Analysis of Depolarization Abnormalities in the Evaluation of Chest Pain Patients

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BACKGROUND

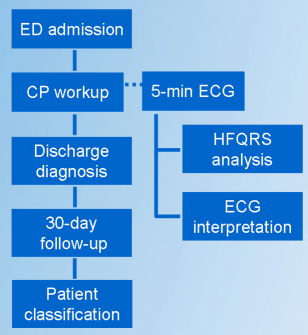
- The initial ECG of patients with acute coronary syndrome (ACS) is often normal or non-diagnostic.
- Myocardial ischemia induces depolarization changes that can be quantified by analysis of high-frequency mid-QRS components (HFQRS).
- HFQRS was shown to be a sensitive marker of ischemia in patients undergoing intra-coronary balloon occlusion and during stress testing.

OBJECTIVES

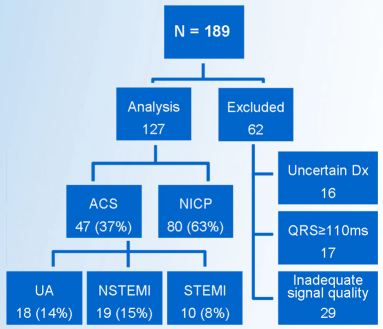
- To evaluate the usefulness of HFQRS analysis in detection of acute myocardial ischemia in patients presenting to the emergency department (ED) with chest pain (CP).

METHODS

Population: 189 patients (see table) presenting to the ED with chest pain. Pts were classified post-hoc based on discharge diagnosis and one-month follow-up as: ST-elevation MI (STEMI), non STEMI (NSTEMI), unstable angina (UA) and non-ischemic chest pain (NICP). Patients with uncertain diagnosis, wide QRS (≥110ms) or inadequate signal quality were excluded.



Study workflow



Patient groups

Data acquisition : Five-minute high resolution 12-lead ECG was acquired in the ED using the HyperQ™ system (BSP Ltd., Tel Aviv, Israel), shortly after patient admission (mean 1.4±2 hrs).

Data analysis:

- HFQRS signal was extracted using custom software. The extent of abnormality in the HFQRS signal was quantified by a designated high-frequency morphological index (HFMI). A threshold of the HFMI index was set to determine diagnosis of myocardial ischemia.
- Conventional ECG was blindly interpreted by a cardiologist and was classified as either 'ischemic', 'non-ischemic' or 'inconclusive'.
- The HFMI index was compared between patient groups, and the sensitivity and specificity of HFMI in detecting acute myocardial ischemia was compared to conventional ECG interpretation.

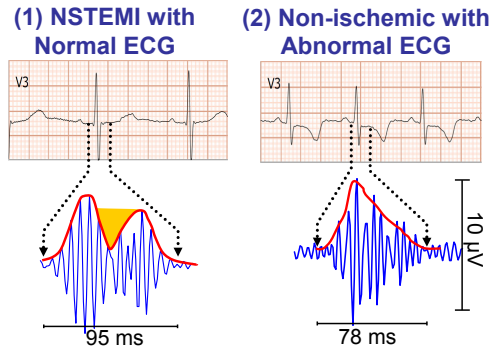
RESULTS

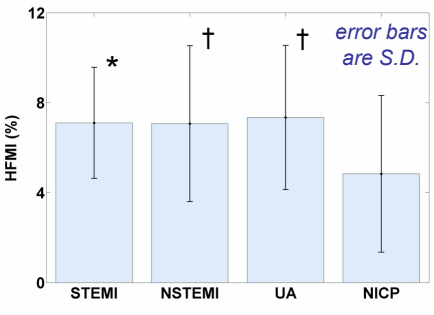
Example 1: positive HFMI (left) 79 year-old female; no history of CAD; normal ECG; NSTEMI diagnosis by elevated Troponin. 3-vessel disease on angiography.

Example 2: negative HFMI (right) 48 year-old female; previous CP hospitalizations; family Hx; ECG abnormalities; normal Troponin level. Discharge diagnosis: non-ischemic CP.

Age	61±13 yrs
Male	119 (63%)
CP onset	7±5 hrs
CAD Hx	79 (42%)
MI Hx	51 (27%)
Smoking	63 (33%)
Hypertension	131 (69%)
Diabetes	62 (33%)
Hyperlipidemia	143 (76%)
Family Hx	84 (44%)

Patient characteristics





* P<0.03, † P<0.01 compared to NICP

Method	Sensitivity (N=47)	Specificity (N=80)
HFMI	70%	80%
ECG (inconclusive considered negative)	34%*	90%
ECG (inconclusive considered positive)	51%†	73%

* P<0.001, † P<0.05 compared to ECG

- HFMI was significantly higher in ACS pts, compared to NICP pts (7.2±3 vs. 4.8±3, P<0.001), with no difference between the three ACS groups (see figure).
- In the subgroup of pts with normal or inconclusive ECG, NSTEMI and UA pts had higher HFMI than NICP pts (7.7±3 vs. 4.7±3, P<0.001).
- HFMI diagnosis was significantly more sensitive than conventional ECG interpretation, with comparable specificities (see table).
- HFMI diagnosis was negative in 12 of 14 NICP pts with inconclusive ECG, and positive in all 8 ACS pts with inconclusive ECG.

CONCLUSIONS

HFQRS analysis provides a new method for sensitive detection of acute myocardial ischemia, complementary to conventional ECG. HFQRS may aid in early risk stratification of patients with chest pain in the emergency department.

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