stryker

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.[3-8]

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	n	Sensitivity for STEMI	Specificity for STEMI	False positive rate for STEMI
Tuscon data (Macfarlane 2004)[5]	1,220 patients with chest pain	N/A	98.5%	1.5%
Tuscon data (Macfarlane 2007)[6]	300 patients with chest pain	89%	N/A	N/A
Denmark data (Clark 2010)[7]	912 patients with ACS symptoms	78%	94%	6%
Los Angeles data (Bosson 2017)[8]	44,611 patients with 12-lead ECGs	92.8%	98.7%	1.3%

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/ESC[9-11]
- Measures ST level at the J point for STEMI as recommended by the AHA/ACCF/ESC[10-11]
- Uses Sgarbossa criteria for STEMI detection in LBBB as recommended by the AHA/ACCF/ESC[10-12]
- Provides interpretive analysis statements for adult and pediatric patients[13]
- Includes criteria for Brugada pattern, a non-ischemic cause of ST elevation

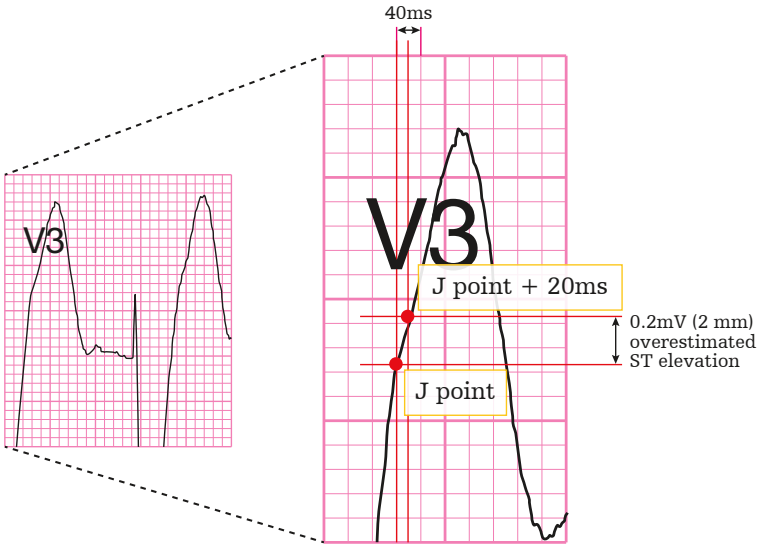
Clinical advantages (cont.)

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[9,10]

J point measurement for STEMI threshold

- The Glasgow program follows the AHA/ACCF/HRS recommendations for STJ measurement at the J point for STEMI[10,11]
- 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)

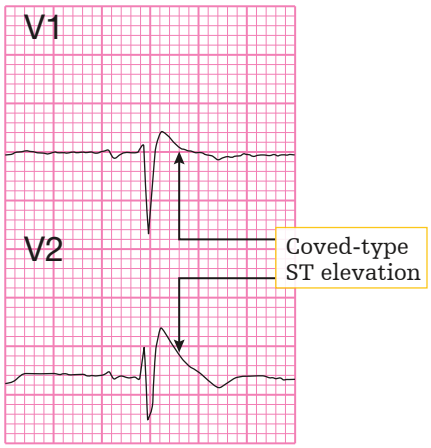
- LBBB can increase the risk of a false negative STEMI interpretation
- LBBB is also a "STEMI imposter" and increases the risk of false positive STEMI interpretation
- The Glasgow program uses Sgarbossa criteria to look for STEMI when the patient has a LBBB[4,12]

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[13]
- 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**[4,14]



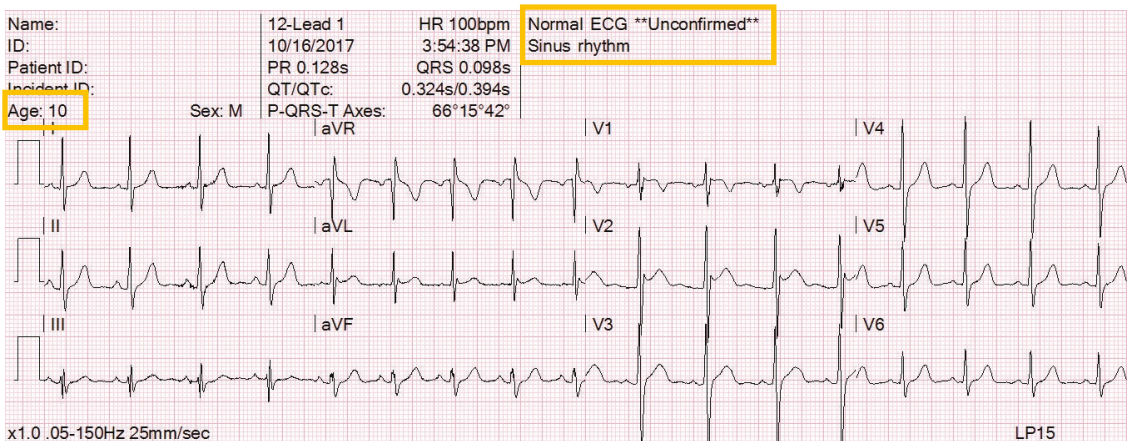
12-lead ECG interpretive program comparison

