Evolution in ECG Interpretation

University of Glasgow ECG analysis program
LiFEPAK® 15 monitor/defibrillator

Key definitions

STEMI (ST elevation myocardial ischemia/infarction)
STJ level (ST level at J point, QRS end)
STEMI imposter (non-ischemic cause of ST elevation)
Sensitivity for STEMI (% of STEMI patients who get a STEMI interpretation)
Specificity for STEMI (% of patients without STEMI who do not get a STEMI interpretation)
False positive rate (% of patients without STEMI who get a STEMI interpretation, = 100% - specificity)
Positive predictive value (% of STEMI interpretations that are actually STEMI; this is strongly affected by STEMI prevalence in the population who get 12-leads)

12-lead ECG interpretive programs are not created equal

The Glasgow ECG analysis program has been used around the world and refined over 30 years.¹ It is considered to be among best-in-class by cardiologists.² The LIFEPAK 15 monitor/defibrillator currently uses Glasgow version 27.³,⁴ As a trusted ECG interpretive algorithm, the Glasgow program offers many leading clinical advantages and has proven performance for STEMI analysis.³,⁵

Published performance

Published performance in hospital and prehospital environments should be a standard expectation of any 12-lead ECG interpretation program. The Glasgow ECG analysis program has been well-studied in both clinical settings.

• Four published articles on STEMI detection in prehospital use
• Over 100 published articles on detection of arrhythmias and morphology abnormalities

Prehospital studies using the Glasgow ECG analysis program

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Sensitivity for STEMI</th>
<th>Specificity for STEMI</th>
<th>False positive rate for STEMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuscon data (Macfarlane 2004)³</td>
<td>1,220 patients with chest pain</td>
<td>N/A</td>
<td>98.5%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Tuscon data (Macfarlane 2007)⁴</td>
<td>300 patients with chest pain</td>
<td>89%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Denmark data (Clark 2010)⁷</td>
<td>912 patients with ACS symptoms</td>
<td>78%</td>
<td>94%</td>
<td>6%</td>
</tr>
<tr>
<td>Los Angeles data (Bosson 2017)⁸</td>
<td>44,611 patients with 12-lead ECGs</td>
<td>92.8%</td>
<td>98.7%</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

Note: Sensitivity and specificity for STEMI should not be compared between different ECG interpretive programs unless testing was done with the same 12-lead ECG data set.

Clinical advantages

The Glasgow ECG analysis program incorporates key clinical features to assist clinicians with diagnostic assessment of patients with challenging 12-leads.

• STEMI thresholds based on age and gender as recommended by the AHA/ACCF/ESC⁹⁻¹¹
• Measures ST level at the J point for STEMI as recommended by the AHA/ACCF/ESC¹⁰⁻¹¹
• Uses Sgarbossa criteria for STEMI detection in LBBB as recommended by the AHA/ACCF/ESC¹⁰⁻¹²
• Provides interpretive analysis statements for adult and pediatric patients¹³
• Includes criteria for Brugada pattern, a non-ischemic cause of ST elevation
Clinical advantages (cont.)

Age and gender based STEMI thresholds

• Age and gender affect normal STJ levels
• Older men require less STJ elevation than younger men for STEMI
• Women require less STJ elevation than men for STEMI
• The AHA-recommended STEMI thresholds are based on age and gender data from University of Glasgow research

J point measurement for STEMI threshold

• The Glasgow program follows the AHA/ACCF/HRS recommendations for STJ measurement at the J point for STEMI
• Measuring after the J point can result in overestimation of the true J point measurement for STEMI

Sgarbossa criteria for STEMI analysis in left bundle branch block (LBBB)

• LBBB can increase the risk of a false negative STEMI interpretation
• LBBB is also a “STEMI imposter” and increases the risk of false positive STEMI interpretation
• The Glasgow program uses Sgarbossa criteria to look for STEMI when the patient has a LBBB

Adult and pediatric interpretive analysis

• Infrequent use of pediatric 12-leads makes pediatric interpretive analysis clinically valuable
• The Glasgow program can be used for patients of any age down to newborns
• ECG criteria for neonates, infants and children
  – Age-dependent bradycardia and tachycardia limits
  – Age-dependent conduction defect limits
  – Age-dependent right ventricular hypertrophy
  – Age-dependent ST depression thresholds

Brugada statement

• Brugada syndrome is an inherited genetic defect that increases risk for spontaneous VT/VF
• It occurs in approximately 1 in 2,000 patients
• A distinct coved-type ST elevation occurs in the right precordial leads
• It is also a “STEMI imposter” and increases the risk of false positive STEMI interpretation
• The Glasgow program uses Brugada pattern criteria according to the Second Consensus Conference on the Brugada Syndrome

12-lead ECG interpretive program comparison

<table>
<thead>
<tr>
<th>12-lead ECG interpretive algorithm</th>
<th>LIFEPAK 15 monitor/defibrillator</th>
<th>ZOLL X Series® monitor/defibrillator</th>
<th>Philips® MRx monitor/defibrillator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow v27.0</td>
<td>Inovise 12L v1.00</td>
<td>DXL vPH100B</td>
<td></td>
</tr>
<tr>
<td>Pediatric interpretation</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>LBBB criteria for STEMI</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>ST measurement taken at the J point</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Published results from testing with prehospital ECGs</td>
<td>4 studies</td>
<td>1 study</td>
<td>No</td>
</tr>
</tbody>
</table>
Pediatric interpretation for a 10-year-old patient

- The Glasgow ECG analysis program gives an appropriate pediatric interpretation.

**12-lead with interpretative statement for STEMI with LBBB**

- Glasgow ECG analysis program uses Sgarbossa criteria for STEMI detection in a patient with a LBBB.

**Adult interpretation for the same 10-year-old patient**

- Same 10-year-old pediatric patient, but taken after entering an adult age of 18 years.
- Interpreting a pediatric 12-lead using criteria for adults can produce inappropriate interpretative statements.
- At least one ECG analysis program is contraindicated for pediatric interpretation.
12-lead with Brugada interpretative statement

- The ST elevation is correctly attributed to the Brugada pattern

References