Stress echo Cardiography

Nov, 2014

Clinical Product Specialist Team
Role of SE

- Cardiac risk stratification
  - Determine how well tolerates stress
  - Assessment of valvular heart disease
  - Evaluate the effectiveness of cardiac treatment plan
  - Assessment of prognosis

- Assessment of myocardial viability
  - Detection of ischemic heart disease
    and the need for further testing
Symptoms occur at end of Ischemic cascade.

- Ischemic Events
  - Increasing Coronary Artery Stenosis
  - Metabolic Alteration
  - Diastolic Dysfunction
  - Systolic Dysfunction
  - Reduced Perfusion Reserve
  - ECG Change, ST
  - Angina

Ischemic Events:
- Low-risk
- High-risk
Methods

- Exercise:
  - Treadmill
  - Supine bicycle
  - Upright bicycle

- Pharmacologic agents
  - Dobutamine
  - Ergonovine
  - Dipyridamole
Methods

- Perform both before and after the stress

Dopamine dose (mcg/kg/min)

- 0
- 3
- 6
- 9
- 12
- 15

Time (min)

- 5
- 10
- 20
- 30

Atropine .5 mg
repeat .25 min

* Atropine may be administered at an earlier stage

Images obtained at rest and at each stage of stress.
**Normal**: increased regional wall thickness and wall motion increased Ejection fraction

**Diseased case**: induced myocardial ischemia appear new wall motion abnormality provoked exhibiting? abnormality (delayed contraction)
Perform both before and after the stress.
Imaging Equipment and Techniques

- Baseline exam needed for LV
  (and RV function, aortic root, valves)
- Tissue Harmonic Imaging
- Compare the pictures at rest to at peak
- Acquisition and side by side display of baseline stress images
- On line or off line analysis
**Imaging Equipment and Techniques**

**Protocol:** Stage & View

**Compare Image:** by Stage/View

<table>
<thead>
<tr>
<th>Stage</th>
<th>View</th>
<th>PLAX</th>
<th>PSAX</th>
<th>A 4C</th>
<th>A2C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td></td>
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<tr>
<td>Low dose</td>
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<td>Peak dose</td>
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<td></td>
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<tr>
<td>Recovery</td>
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</tr>
</tbody>
</table>
Preparing Ultrasound system

- Connect ECG

- Go to “System Preset” -> “User Setting” -> “User Define Key”

- Assign 1 of User Key for “Stress echo”
Default Protocols

- Go to “System Preset”
- “Advanced Cardiac”
- Select 1 of protocols -> “Add”, if adjust protocol

Protocol Customization
Protocol Customization

- Create New Protocol
  - Click “Add”
  - Type a New Name -> “OK”
Protocols Customization

- Acquisition Parameter
  - ECG connect (Cycle / Time)
  - Acquisition Mode (Retrospective/Prospective)
  - Clips/Loops (1/4)
  - Length (cycle/sec)
  - Timer (On entry/On acquisition)
  - Freeze key / Acquire key (Soft Key “5”)
Protocol Customization

- Acquisition Parameters Set-Up

  Switch:
  - pre-view acquired image
    - After view
      - show loops immediately after acquisition
    - After Stage
      - show loops at the end of each stage

![Protocol Customization Interface](image)
Protocol Customization

- Acquisition Parameters Set-Up
  - Switch:
    - pre-view acquired image to “Accept” or “Reject”
      - Accept = Freeze
        - go to next view
      - Reject =
        - Reject current loops and re-acquire
Protocol Customization

- Acquisition Parameters Set-Up

  Timer Type:
  - **On entry**
    - Timer starts as soon as entering the stage
  - **On acquisition**
    - Timer starts when pressing the acquisition key

![Image of protocol customization interface](image-url)
Protocol Customization

- Acquisition Parameters Set-Up

  - Timer Type:
    - On entry
      - Timer starts as soon as entering the stage
    - On acquisition
      - Timer starts when pressing the acquisition key
Workflow

- Perform a stress echo study
  ① After registering a patient data, press the assigned user-defined key.
  ② Protocol select-> OK
  ③ Optimize your image first, then Adjust ROI using a trackball
Protocol Customization

