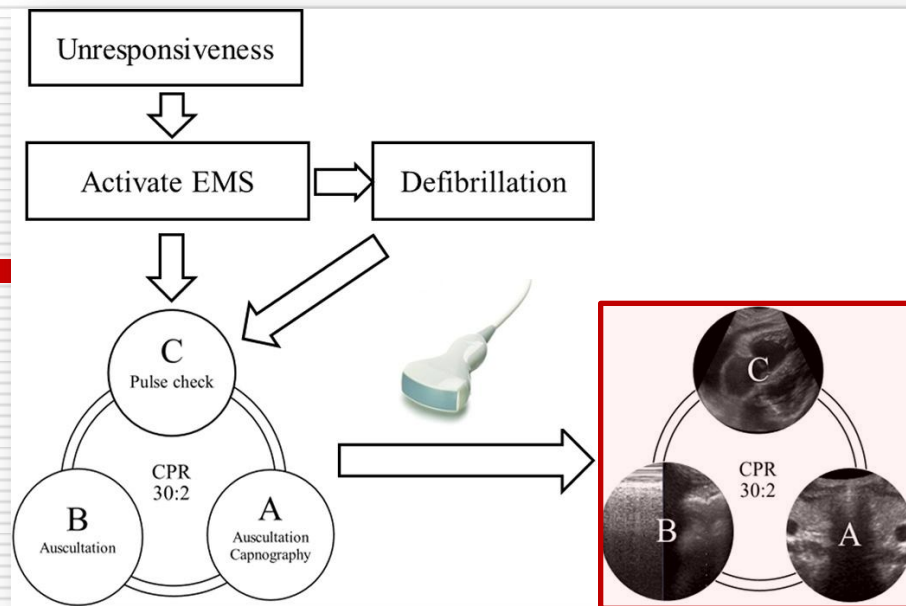


Table 2
Test characteristics for each US-C, A, and B examinations.

	Reference		Sen ^a , % (95% C.I. ^a)	Spe ^a , % (95% C.I. ^a)	PPV ^a , % (95% C.I. ^a)	NPV ^a , % (95% C.I. ^a)
US-C	ROSC ^b	Non-ROSC				
Presence of cardiac activity, n	45	2	62 (50-73)	98 (95-100)	96 (90-100)	78 (71-86)
Absence of cardiac activity, n	28	102				
US-A	Tracheal intubation ^c	Esophageal intubation				
Sonographic tracheal intubation, n	156	0	100 (100)	100 (100)	100 (100)	100 (100)
Sonographic esophageal intubation, n	0	21				
US-B	Proper ventilation ^c	Improper ventilation				
Sonographic proper ventilation, n	174	0	99 (98-100)	100 (100)	100 (100)	67 (13-100)
Sonographic improper ventilation, n	1	2				

^a ROSC denotes return of spontaneous circulation; Sen, sensitivity; Spe, specificity; PPV, positive predictive value; NPV, negative predictive value; CI, confidence interval.
^b The reference standard is the result of auscultation.
^c The reference standard is the result of auscultation.

