**Supplemental Table 1**. Summary of Finding (SoF) table regarding IVC variability and volume responsiveness

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| We recommend intensivists consider measuring inferior vena cava (IVC) collapsibility in patients on positive pressure ventilation, by Bedside cardiac ultrasound to assess fluid responsiveness prior to undergoing large volume fluid resuscitation. Any patient who has >15% change in vena caval diameter should be considered preload responsive. Patients with a smaller change in IVC diameter may not respond favorably to volume resuscitation. **Grade 1B Bibliography: Ref 14-20** | | | | | | | | | |
| **Quality assessment** | | | | | | | **Summary of Findings** | | |
| **(7 studies)** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Publication bias** | **Overall quality of evidence** | **Studies result range** | |  |
| **sensitivity** | **specificity** |
| **Diagnostic accuracy** | | | | | | | | | |
| observational  studies | serious risk of bias | No serious inconsistency | No Indirectness | No Imprecision | Undetected | ⊕⊕⊕⊝ **MODERATE** | 90-100% | 70-90% |  |
|
|
|

Notes

1. Some studies reported correlation coefficient as and end point between Cardiac output and volume
2. Higher sensitivity for fluid responsiveness is achieved with using cutoff value of 15%

**Supplemental Table 2**. Summary of Finding (SoF) table regarding TEE for volume responsiveness

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| We recommend that transesophageal echocardiography (TEE) presents a reliable, low risk, and timely solution to help the practitioner evaluate a patient’s preload responsiveness when transthoracic echocardiography (TTE) cannot be performed. **Grade 1C Bibliography: Ref 20-34-35** | | | | | | | | | |
| **Quality assessment** | | | | | | | **Summary of Findings** | | |
| **(3 studies)** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Publication bias** | **Overall quality of evidence** | **Studies result range** | |  |
| **sensitivity** | **specificity** |
| **Diagnostic accuracy** | | | | | | | | | |
| observational  studies | serious risk of bias | No serious inconsistency | No Indirectness | No Imprecision | Undetected | ⊕⊕⊝⊝ **LOW** | 90-93% | 83-100% |  |
|
|
|

Notes

1. Also reported high correlation coefficient ( r=0.923)
2. SVC by TEE yielded better accuracy (sensitivity 90% and specificity 100%)

**Supplemental Table 3**. Summary of Finding (SoF) table regarding assessment of pulmonary hypertension

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| We recommend bedside cardiac ultrasonography should be used to measure pulmonary arterial pressures in all patients with suspected primary or secondary pulmonary hypertension provided that operator has the required training for this . Grade 1B **Bibliography: Ref 35, 43-58** | | | | | | | | | |
| **Quality assessment** | | | | | | | **Summary of Findings** | | |
| **(17 studies)** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Publication bias** | **Overall quality of evidence** | **Studies result range** | |  |
| **sensitivity** | **specificity** |
| **Diagnostic accuracy** | | | | | | | | | |
| observational  studies | serious risk of bias | No serious inconsistency | No Indirectness | No Imprecision | Undetected | ⊕⊕⊕⊝ **MODERATE** | specificity | 76-96% |  |
|
|
|

Notes

1. End point is diagnostic accuracy for measurement of pulmonary hypertension (non-therapeutic end point). Cohort observational design considered as appropriate for this end-point

**Supplemental Table 4**. Summary of Finding (SoF) table regarding pulmonary embolism

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| We recommend that bedside cardiac ultrasonography and a venous exam of the proximal bilateral lower extremities should be performed in patients with suspected pulmonary embolism and should be used prior to computed tomography in unstable patients. Grade 1C **Bibliography: Ref 50-58** | | | | | | | | | |
| **Quality assessment** | | | | | | | **Summary of Findings** | | |
| **(9 studies)** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Publication bias** | **Overall quality of evidence** | **Studies result range** | |  |
| **sensitivity** | **specificity** |
| **Diagnostic accuracy** | | | | | | | | | |
| observational  studies | serious risk of bias | No serious inconsistency | No Indirectness | No Imprecision | Undetected | ⊕⊕⊝⊝ **LOW** | 13-76% | 76-96% |  |
|
|
|

Notes

1. Two end points were considered, as diagnostic utility (alone or in combination with venous Doppler) and as a management utility (for follow-up or as predictor)
2. Very wide variability and low sensitivity of McConnell’s Sign (13-76%)

