Reducing Sedation and Anesthesia in Pediatric CT

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AAPM 2019 Annual Meeting SAM Session

Learning Objectives

1. CT refresher: What determines speed?
2. Technical approaches to fast acquisition

1. CT refresher: What effects scan speed?

\[
\text{Scan speed} = \frac{\text{Detector collimation} \times (N \times T) \times \text{pitch}}{\text{Rotation time}} = \frac{\text{cm}}{s}
\]

\[
\text{Effective mAs} = \frac{\text{mA} \times s}{\text{pitch}}
\]
A look back

<table>
<thead>
<tr>
<th>Canon</th>
<th>GE</th>
<th>Philips</th>
<th>Siemens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>Aquilion 64</td>
<td>VCT 64</td>
<td>Sensation 64</td>
</tr>
<tr>
<td>Year</td>
<td>2006</td>
<td>2004</td>
<td>2004</td>
</tr>
<tr>
<td>Detector coverage (mm)</td>
<td>32 (64 x 0.5)</td>
<td>40 (64 x 0.625)</td>
<td>40 (64 x 0.625)</td>
</tr>
<tr>
<td>kV range</td>
<td>80-135</td>
<td>80-140</td>
<td>80-140</td>
</tr>
<tr>
<td>Rotation time (s)</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Max speed (cm/s)</td>
<td>11</td>
<td>13.75</td>
<td>13.0</td>
</tr>
<tr>
<td>Reconstruction</td>
<td>FBP</td>
<td>FBP</td>
<td>FBP</td>
</tr>
</tbody>
</table>

Today

<table>
<thead>
<tr>
<th>Canon</th>
<th>GE</th>
<th>Philips</th>
<th>Siemens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>Aquilion One</td>
<td>GENESIS</td>
<td>SOMATOM Force</td>
</tr>
<tr>
<td>Detector coverage (mm)</td>
<td>160 (320 x 0.5)</td>
<td>160 (256 x 0.625)</td>
<td>57.6 (2x96x 0.6)</td>
</tr>
<tr>
<td>kV range</td>
<td>80 - 135</td>
<td>70-140</td>
<td>80-140</td>
</tr>
<tr>
<td>Rotation time (s)</td>
<td>0.275</td>
<td>0.25 s</td>
<td>0.27</td>
</tr>
<tr>
<td>Max speed (mm/s)</td>
<td>16 cm / 0.275 (Ax) 20 cm/s (H)</td>
<td>16 cm / 0.28 (Ax) 43.7 cm/s (H)</td>
<td>20 cm/s (DDE) 73.7 cm/s (Limited FOV)</td>
</tr>
</tbody>
</table>

2. Technical approaches to fast acquisition

Scan speed = \[
\frac{\text{Detector collimation (N x T) x pitch}}{\text{Rotation time}} \text{ cm/s}
\]
2. Technical approaches to fast acquisition

\[
\text{Scan speed} = \frac{\text{Detector collimation} \times \text{pitch} \times \text{cm}}{\text{Rotation time} \times \text{s}}
\]

**Benefits**
- Single detector = 96 * 0.6 mm
- Max pitch = 3.2
- Max speed = 73.7 cm/s
- Clinical max = ~55

**Limitations**
- 5.76 cm Volumetric
- FOV (pitch 3.2) = 32 cm
- Max mA (80 kV) = 1300
- No gantry tilt
1. Technical approaches to fast acquisition

**Example:**
- Max Eff = 300
- Pitch = 2.8 to 1.97
- Scan time = 1.41 to 1.99 s

```
11
Pitch = 3.2, Eff mAs = 81
5 kg

20 kg
Pitch = 1.6, Eff mAs = 198
Pitch = 3.2, Eff mAs = 81
```
2. Technical approaches to fast acquisition

\[ \text{Scan speed} = \frac{\text{Detector collimation (N x T)}}{\text{Rotation time (s)}} \times \text{pitch (cm)} \]

**Limitations**

- 5.76 cm Volumetric
- FOV (pitch 3.2) = 32 cm
- Max mA (80 kV) = 1300
- No gantry tilt
1. Technical approaches to fast acquisition

\[
\text{Scan speed} = \frac{\text{Detector collimation (N x T)}}{\text{pitch}} \cdot \frac{\text{cm}}{\text{Rotation time}} \cdot \frac{s}{s}
\]

**Benefits**

- 320 \times 0.5 \text{ mm} / 256 \times 0.625
- 16 cm Volumentric
- 4-8 cm Helical
- <76 cm

\[16\text{cm/0.275} = 58 \text{ cm/s}\]

Images courtesy of Canon Medical Systems USA
1. Technical approaches to fast acquisition

Scan speed = \( \frac{\text{Detector collimation} \times \text{pitch} \times \text{cm}}{\text{rotation time} \times s} \)

Limitations

- No AEC in Axial
- Increased scatter
- 4-8 cm Helical
  >16 cm
  \( mAs = 20 - 43.7 \text{ cm/s} \)


3. Clinical examples

\[ \text{Scan speed} = \frac{96 \times 0.6 \times 2.45}{0.25} = 56 \text{ cm/s} \]

30 cm = 0.53 s
Thank you!