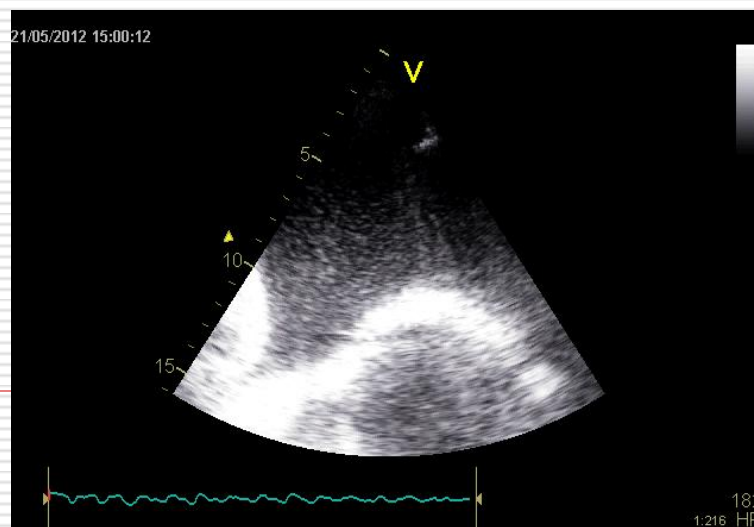
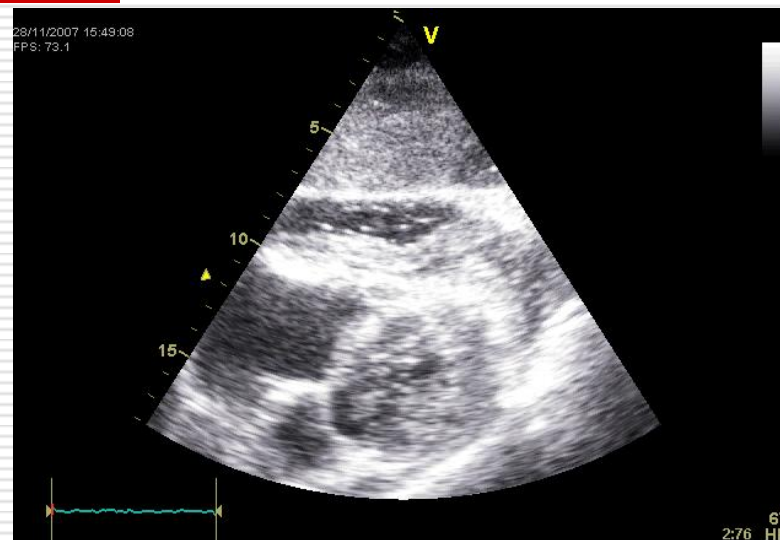
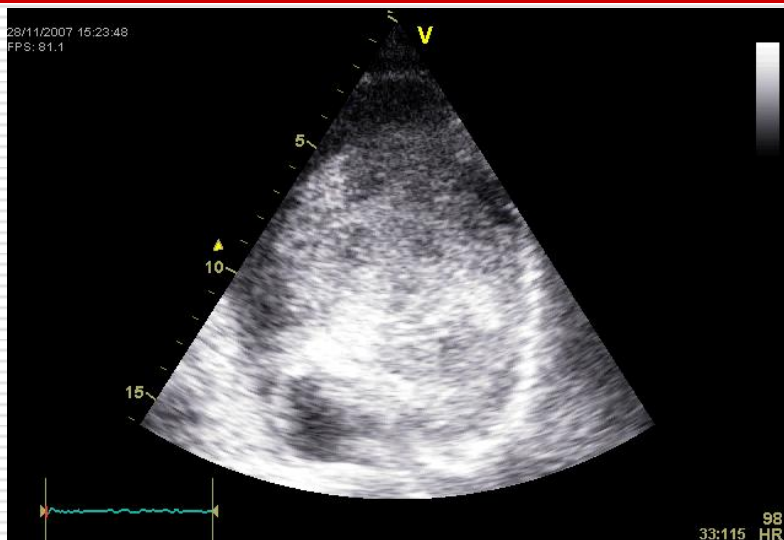
Table 3
Test characteristics of sonographic cardiac activity for return of spontaneous circulation detected at different time points.

Time point	Cardiac activity, n	ROSC ^a , n	Sensitivity, % (95% C.I. ^a)	Specificity, % (95% C.I. ^a)	PPV ^a , % (95% C.I. ^a)	NPV ^a , % (95% C.I. ^a)
Less than 4 min of CPR ^b (n = 14)	1	6	0	88 (47-100)	0	54 (25-81)
4-6 min (n = 22)	2	14	7 (0-34)	88 (47-97)	50 (1-99)	35 (15-59)
6-8 min (n = 28)	5	13	38 (14-68)	100 (78-100)	100 (48-100)	65 (43-84)
8-10 min (n = 36)	12	13	92 (64-100)	100 (85-100)	100 (74-100)	96 (79-100)
10-12 min (n = 48)	16	16	100 (79-100)	100 (89-100)	100 (79-100)	100 (89-100)
12-14 min (n = 26)	10	10	100 (69-100)	100 (79-100)	100 (69-100)	100 (79-100)
14-16 min (n = 3)	1	1	100 (3-100)	100 (16-100)	100 (3-100)	100 (16-100)