- Store to “User Key”
  - All your changes can be saved an “New protocol”
  - Stress echo protocol can be tied to “User Key”

- Loop format
  - ROI or Full Screen
Workflow

- **Acquisition**
  1. 1 person record “Baseline” BP, ECG.
  2. Acquiring an image, Press “Freeze” / Soft Key “5”
  3. Select to Accept -> go to Next view
     Reject -> again Acquire same View

![Image of UI interface with icons and instructions]

- (Tick): Images are acquired
- (Arrow): current status images are acquiring
## Acquisition Menu

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skip View</td>
<td>Select the next view in the current stage. You can cancel(skip) the view.</td>
</tr>
<tr>
<td>Skip Stage</td>
<td>Select the next stage. You can cancel(skip) the stage.</td>
</tr>
<tr>
<td>ROI Position</td>
<td>Adjust the position of ROI during the acquisition.</td>
</tr>
<tr>
<td>Clock</td>
<td>Display the elapsed time from the start of the stress exam.</td>
</tr>
<tr>
<td>Review</td>
<td>Review the acquired images.</td>
</tr>
<tr>
<td>Frequency Line Density</td>
<td>Configure image settings for acquisition. The settings are applied for each view in all stages.</td>
</tr>
<tr>
<td>Focus Pos.</td>
<td></td>
</tr>
</tbody>
</table>
## Acquisition Menu

<table>
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<tr>
<th>Toolbar Button</th>
<th>Description</th>
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</table>
| [Accept] or [Reject]    | • Accept the acquired image  
                          • Reject the view and re-acquire a new image                                                                                   |
| [Enter Acquisition]    | Exit the Stress echo screen and redispaly the real-time imaging screen. This button is available only when acquisition of Stress Echo loops is not yet complete. |
| [Select layout]        | • Enables to display the layout from 1X1 up to 4X3.                                                                                   |
|                         | (Only activated in Review mode)                                                                                                        |
| [Toggle auto layout]    | Provides automatically optimized layout for your selected images                                                                        |
| [Hide Overlays]         | Enables to hide all information including stage, view and fps etc.                                                                   |
| [Dog-ear]               | Dog-ear the current image to scroll through other images                                                                                  |
End Points

- Target HR: 85% of max HR (if soon after MI, 70%)
- New or worsening RWMA
- Severe symptoms (Chest pain, Dyspnea)
- Hypertensive blood pressure response: >220mmHg systolic, >110mHg diastolic
- Hypotension: >20mmHg decrease compared with previous stage
- Significant ischemic ECG changes
- Significant ventricular or supraventricular dysrhythmias
Protocols & Review

Protocol:

- Baseline
- Low dose
- Peak dose
- Recovery
## Protocols & Review

**Protocol:** Stage & View

Compare Image: by Stage/View

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</table>
Review

- Review by Stage/ By View
- Playback
  - Same Start
  - Free Run
  - Align
# Protocols & Review

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</table>
| ![Sync Mode Selection](image) | **[Sync Mode Selection]**  
  - Free  
  - Start: synchronized by the starting point  
  - Align: synchronized by the length of time |

| ![Playback Mode Selection](image) | **[Playback Mode Selection]**  
  - Loop: from the beginning to the end point.  
  - Once: Plays once from the beginning to the end point.  
  - Sweep: Plays back in both directions |

| ![R-R](image) | **R-R]**: Displays the complete loop(all loops).  
**[Systole only]**: Displays the systolic segment only.  
**[Diastole only]**: Displays the diastolic segment only. |
Response

- Normal response: increase regional wall motion
  increase in ejection fraction
  decrease in ESV