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

12-lead comparison for a pediatric patient

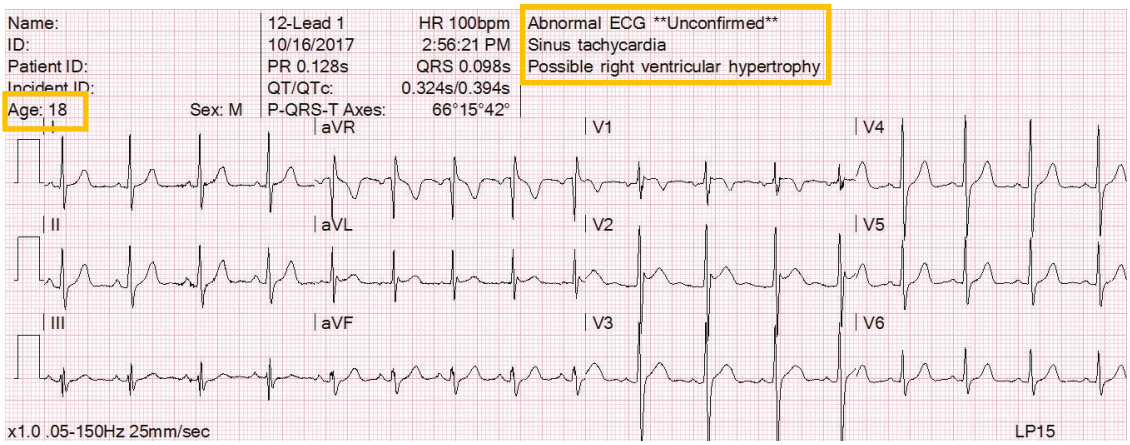
Pediatric interpretation for a 10-year-old patient

- The Glasgow ECG analysis program gives an appropriate pediatric interpretation



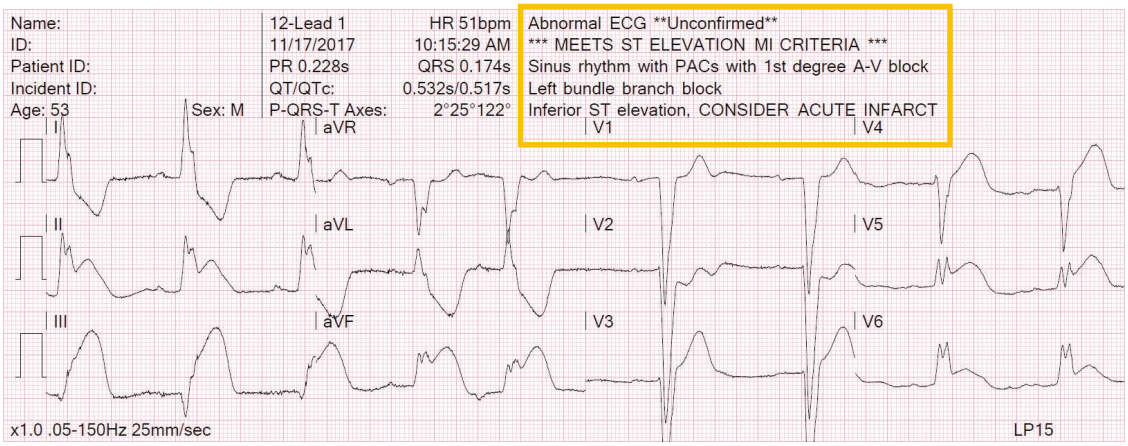
Adult interpretation for the same 10-year-old patient

- 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[15,16]