Podpora terapie - guiding perikardiální/pleurální punkce, kontrola pozice endotracheální kanyly, podpora kanylace centrální žíly (pokud je to nutné)

Guiding perikardiální/pleurální punkce



Tracheální ultrasonografie

Tracheální ultrasonografie v reálném čase je přesná metoda **identifikace správné polohy endotracheální kanyly během KPR** bez nutnosti přerušení komprese hrudníku.

Z 89 zahrnutých pacientů bylo 7 (7,8%) intubováno do jícnu.

Senzitivita, specifická, pozitivní prediktivní hodnota a **negativní prediktivní hodnota** tracheální ultrasonografie byly **100%** (95% interval spolehlivosti [CI]: 94,4-100%), 85,7% (95% CI: 42,0-99,2%), 98,8% (95% CI: 92,5-99,0%) a **100%** (95% CI: 54,7-100%).

Summary of tracheal and esophageal intubation by tracheal ultrasonography.

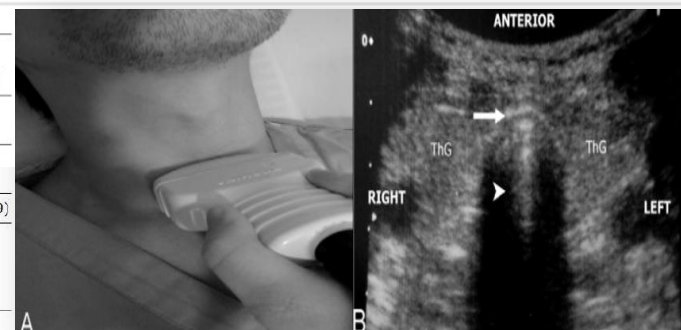
	Total (n=89)		Sonographer 1 (n=37)		Sonographer 2 (n=23)		Sonographer 3 (n=29)	
	US tracheal	US esophageal	US tracheal	US esophageal	US tracheal	US esophageal	US tracheal	US esophageal
Tracheal intubation, n	82	0	33	0	22	0	27	0
Esophageal intubation, n	1	6	1	3	0	1	0	2

US, ultrasound.

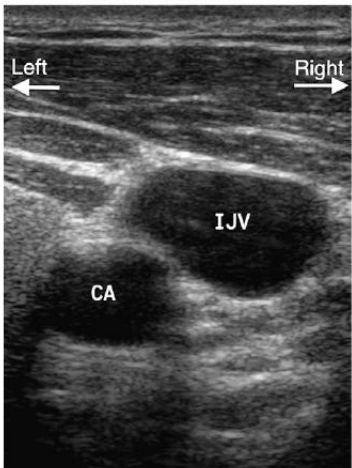
Test characteristics for tracheal intubation by sonographers.

	Total (n=89)	Sonographer 1 (n=37)	Sonographer 2 (n=23)	Sonographer 3 (n=29)
Sensitivity, % (95% CI)	100.0 (94.4–100.0)	100.0 (87.0–100.0)	100.0 (81.5–100.0)	100.0 (84.5–100.0)
Specificity, % (95% CI)	85.7 (42.0–99.2)	75.0 (21.9–98.7)	100.0 (5.5–100.0)	100.0 (19.8–100.0)
PPV, % (95% CI)	98.8 (92.5–99.9)	97.1 (82.9–99.8)	100.0 (82.5–100.0)	100.0 (84.5–100.0)
NPV, % (95% CI)	100.0 (54.7–100.0)	100.0 (31.0–100.0)	100.0 (5.5–100.0)	100.0 (19.8–100.0)

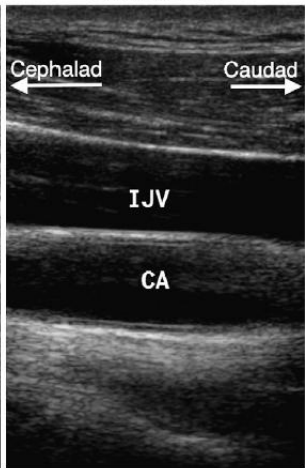
PPV, positive predictive value; NPV, negative predictive value; CI, confidence interval.