**Supplemental Table 5**. Summary of Finding (SoF) table regarding Sepsis

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| We suggest that all patients admitted for sepsis may receive a bedside cardiac ultrasonography to evaluate for signs of LV dysfunctions both systolic and diastolic to help guide inotropic therapy. Grade 2C **Bibliography: 66-77 plus MA$** | | | | | | | |
| **Quality assessment** | | | | | | | **Summary of Findings** |
| **3 multi-central trials\* and 1 meta-analysis$** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Publication bias** | **Overall quality of evidence** | **RR** (95% CI) |
|
| **Early Goal Directed Therapy (EGDT) subgroups in first 6 hours** | | | | | | | |
|  | No serious risk of bias | No inconsistency | Very serious indirectness | No serious imprecision | Undetected | ⊕⊝⊝⊝ **VERY LOW** | **0.77**  **(CI 0.67-0.89)** |
|
|
|

$ MA = meta-analysis www.ccforum.com/content/18/5/570

1. Meta-analysis with predefined subgroup analysis according to the timing of EGDT for resuscitation suggested that a mortality benefit was seen only in the subgroup of EGDT within the first 6 hours (seven trials)
2. All 3 SSC multi-central trials failed to show proven beneficial effect for data driven from Central line to guide early goal directed therapy (EGDT), therefore ECHO was proposed as a monitoring alternative for the 6 hours bundle.
3. Very serious indirectness in the intervention (no head to head comparison of ECHO versus Central line) and restricted benefit to certain subgroup warranted downgrading of evidence to be very low and considered as best practice based on expert opinion.

**Supplemental Table 6**. Summary of Finding (SoF) table regarding ACLS

| **We suggest that bedside cardiac ultrasonography may be performed during asystole to guide further resuscitative efforts. Grade 2C**  **Bibliography: 81-111** | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Quality assessment** | | | | | | | **Effect** | | **Quality** | **Importance** |
| **№ of studies** | **Study design** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Other considerations** | **Relative (95% CI)** | **Absolute (95% CI)** |  |  |
| Electrical Asystole | | | | | | | | | | |
| 11 | observational studies | Very serious | No serious | serious | not serious | none | not estimable | not estimable | ⊕⊝⊝⊝ **VERY LOW** | Critical |
| Pulseless Electrical Activity (PEA) | | | | | | | | | | |
| 14 | observational studies | Very serious | No serious | serious | not serious | none | not estimable | not estimable) | ⊕⊝⊝⊝ **VERY LOW** | Critical |

1. All studies done in ACLS context are of low quality
2. Despite ultrasound capabilities of diagnosis and of detecting some of the etiological causes, however the benefit out of this on resuscitation outcome was not estimable.

**Supplemental Table 7**. Summary of Finding (SoF) table regarding CAD induced arrhythmia

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| We recommend that bedside cardiac ultrasonography should be performed in patients with ventricular tachycardia/fibrillation arrest following return of spontaneous circulation (ROSC) to look for segmental wall motion abnormalities as a surrogate for CAD being the primary cause of cardiac arrest. Grade 1B **Bibliography: Ref 112-115 plus 1 handheld study\*** | | | | | | | | | |
| **Quality assessment** | | | | | | | **Summary of Findings** | | |
| **(5 studies)** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Publication bias** | **Overall quality of evidence** | **Studies result range** | |  |
| **sensitivity** | **specificity** |
| **Diagnostic accuracy** | | | | | | | | | |
| observational  studies | serious risk of bias | No serious inconsistency | No Indirectness | No Imprecision | Undetected | ⊕⊕⊕⊝ **MODERATE** | 92-100% | 82-93% |  |
|
|
|

1. **\***study for accuracy of handheld ECHO to detect CAD [www.ncbi.nlm.nih.gov/pubmed/15276122](http://www.ncbi.nlm.nih.gov/pubmed/15276122)
2. Studies diagnosing CAD with consideration of studies diagnosing complications of CAD (such as valvualr dysfunction, rapture wall or tamponade) yielded moderate level of evidence for this recommendation (see table Sof-8).
3. Settings is semi-urgent to rule out major CAD related complications