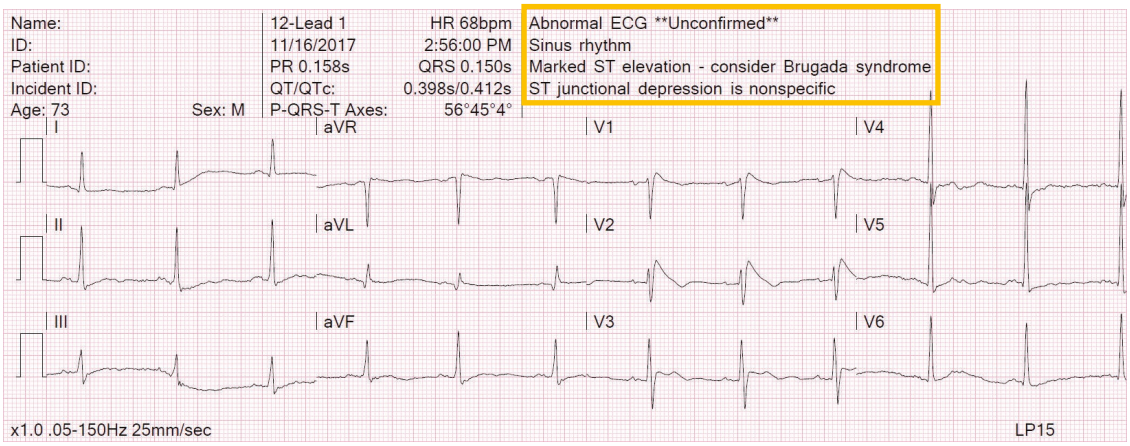
12-lead with interpretative statement for STEMI with LBBB

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



12-lead with Brugada interpretative statement

- The ST elevation is correctly attributed to the Brugada pattern



References

1. Macfarlane P, Devine B, Clark E. The University of Glasgow (Uni-G) ECG analysis program. *Computers in Cardiology.* 2005;32:451-454.
2. Willems J, Abreu-Lima C, Arnaud P, et al. The diagnostic performance of computer programs for the interpretation of electrocardiograms. *N Engl J Med.* 1991;325:1767-73.
3. Glasgow 12-lead ECG Analysis Program: Statement of Validation and Accuracy. Redmond, WA: Physio-Control; 2009.
4. Glasgow 12-lead ECG Analysis Program: Physician's Guide. Redmond, WA: Physio-Control; 2009.
5. Macfarlane P, Browne D, Devine B, et al. Modification of ACC/ESC criteria for acute myocardial infarction. *J Electrocardiol.* 2004;37(suppl):98-103.
6. Macfarlane P, Hampton D, Clark E, et al. Evaluation of age and sex dependent criteria for ST elevation myocardial infarction. *Computers in Cardiology.* 2007;34:293-6.
7. Clark E, Sejersten M, Clemmensen P, et al. Automated electrocardiogram interpretation programs versus cardiologists' triage decision making based on teletransmitted data in patients with suspected acute coronary syndrome. *Am J Cardiol.* 2010;106:1696-702.
8. Bosson N, Sanko S, Stickney R, et al. Causes of prehospital misinterpretations of ST elevation myocardial infarction. *Prehosp Emerg Care.* 2017;21:283-290.
9. Macfarlane P. Age, sex, and the ST amplitude in health and disease. *J Electrocardiol.* 2001;34(suppl):235-41.
10. Wagner G, Macfarlane P, Wellens H, et al. AHA/ACCF/HRS recommendations for the standardization and interpretation of the electrocardiogram: part VI: acute ischemia/infarction. *Circulation*. 2009;119;e262-70.
11. Thygesen K, Alpert J, Jaffe A, et al. Joint ESC/ACCF/AHA/WHF Task Force. Third universal definition of myocardial infarction. *Circulation*. 2012;126:2020-35.
12. Sgarbossa E, Pinsky S, Barbagelata A, et al. Electrocardiographic diagnosis of evolving acute myocardial infarction in the presence of left bundle branch block. *N Engl J Med.* 1996;334:481-7.
13. Macfarlane P, Coleman E, Devine B, et al. A new 12-lead pediatric ECG interpretation program. *J Electrocardiol.* 1990;23(suppl):76-81.
14. Antzelevitch C, Brugada P, Borggrefe M, et al. Brugada syndrome: report of the second consensus conference. *Circulation*. 2005;111;659-70.
15. Inovise 12L Interpretive Algorithm Physician's Guide. (9650-001357-01 Rev. C). Chelmsford, MA: ZOLL Medical Corp; 2015.
16. X Series® Operator's Guide, 9650-002355-01-50 Rev 9, 2017. Chelmsford, MA: ZOLL Medical Corp.

All claims valid as of June 2018.

Physio-Control is now part of Stryker.

For further information, please contact Physio-Control at 800.442.1142 (U.S.), 800.668.8323 (Canada) or visit our website at www.physio-control.com

Physio-Control Headquarters
11811 Willows Road NE
Redmond, WA 98052
www.physio-control.com

Customer Support
P. O. Box 97006
Redmond, WA 98073
Toll free 800 442 1142
Fax 800 426 8049

Physio-Control Canada
Physio-Control Canada Sales, Ltd.
45 Innovation Drive
Hamilton, ON
L9H 7L8
Canada
Toll free 800 668 8323
Fax 877 247 7925

GDR 3335513_C