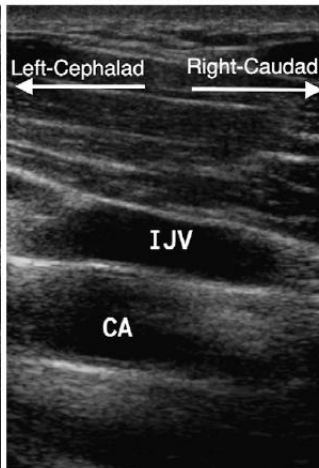
A: short axis



B: long axis



C: oblique axis



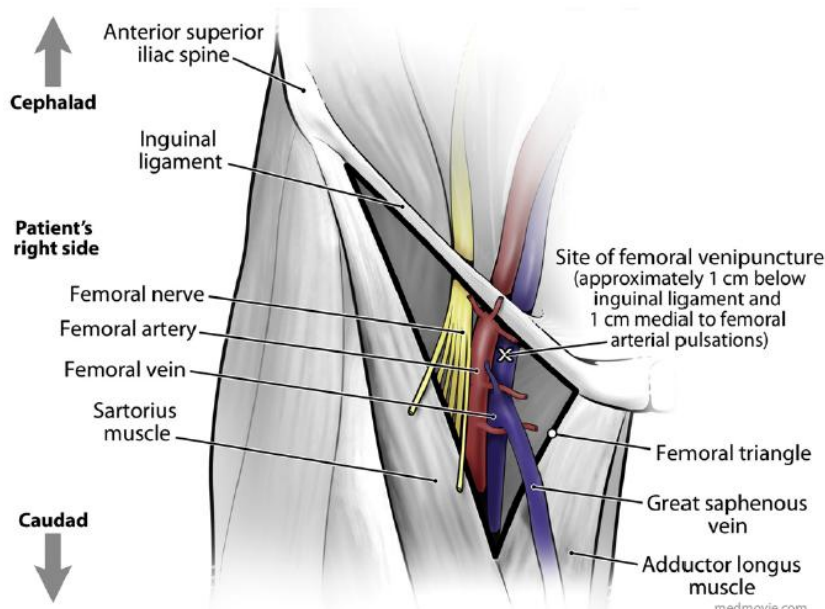
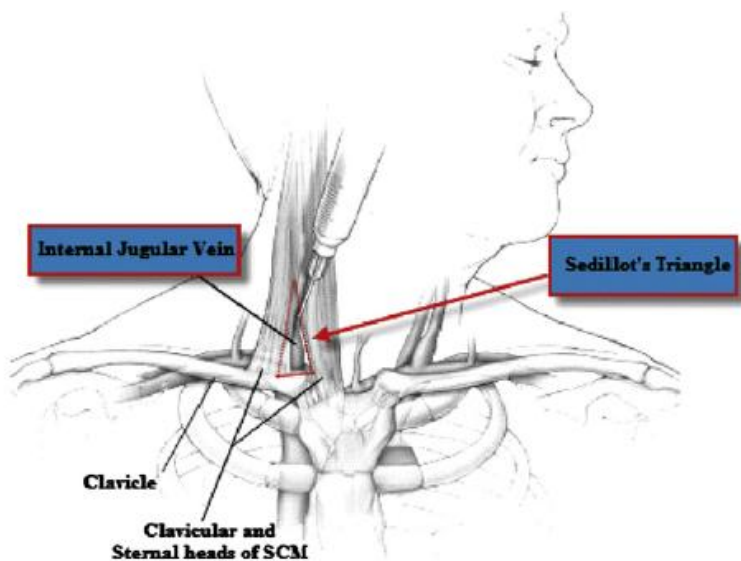
GUIDELINES AND STANDARDS

