## Contents:

### Adult Critical Care Ultrasound

<table>
<thead>
<tr>
<th>Topic</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>STARS Protocol for the Assessment of Shock</td>
<td>3-8</td>
</tr>
<tr>
<td>Subcostal 4-Chamber View</td>
<td>3</td>
</tr>
<tr>
<td>Subcostal IVC View</td>
<td>4</td>
</tr>
<tr>
<td>Apical 4-Chamber View</td>
<td>5</td>
</tr>
<tr>
<td>RV Focused View</td>
<td>5</td>
</tr>
<tr>
<td>Apical 4-Chamber View</td>
<td>6</td>
</tr>
<tr>
<td>Apical 2- and 3-Chamber Views</td>
<td>6</td>
</tr>
<tr>
<td>Respiratory and Diaphragmatic/Lung Interfaces</td>
<td>6</td>
</tr>
<tr>
<td>Parasternal Long-Axis View</td>
<td>7</td>
</tr>
<tr>
<td>Right Ventricle Inflow View</td>
<td>7</td>
</tr>
<tr>
<td>Parasternal Short-Axis View</td>
<td>8</td>
</tr>
<tr>
<td>Lung Ultrasound</td>
<td>8</td>
</tr>
</tbody>
</table>

### Fundamental Critical Care Support: Obstetrics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management of Severe Preeclampsia</td>
<td>9</td>
</tr>
<tr>
<td>Criteria for Preeclampsia with Severe Features</td>
<td>10</td>
</tr>
<tr>
<td>Risk Factors for Developing Preeclampsia</td>
<td>11</td>
</tr>
</tbody>
</table>

### Fundamental Critical Care Support

<table>
<thead>
<tr>
<th>Topic</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemodynamic Profiles of Shock</td>
<td>12</td>
</tr>
<tr>
<td>Hemorrhage Classification a</td>
<td>13</td>
</tr>
<tr>
<td>Glossary</td>
<td>14</td>
</tr>
</tbody>
</table>
Subcostal 4-Chamber View

- Pericardial effusion (abnormal > 10 mm)
- Pleural effusion/ascites
- Right ventricle free wall thickness (abnormal > 5 mm)
- Qualitative STARS
  - Motion of tricuspid and mitral annulus (longitudinal)
  - Approximation and thickening of myocardial walls
- Color flow Doppler evaluation of tricuspid and mitral valves

Explore the full range of critical care ultrasound products at sccm.org/ultrasound.
Adult Critical Care Ultrasound

STARS Protocol for the Assessment of Shock

Subcostal IVC View

- IVC distensibility index → mechanical ventilation
  \[ \Delta \text{IVC} = \frac{(\text{IVC max} - \text{IVC min})}{[(\text{IVC max} + \text{IVC min})/2]} \times 100\% > 12\% \]
- IVC collapsibility index:
  \[ \frac{(\text{IVC max} - \text{IVC min})}{\text{IVC max}} \times 100 \text{ (spontaneous)} \]
- LV septal thickness
  (abnormal > 9 mm for female patients/10 mm for male patients)
- SEATAK (abnormal < 14 mm)
- Hepatic vein systolic versus diastolic PWD
  (normal = S > D, abnormal could suggest significant tricuspid regurgitation, RHF/hepatic congestion)
Apical 4-Chamber View
- Color flow Doppler evaluation of tricuspid and mitral valves
- Ejection fraction: Simpson’s method/MAPSE
- Diastolic function: E/A – E/e’ ratios/pulmonary vein waveforms
- Left atrial pressure: E/e’ + 4
- Evaluation of RWMA
- Pericardial effusion (abnormal > 10 mm)
- Mitral and tricuspid inflow Doppler velocity variation if suspicion of pericardial tamponade → tamponade physiology
- Right ventricular systolic pressure: 
  \[4 \times (\text{maximal tricuspid regurgitation velocity})^2 + \text{RAP}\]
- MAPSE (abnormal < 10 mm)/TAPSE (abnormal < 16 mm)

RV Focused View
- Basal, mid-cavity, and longitudinal diameters
- TAPSE: abnormal < 17 mm
- Tricuspid tissue Doppler peak velocity (S’): abnormal < 10 cm/s
- Right ventricle fractional area change: abnormal < 35%
Apical 4-Chamber View
- LVOT VTI (normal > 18 cm)
- LVOT VTI respiratory variability index (> 10% or > 12%; two distinct trials)
- Color flow Doppler: aortic valve regurgitation
- Evaluation for LVOT dynamic obstruction and aortic stenosis
- Continuous wave Doppler evaluation of aortic valve velocity, if there is aliasing in LVOT VTI with PWD. (Severely abnormal peak velocity > 4 m/sec, mean gradient > 40 mm Hg.)