**Supplemental Table 8**. Summary of Finding (SoF) table regarding ACS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **We recommend that patients with suspected ACS and AMI should receive a bedside cardiac ultrasonography. Grade 1C**  **Bibliography: see table SoF-7 plus 119-122** | | | | | | | | | |
| **Quality assessment** | | | | | | | **Summary of Findings** | | |
| **(9 studies)** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Publication bias** | **Overall quality of evidence** | **Studies result range** | |  |
| **sensitivity** | **specificity** |
| **Diagnostic accuracy** | | | | | | | | | |
| observational  studies | serious risk of bias | No serious inconsistency | Serious Indirectness | No Imprecision | Undetected | ⊕⊕⊝⊝ **LOW** | 92-100% | 82-93% |  |
|
|
|

1. Studies similar to table SoF-7, however the settings is semi-elective and has to be compared to full study ECHO. Therefore, the evidence was downgraded for the indirectness of settings.

**Supplemental Table 9**. Summary of Finding (SoF) table regarding tamponade and pericardial effusion

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| We recommend that bedside cardiac ultrasonography should be performed to diagnose cardiac tamponade and to increase the effectiveness and safety of pericardiocentesis and guide performance of the procedure. Grade 1B **Bibliography: Ref 123-134 plus 2 studies\*** | | | | | | | | | |
| **Quality assessment** | | | | | | | **Summary of Findings** | | |
| **(14 studies)** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Publication bias** | **Overall quality of evidence** | **Studies result range** | |  |
| **sensitivity** | **specificity** |
| **Diagnostic accuracy** | | | | | | | | | |
| observational  studies | No risk of bias | No serious inconsistency | No Indirectness | No Imprecision | Undetected | ⊕⊕⊕⊝ **MODERATE** | 96% | 98% |  |
|
|
|
| **Success and Complication rate** | | | | | | | | | |
| observational  studies | serious risk of bias | No serious inconsistency | No Indirectness | No Imprecision | Undetected | ⊕⊕⊝⊝ **LOW** | Success rate  Complication rate | 97%  4.7% |  |
|
|
|

**\*2** studies were added

1. Diagnostic accuracy study http://www.ncbi.nlm.nih.gov/pubmed/11574793

2. Success rate study

[http://www.mayoclinicproceedings.org/article/S0025-6196(11)62211-8/fulltext](http://www.mayoclinicproceedings.org/article/S0025-6196(11)62211-8/fulltext 3)

[3](http://www.mayoclinicproceedings.org/article/S0025-6196(11)62211-8/fulltext 3). Contrast studies are case series

**Supplemental Table 10**. Summary of Finding (SoF) table regarding undifferentiated hemodynamic instability

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| We recommend that bedside cardiac ultrasonography should be performed in patients with hemodynamic instability to identify underlying treatable causes and to help with fluid resuscitation. **Grade 1B**  Bibliography 135-136 | | | | | | |
| **Quality assessment** | | | | | | |
| **(2 studies**  **1 RCT and 1 observational)** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Publication bias** | **Overall quality of evidence** |
|
| 1 RCT | No serious risk of bias | No serious inconsistency | Serious indirectness | No imprecision | Undetected | ⊕⊕⊕⊝ **MODERATE** |

|  |  |  |
| --- | --- | --- |
| **Outcome (ref 134)** | **Illustrative comparative** | |
| Early US | Late US |
|  |  |  |
| **Success in reaching diagnosis** | 80%  (C.I. 70%-80%) | 50%  (C.I. 40%-60%) |

