Techniques for Monitoring the "Ambulatory Patient"

The movement of the ambulatory patient creates a continuous challenge for an artifact free (or at least artifact minimized) ECG signal.

By Daniel Walton

Good techniques often make the difference between a good study and an unusable study.

Skin preparation: If the patient has hair in the electrode area, it should be shaved with a safety razor. Shave an area slightly larger than the electrode itself. Rub the electrode site briskly to remove the top surface layer of the skin. Good results can be achieved with a prep that has a pumice-like quality to it similar to the kinds used in beauty shops to create a softer skin in a pedicure. "Green Prep" and NuPrep both feel like a cream with very fine sand in it. Some prefer the 3M Skin Prep tape, which comes on a roll like scotch tape and is tacky on one side while the other side feels like sandpaper. You tear off a small piece and sand off the top surface layer of the skin. Neither process is painful and both work well to reduce the skin resistance. Next use an alcohol-soaked pad to clean the area of body oils and loose skin, then dry completely before placing the electrode on the site. Alcohol left behind could destroy the adhesive properties on the electrode and cause the electrode to fall off during the test.

Checking the electrode: Before placing the electrode on the patient, touch the pad to make sure the pad is moist with gel.

Stress loops and lost lead protection: Ambulatory patients often cause signal interference and signal loss with movements that pull on the electrode wires. Sometimes this pressure will pull the lead wire completely off the electrode causing a complete signal loss for the remainder of the test, which may result in the need to re-test the patient. Stress loops and tape over the electrode snap will often prevent these problems from occurring.

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occurring. Another excellent product is the Cliptrode 2002, which is designed for monitoring the ambulatory patient. The Cliptrode 2002 has the stress loop and loss lead protection designed into the electrode itself without the need of tape. The built-in clip allows the creation of a stress loop, which transfers any pressure from the electrode wire to the edge of the electrode adhesive instead of the signal pickup point and thereby minimizes or eliminates the artifact and keeps the pressure from popping the lead off. See the diagram to the right showing the standard stress loop and Clipatrode stress loop.

**Electrode preparations make a measurable difference**

The purpose of this study was to objectively determine if electrode prep really makes a measurable difference in obtaining usable ECG waveforms from ambulatory patients.

**The following table provides a summary of my test and measurement results.**

<table>
<thead>
<tr>
<th>ID</th>
<th>Prep Name</th>
<th>Impedance</th>
<th>MIR</th>
<th>AR</th>
<th>ETR</th>
<th>OR</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP</td>
<td>Less Prep (No Prep)</td>
<td>3.9M ohms</td>
<td>7</td>
<td>1</td>
<td>7</td>
<td>15</td>
<td>No application required</td>
</tr>
<tr>
<td>AP</td>
<td>Alcohol Prep</td>
<td>1.0M ohms</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>14</td>
<td>Easy application</td>
</tr>
<tr>
<td>AT</td>
<td>Abrasive Tape Prep</td>
<td>2.9K ohms</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>9</td>
<td>Mild discomfort in application</td>
</tr>
<tr>
<td>GP</td>
<td>Green Prep</td>
<td>5.0K ohms</td>
<td>4</td>
<td>7</td>
<td>1</td>
<td>12</td>
<td>Difficult to get out comes out in a big blob. Difficult to remove excess.</td>
</tr>
<tr>
<td>NP</td>
<td>NuPrep</td>
<td>1.2K ohms</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>Easy application</td>
</tr>
<tr>
<td>RP</td>
<td>Redux Paste</td>
<td>9.2K ohms</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>12</td>
<td>Easy application</td>
</tr>
<tr>
<td>SP</td>
<td>Scour Pad Prep</td>
<td>2.2K ohms</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>8</td>
<td>Painful during application</td>
</tr>
</tbody>
</table>

**Abbreviations**

MIR  Measured Impedance Rating
AR   Application Rating. How easy was the prep to use and was there any discomfort for the patient.
ETR  Electrode Tape Rating. How well does the prep deal with induced artifact.
OR   Overall Rating. The sum of the ratings. Lower number is better.

Ratings: All ratings are on a scale of 1 to 7 with 1 being the best and 7 the worst.

Additional products and supplies used to perform this test were a Holter recorder manufactured by NorthEast Monitoring that displayed the ECG waveforms, and the Cliptrode brand of electrode from Danlee. The same lead wires were used for all ECG waveforms.