- Ischemic response: increase in ESV
  newly develop wall motion abnormality
  delayed contraction
  decrease in ejection fraction
  change in LV shape and volumes
  abnormal RV function with stress
    (global and segmental)
  changes in LV filling pattern/pressures
<table>
<thead>
<tr>
<th>Method</th>
<th>Regional</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>Ischemic</td>
<td>Ischemic</td>
</tr>
<tr>
<td>Treadmill/Supine</td>
<td>↑ function</td>
<td>↓ function</td>
</tr>
<tr>
<td>Bicycle</td>
<td></td>
<td>↓ ESV ↑ EF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↑ ESV; EF in 3vessel or LAD</td>
</tr>
<tr>
<td>Dobutamine</td>
<td>↑ function At Low</td>
<td>↓ function At peak vs Low dose</td>
</tr>
<tr>
<td></td>
<td>and Peak dose</td>
<td>rest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↓ ESV ↑ EF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Often same as normal, infrequently ↓ EF; rarely cavity dilatation</td>
</tr>
<tr>
<td>Vasodilator</td>
<td>↑ function</td>
<td>↓ function</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↓ ESV ↑ EF</td>
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<td></td>
<td>Often same as normal, infrequently ↓ EF; rarely cavity dilatation</td>
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Coronary territories
## Interpretation of Wall Motion (WM)

<table>
<thead>
<tr>
<th>Rest</th>
<th>Stress</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal WM</td>
<td>Hyperdynamic</td>
<td>Normal</td>
</tr>
<tr>
<td>Normal WM</td>
<td>New WM abnormality or lack of hyperdynamic WM&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Ischemia</td>
</tr>
<tr>
<td>WM abnormality</td>
<td>Worsening (hypokinesis $\rightarrow$ akinesis) (akinesis $\rightarrow$ dyskinesis)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Ischemia</td>
</tr>
<tr>
<td>WM abnormality</td>
<td>Unchanged</td>
<td>Infarct</td>
</tr>
<tr>
<td>Akinetic WM</td>
<td>Improved, biphasic response</td>
<td>Viable myocardium</td>
</tr>
</tbody>
</table>

<sup>a</sup> May not indicate ischemia in the setting of low workload or β-blockade

<sup>b</sup> May not indicate ischemia
Wall Motion Scoring

- Give each segment a score 16 or 17 segments model
  - Normal 1
  - Hypokinetic 2
  - Akinetic 3
  - Dyskinetic 4
  - Aneurysmal 5

- Add up all segment scores and divide by number of segment seen
- 1 is normal
Stress Echocardiography Report

Wall Motion: Rest
Score index 1.06 (normal 1.00)
Apical Cap  Apex  Mid-vent  Base
Ant.  Lat.  Inf.

Wall Motion: Stress  (Worsening wall motion abnormality)
Score index 1.12

Legend and score values
- Normal
- Hypokinesis
- Aneurysm
- Not seen
- Dyskinesia
- Scarred

Summary
- Exercise echo mildly positive for ischemia
- Good exercise capacity (8 minutes Bruce protocol, 102% functional aerobic capacity)
- Rest images: Normal left ventricular size, ejection fraction of 56%, inferior wall hypokinesis
- Exercise images: Decrease in end systolic size; inferior wall worsened
# Review Tool bar

<table>
<thead>
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</table>
| ![Score all unscored sectors in all visible views](image) | [Score all unscored sectors in all visible views]  
For example, enables to mark “1~5” in all segments at once. |
| ![Score all unscored sectors in all selected views](image) | [Score all unscored sectors in all selected views] |
| ![Reset score of all sectors in all visible views](image) | [Reset score of all sectors in all visible views] |
| ![Reset score of all sectors in all selected views](image) | [Reset score of all sectors in all selected views] |
| ![Show/Hide Bull’s eye](image) | [Show/Hide Bull’s eye] |
Assessment of Regional LV Fx

- Visual and semi-quantitative score

- Quantitative:
  - Systolic: %thickening, regional systolic velocity, systolic strain
  - Diastolic: lengthening rate, regional diastolic velocity
  - Timing of cardiac events
Clinical report

- Protocol used
- Baseline and peak HR and BP
- Reasons for termination
- Symptoms during stress
- Arrhythmias during stress
- EKG changes, if any
- Baseline and peak LV/RV segmental and global function
- Conclusion about ischemia/scar/viability and the territory where it occurred
Save Study and Report

- press [Exit] on the left side of the control panel or [2D] knob
- [Save Examination], and select “Yes” to save the result.

*Note*: ‘No’ -> all of the current results are deleted.

“Cancel” -> the system would be back to the current exam mode.