3D QRS area calculation from X, Y, Z vectorcardiographic leads: Area subtended by negative deflections should be added and not subtracted

Background

- 3D QRS area is a novel ECG measure of left ventricular electrical dysynchrony that has been shown to strongly predict response to cardiac resynchronization therapy. It is a surrogate for the instantaneous absolute 3D QRS voltage time integral (VTI).
- Different groups have calculated the 3D QRS area using two different methods, either taking the sum or the difference of areas subtended by positive and negative deflections in orthogonal ECG leads (Panel A). (1-5)

Research Question

It is unknown which calculation method is a more reliable surrogate for the absolute 3D voltage time integral.

Methods and Materials

- 602 ECGs were retrospectively reviewed.
- Orthogonal ECG leads were converted to X, Y, Z leads using matrices.
- Individual areas subtended by the positive and negative deflections in X, Y, Z leads were measured.
- Root-mean-square 3DQRS area was calculated by one of two methods: (a) summation or (b) difference of areas subtended by positive and negative deflections.

Main Findings

1. The summation method consistently estimated VTI_{QRS,30} (β 0.94, r^2 0.99), whereas the difference method was an inconsistent underestimate (β 0.76, r^2 0.67).

2. Mean 3D QRS area with the summation method was 36.5 ± 13 µVs and with the difference method was 25.7 ± 13 µVs.

VTI_{QRS,30} = 30.06 µVs

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<tr>
<th>Summation method</th>
<th>Difference method</th>
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<td>3D QRS Area: 36.5 ± 13 µVs</td>
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3D QRS area calculation by summation as opposed to difference of areas subtended by positive and negative deflections in X, Y, Z leads is a more reliable surrogate for the absolute 3D voltage time integral.

Conclusion

- 3D QRS area calculation from X, Y, Z vectorcardiographic leads: Area subtended by negative deflections should be added and not subtracted.

References

- Cardiovascular Research & Artificial Intelligence Center

Note: Notting to disclose.

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