**1. \***additionalobservational study http://www.ncbi.nlm.nih.gov/pubmed/23584471 Reported high agreement with K=0.97

1. Downgrading the evidence for indirectness

**Supplemental Table 11**. Summary of Finding (SoF) table regarding prosthetic valve endocarditis

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| We recommend that the evaluation for prosthetic valve endocarditis should best be performed by a trained cardiologist. A TEE can be performed in the ICU by the critical care physician if the physician has advanced training in echocardiography and is adept at performing TEE. Grade 1B  **Bibliography: 143-145 plus MA\*** | | | | | | | |
| **Quality assessment** | | | | | | | |
| **Studies** | **Design** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Other** | **Overall quality of evidence** |
| **Diagnostic accuracy** | | | | | | | |
| I meta-analysis**\*** (20 studies) plus 3 observational | observational | No | No | Yes | No | No | ⊕⊕⊕⊝ **MODERATE** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Outcomes**  **Accuracy of TEE versus TTE\*** | **Illustrative comparative**  **(95% CI)** | | **Quality of the evidence (GRADE)** |
| **TTE** | **TEE** | ⊕⊕⊕⊝ **MODERATE** |
| Vegetation | Sen 29 %  [95 % CI: 9–6 2 %]  Sp 94 %  [95 % CI: 86–100 %] | Sn 82 %  [95 % CI: 69–90 %])  Sp 96 %  [95 % CI: 61–97 % |
| Periannular complications | Sen 36 %  [95 % CI: 27–46 %]  Sp 93 %  [95 % CI: 84–97 %] | Sen 86 %  [95 % CI: 81––90 %])  Sp 100 %  [95 % CI: 51–100 %]) |
| PHV dehiscence | Sen 11 %  95 % CI: 1–73 %]  Sp 100 %  [95 % CI: 72–100 %] | Sen 94 %  [95 % CI: 37––100 %]  Sp 97 %  [95 % CI: 84–99 %]) |
| Other signs of PHV endocarditis | Sen 33 %  [95 % CI: 24–42 %]  Sp 100 %  [95 % CI: 76–100 %] | Sen 86 %  [95 % CI: 77–92 %]  Sp 95 %  [95 % CI: 82–99 %] |

**\* MA meta-analysis http://www.ncbi.nlm.nih.gov/pubmed/25680715**

TTE=transthoeacic Echo TEE= Trans Esophageal Echo

**Supplemental Table 12**. Summary of Finding (SoF) table regarding transoesphageal ECHO in poor window of TTE

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| We recommend that a trained physician should perform TEE in patients with poor visualization of cardiac structures with TTE. Grade 1B  **Bibliography: 170-173** | | | | | | | |
| **Quality assessment** | | | | | | | |
| **Studies** | **Design** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Other** | **Overall quality of evidence** |
| **Diagnostic accuracy** | | | | | | | |
| 2 meta-analysis(22 studies) plus 1 observational | observational | No | No | Yes | No | No | ⊕⊕⊕⊝ **MODERATE** |

1. Change of management by TEE occurred in 80%

2. New diagnosis 70- 98 %

**Supplemental Table 13**. Summary of Finding (SoF) table regarding hepatopulmonary syndrome

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| We recommend that a bubble echocardiography study with agitated saline to be used in favor of nuclear scintigraphy to diagnose intrapulmonary shunting in hypoxic patients with chronic liver disease to evaluate hepatopulmonary disease. Grade 1C **Bibliography: Ref 180-188** | | | | | | | | | |
| **Quality assessment** | | | | | | | **Summary of Findings** | | |
| **(9 studies)** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Publication bias** | **Overall quality of evidence** | **Studies result range** | |  |
|  |  |
| observational  studies | serious risk of bias | No serious inconsistency | Serious Indirectness | No Imprecision | Undetected | ⊕⊝⊝⊝ **LOW** | Good correlation with CT in high grade cases of contrast ECHO | |  |

Notes

1. Two end points diagnostic accuracy and comparable quantification to CT

2. Only high grade cases by contrast Echo had good correlation with CT

3. No reported diagnostic accuracy

**Supplemental Table 14**. Summary of Finding (SoF) table regarding reversible causes of cardiac arrest

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| We recommend that BCU be performed to exclude reversible causes of cardiac arrest in critically ill children. Grade 1C  **Bibliography: 189-191** | | | | | | | |
| **Quality assessment** | | | | | | | |
| **Studies** | **Design** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Other** | **Overall quality of evidence** |
| Case series and observational studies | observational | Very Serious risk of bias | No | serious | No | No | ⊕⊝⊝⊝ **LOW** |

**Supplemental Table 15**. Summary of Finding (SoF) table regarding reversible causes of cardiac arrest

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| We recommend that pediatric BCU be used in the assessment and management of hypovolemic shock to determine preload responsiveness in critically ill children. Grade 1B  **Bibliography: 193-209** | | | | | | | |
| **Quality assessment** | | | | | | | |
| **Studies** | **Design** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Other** | **Overall quality of evidence** |
| 1 meta-analysis and rest are observational studies | observational | Serious risk of bias | No | No | No | No | ⊕⊕⊕⊝ **MODERATE** |

The most predictor indicator is ΔVpeak, in aortic blood flow velocity with AUC of ROC between 0.8 to 1

ΔVpeak= the difference of peak Aortic flow velocity during the inspiratory/expiratory phases

See graph below From reference 201