Apical 2- and 3-Chamber Views
- Complete evaluation of RWMA

Respiratory and Diaphragmatic/Lung Interfaces
- Pleural effusions/ascites
- Consolidation syndrome/B-Lines
- Diaphragmatic excursion in spontaneous breathing trials
Parasternal Long-Axis View

- Fraction shortening if there is no suspicion of RWMA
- Mitral leaflet motion: E-point septal separation (abnormal > 7 mm)
- Color flow Doppler evaluation of mitral and aortic valves
- Measure LVOT diameter
- RVOT diameter in diastole (abnormal > 3.5 cm)
- Pericardial effusion size (abnormal > 10 mm)
- Evaluation of RWMA

Right Ventricle Inflow View

- Color flow Doppler: tricuspid valve regurgitation
- Right ventricular systolic pressure:
  \[4 \times (\text{maximal tricuspid regurgitation velocity})^2 + \text{RAP}\]
Adult Critical Care Ultrasound

STARS Protocol for the Assessment of Shock

Parasternal Short-Axis View
- Pericardial effusion (abnormal > 10 mm)
- Proximal RVOT diameter (basal short axis view): abnormal > 35 mm
- Color flow Doppler: tricuspid and pulmonary valve regurgitation
- Mid-papillary: fractional area change if there is no RWMA
- Left ventricular hypertrophy
  (septal: abnormal > 10 mm); (inferior: abnormal > 9 mm)
- IVS motion (abnormal: flattening or paradoxical motion compared to left ventricle)
- Evaluation of RWMA
- Pulmonary vascular resistance:
  - Maximal tricuspid regurgitation velocity/RVOT VTI × 10 + 0.16 if > 0.175 (> 2 Wood units)
  - If > 0.275 (> 6 Wood units)

Lung Ultrasound
- Anterior lung regions:
  - Pleural sliding and A line artifacts versus B lines
Management of Severe Preeclampsia

Fundamental Critical Care Support (FCCS): Obstetrics fills the need and desire for information concerning the critically ill obstetric population.

Sccm.org/50years
Criteria for Preeclampsia with Severe Features

FCCS: Obstetrics provides resources for those caring for obstetric patients and to aid in caring for those with preeclampsia, one of the main causes of maternal death globally. Review criteria for preeclampsia with severe features.

- Systolic blood pressure ≥ 160 mm Hg
- Diastolic blood pressure ≥ 110 mm Hg

and

- Proteinuria: Defined as greater than or equal to 300 mg per 24 hour urine collection (or this extrapolated from a timed collection), protein/creatinine ratio greater than 0.3, or a dipstick reading of 1+

or, in the absence of proteinuria, the setting of the following:

- Persistent headache
- Changes in vision
- Persistent pain in the epigastrium or right upper quadrant
- Change in liver function tests (AST, ALT) greater than 2 times the upper limit of normal
- Increase in creatinine (> 1.1 mg/dL) or a doubling of the serum creatinine concentration in the absence of renal disease
- Oliguria (diuresis < 500 mL in 24 hours or < 100 mL in 4 hours)
- Thrombocytopenia (<100,000 platelets)
- Acute pulmonary edema

Explore the full range of Fundamental Critical Care Support: Obstetrics products at sccm.org/obstetrics.
Preeclampsia can result in maternal multiorgan system failure. Review risk factors for developing preeclampsia.

