Introduction:
We sought to assess the feasibility of 3D volumetric analysis with transthoracic echocardiography in critically ill patients. We choose a cohort typical of ICU where accurate volumetric analysis is important: hypoxic, mechanically ventilated patients. 3D analysis is enticing in simplicity and wealth of data available. It is accurate in cardiology patients[1] but has not been assessed in the ICU.

Methods:
Patients were imaged within 24 hours of admission. Inclusion criteria: adult, hypoxic (P:F <300), mechanically ventilated, Doppler stroke volume (SV) assessment possible. Echocardiography: Seimens SC2000 real-time volumetric analysis with standard B-mode and Doppler assessment. Images unacceptable if >2 segments unable to be seen in 2 volumetric planes. 3D Left ventricle (LV) and right ventricle (RV) analysis with Tomtec Imaging and Seimens Acuson respectively and compared to Doppler derived SV. 30% limit of agreement considered clinically acceptable[2]. Imaging was optimised for volumetric analysis (20-45 vols/sec).

Results:
92 patients, 83 in sinus, 9 in AF. No significant difference seen between Doppler vs 2D Simpson’s biplane, 3D LV or 3D RV SV estimation. Feasibility, SV values and bias are reported in Table 1 and Figure 1. Limit of agreement for corrected Doppler vs LV 3D SV = -48% to 55%; RV 3D SV = -62.7% to 84.3%.

Conclusion:
3D LV and RV volumetric analysis is feasible in majority of patients requiring mechanical ventilation, however lacks agreement with Doppler derived stroke volume assessment. Although images may appear sufficient, the semi-automated software appears to underestimate stroke volume. Further larger studies using thermodilution are warranted.

References:

Table 1:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Feasibility, n (%)</th>
<th>Stroke volume, Median (IQR)</th>
<th>Bias, mean difference (ml)</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doppler</td>
<td>92 (100%)</td>
<td>54 (43-64)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2D Simpson´s biplane</td>
<td>78 (85%)</td>
<td>52.2 (40-65)</td>
<td>-0.17</td>
<td>-2.9 to 2.5</td>
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<tr>
<td>3D LV</td>
<td>66 (72%)</td>
<td>49.5 (35-59)</td>
<td>-2.6</td>
<td>-5.5 to 0.2</td>
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<tr>
<td>3D RV</td>
<td>51 (55%)</td>
<td>43 (33-58)</td>
<td>-4.1</td>
<td>-9 to 0.9</td>
</tr>
</tbody>
</table>

Doppler vs 2D and 3D stroke volume assessment

Image 1:
Bland-Altman plots for Doppler vs 3D biventricular stroke volume assessment