Guidelines for Performing Ultrasound Guided Vascular Cannulation: Recommendations of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists

Christopher A. Troianos, MD, Gregg S. Hartman, MD, Kathryn E. Glas, MD, MBA, FASE, Nikolaos J. Skubas, MD, FASE, Robert T. Eberhardt, MD, Jennifer D. Walker, MD, and Scott T. Reeves, MD, MBA, FASE, for the Councils on Intraoperative Echocardiography and Vascular Ultrasound of the American Society of Echocardiography, *Pittsburgh, Pennsylvania; Lebanon, New Hampshire; Atlanta, Georgia; New York, New York; Boston, Massachusetts; and Charleston, South Carolina*

(J Am Soc Echocardiogr 2011;24:1291-318.)

Keywords: Anatomy, Artery, Cannulation, Femoral, Guidelines, Internal jugular, Pediatric, Peripheral, Subclavian, Ultrasound, Vascular, Venous



Part 7: Adult Advanced Cardiovascular Life Support

2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Mark S. Link, Chair; Lauren C. Berkow; Peter J. Kudenchuk; Henry R. Halperin; Erik P. Hess; Vivek K. Moitra; Robert W. Neumar; Brian J. O'Neil; James H. Paxton; Scott M. Silvers; Roger D. White; Demetris Yannopoulos; Michael W. Donnino

- Ultrasound (cardiac or noncardiac) **may be considered** during the management of cardiac arrest, although its usefulness has not been well established (Class IIb, LOE C-EO).
- If a qualified sonographer is present and use of ultrasound does not interfere with the standard cardiac arrest treatment protocol, then ultrasound **may be considered** as an adjunct to standard patient evaluation (Class IIb, LOE C-EO).

<http://ECCGuidelines.heart.org>

Ultrasound During Cardiac Arrest^{ALS 658}

Bedside cardiac and noncardiac ultrasound are frequently used as diagnostic and prognostic tools for critically ill patients.⁴⁴ Ultrasound may be applied to patients receiving CPR to help assess myocardial contractility and to help identify potentially treatable causes of cardiac arrest such as hypovolemia, pneumothorax, pulmonary thromboembolism, or pericardial tamponade.⁴⁵ However, it is unclear whether important clinical outcomes are affected by the routine use of ultrasound among patients experiencing cardiac arrest.

2015 Evidence Summary

One limited study with a small sample size was identified that specifically addressed the utility of ultrasound during cardiac arrest. This study evaluated bedside cardiac ultrasound use during ACLS among adult patients in pulseless electrical activity arrest and found no difference in the incidence of ROSC when ultrasound was used.⁴⁶

2015 Recommendations—Updated

Ultrasound (cardiac or noncardiac) may be considered during the management of cardiac arrest, although its usefulness has not been well established (Class IIb, LOE C-EO).

If a qualified sonographer is present and use of ultrasound does not interfere with the standard cardiac arrest treatment protocol, then ultrasound may be considered as an adjunct to standard patient evaluation (Class IIb, LOE C-EO).

Závěry

1. Echokardiografie umožňuje potvrdit či vyloučit některé z **příčin srdeční zástavy**, které nejsou diagnostikovatelné jinou okamžitě dostupnou modalitou (hypovolémie, tamponáda, plicní embolie, těžká dysfunkce levé či pravé komory, infarkt myokardu a tenzní pneumotorax).
2. Echokardiografie poskytuje důležité informace po celou dobu péče o pacienta, bylo prokázáno, že **získaný echokardiografický náleznění terapeutický přístup** u 60-80% pacientů v přednemocniční péči, zlepšuje diagnostickou přesnost a efektivitu péče na odděleních urgentního příjmu.
3. Pokud je prováděna adekvátně vyškoleným lékařem, nemá periresuscitační echokardiografie negativní vliv na kvalitu na kardiopulmonální resuscitace, **může potenciálně zlepšit prognózu** a změnit celý následný management pacienta v akutní kardiologické péči.