- Age < 20 years or > 35 years
- Nulliparity
- Mother with a history of preeclampsia
- Sister with a history of preeclampsia
- Obesity
- Long birth interval
- Trophoblastic disease
- Hypertension
- Diabetes
- Systemic lupus erythematosus
- Preeclampsia in a previous pregnancy
- History of migraines
- Multiple gestation (twins, triplets, etc.)
Fundamental Critical Care Support (FCCS) is constructed to provide nonintensivists with the training to manage critically ill patients for the first 24 hours or until appropriate critical care consultation can be arranged.

### Hemodynamic Profiles of Shock

<table>
<thead>
<tr>
<th>Type of Shock</th>
<th>Heart Rate</th>
<th>Cardiac Output</th>
<th>Ventricular Filling Pressures</th>
<th>Systemic Vascular Resistance</th>
<th>Pulse Pressure</th>
<th>Svo$_2$ or Scvo$_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiogenic</td>
<td>↑</td>
<td>↓</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Hypovolemic</td>
<td>↑</td>
<td>↓</td>
<td>↓</td>
<td>↑</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Distributive</td>
<td>↑</td>
<td>↑ or N$_a$</td>
<td>↓</td>
<td>↓</td>
<td>↑</td>
<td>↑ or N$_a$</td>
</tr>
<tr>
<td>Obstructive</td>
<td>↑</td>
<td>↓</td>
<td>↑ or N$_b$</td>
<td>↑</td>
<td>↓</td>
<td>↓</td>
</tr>
</tbody>
</table>

Abbreviations: Svo$_2$, mixed venous oxyhemoglobin saturation; Scvo$_2$, central venous oxyhemoglobin saturation; N, normal.

$_a$ May be decreased before or early in resuscitation.

$_b$ Left ventricular filling pressures may be normal or low in massive pulmonary embolism.

Explore the full range of Fundamental Critical Care Support products at sccm.org/fccs.
### Hemorrhage Classification

<table>
<thead>
<tr>
<th>Blood loss (mL)&lt;sup&gt;b&lt;/sup&gt;</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 750</td>
<td>750-1500</td>
<td>1500-2000</td>
<td>&gt;2000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blood loss (% blood volume)</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 15%</td>
<td>15%-30%</td>
<td>30%-40%</td>
<td>&gt;40%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heart rate (beats/min)</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>100-120</td>
<td>120-140</td>
<td>&gt;140</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Systolic blood pressure (mm Hg)</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Normal</td>
<td>Decreased</td>
<td>Decreased</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pulse pressure</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal or increased</td>
<td>Decreased</td>
<td>Decreased</td>
<td>Decreased</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respiratory rate (breaths/min)</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-20</td>
<td>20-30</td>
<td>30-40</td>
<td>&gt;35</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Urine output (mL/h)</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;30</td>
<td>20-30</td>
<td>5-15</td>
<td>Negligible</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mental status</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slightly anxious</td>
<td>Mildly anxious</td>
<td>Anxious, confused</td>
<td>Confused, lethargic</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resuscitation fluid</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral crystalloid</td>
<td>Crystalloid</td>
<td>Crystalloid and blood</td>
<td>Blood and crystalloids</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Adapted with permission from the American College of Surgeons. American College of Surgeons Committee on Trauma. *Advanced Trauma Life Support for Doctors (ATLS): Student Course Manual*. 9th ed. Chicago, IL: American College of Surgeons; 2012.

<sup>b</sup> For 70-kg man.
**Glossary**

**D:** diastolic wave

**E/A:** early/late diastolic filling velocity

**E/e’:** early mitral filling velocity (PW Doppler)/early diastolic mitral annular velocity (tissue Doppler)

**IVC:** inferior vena cava

**IVS:** interventricular septum

**LV:** left ventricle

**LVOT:** left ventricular outflow tract

**MAPSE:** mitral annular plane systolic excursion

**PWD:** pulsed wave Doppler

**RAP:** right atrial pressure

**RHF:** right heart failure

**RVOT:** right ventricular outflow tract

**RWMA:** regional wall motion abnormalities

**S:** systolic wave

**SEATAK:** subcostal echocardiographic assessment of tricuspid annulus kick

**STARS:** subcostal To Apical, Respiratory and paraSternal

**TAPSE:** tricuspid annular plane systolic excursion

**VTI:** velocity-time integral