Radial Artery Occlusion Prevention and Recanalization

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Disclosures

• Consultant: Medtronic, Terumo
• Equity: Vasoinnovations Inc
RAO Happens !!!!!!!

2015 PubMed RAO Rates

- Rotterdam: 3.90%
- AJULAR: 8.90%
- Edris et al.: 14.90%
- HANGAR: 9.20%
- Degirmencioglu: 5.50%
- Hahalis et al.: 14%

RAO Incidence

Mean Reported RAO Incidence: 9.40%

Mechanism of RAO

- Thrombosis (acute)
- Rapid organization with fibrotic lumen obliteration
Mechanism of RAO

Pancholy SB J Inv Cardiol 2009
Mechanism of RAO

Pancholy SB J Inv Cardiol 2009

Mechanism of RAO

Pancholy SB J Inv Cardiol 2009
Mechanism of RAO

Aminian A et al. EuroIntervention 2017
Figure 2

1926 patients randomized at 12 sites

- 967 patients assigned to GSS6Fr
- 959 patients assigned to GSSFr

Protocol Violation N=24
Failed Radial Puncture N=12

- GSS6Fr in 921 patients
- GSSFr in 917 patients

- Patent Hemostasis in 448 patients
- Institutional Hemostasis in 473 patients

- Patent Hemostasis in 470 patients
- Institutional Hemostasis in 447 patients

Table 2. Primary end-point (RAO)

<table>
<thead>
<tr>
<th>Sheath type</th>
<th>GSS6Fr</th>
<th>GSSFr</th>
<th>( P_{\text{non-inferiority}} )</th>
<th>( P_{\text{value}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>921</td>
<td>917</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAO (%)</td>
<td>32 (3.47)</td>
<td>16 (1.74)</td>
<td>0.150</td>
<td></td>
</tr>
<tr>
<td>Hemostasis protocol</td>
<td>Patent</td>
<td>Institutional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>918</td>
<td>920</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAO (%)</td>
<td>24 (2.61)</td>
<td>24 (2.61)</td>
<td>1.0000</td>
<td></td>
</tr>
</tbody>
</table>
Sheathless Technique

Table 6. Univariate Analysis of RAO and Access Site Crossover Owing to Grade 4

<table>
<thead>
<tr>
<th>RAS.</th>
<th>RAO + grade 4 RAS (+) (n=9)</th>
<th>RAO + grade 4 RAS (-) (n=594)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, (year)</td>
<td>73.0 ± 9.3</td>
<td>69.7 ± 10.1</td>
<td>0.418</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>3 (50.0)</td>
<td>112 (18.8)</td>
<td>0.088†</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>24.9 ± 2.7</td>
<td>24.4 ± 3.3</td>
<td>0.755</td>
</tr>
<tr>
<td>Diabetes, n (%)</td>
<td>5 (83.3)</td>
<td>289 (48.7)</td>
<td>0.116†</td>
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<tr>
<td>Chronic kidney disease, n (%)</td>
<td>3 (50.0)</td>
<td>114 (19.2)</td>
<td>0.092‡</td>
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<td>Beta-blocker, n (%)</td>
<td>5 (83.3)</td>
<td>193 (32.5)</td>
<td>0.017‡</td>
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<tr>
<td>Calcium channel blocker, n (%)</td>
<td>2 (33.3)</td>
<td>305 (51.4)</td>
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<tr>
<td>Mean diameters of radial arteries, (mm)</td>
<td>1.78 ± 0.73</td>
<td>2.20 ± 0.46</td>
<td>0.026</td>
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<tr>
<td>6.5-Fr SH-GC, n (%)</td>
<td>0 (0.0)</td>
<td>330 (50.5)</td>
<td>0.031‡</td>
</tr>
<tr>
<td>Mean sheath/radial artery ratio</td>
<td>1.61 ± 0.67</td>
<td>1.09 ± 0.25</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean procedure time, (min)</td>
<td>78.2 ± 42.7</td>
<td>45.7 ± 20.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Previous ipsilateral TRI, n (%)</td>
<td>1 (66.7)</td>
<td>299 (50.3)</td>
<td>0.686‡</td>
</tr>
<tr>
<td>Previous CABG, n (%)</td>
<td>2 (33.3)</td>
<td>10 (1.7)</td>
<td>0.005‡</td>
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Horie K et al. Eurointervention 2017
Sheathless Technique

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<td>6.5-Fr SH-GG, n (%)</td>
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<td>0.031‡</td>
</tr>
<tr>
<td>Mean sheath/radial artery ratio</td>
<td>1.61 ± 0.60</td>
<td>1.69 ± 0.25</td>
<td>&gt;0.001</td>
</tr>
<tr>
<td>Mean procedure time, (min)</td>
<td>78.2 ± 42.7</td>
<td>45.7 ± 20.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Previous isoprenaline TRU, n (%)</td>
<td>106 (67.6)</td>
<td>299 (50.3)</td>
<td>0.686‡</td>
</tr>
<tr>
<td>Previous CABG, n (%)</td>
<td>2 (33.3)</td>
<td>10 (1.7)</td>
<td>0.005‡</td>
</tr>
</tbody>
</table>

Horie K et al, Eurointervention 2017

UFH Dose and RAO

Spaulding C et al, CCI 1996
Heparin Dose matters!

Bernat I et al, Am J Cardiol

UFH Dose and RAO

Hahalis G et al, Int J Cardiol 2015
bossard M et al Can J Cardiol 2017

Bossard M et al Can J Cardiol 2017
Warfarin is not enough!!!!

RAO: Flow cessation

Sanmartin et al CCI 2007; 70: 185-9
Patent Hemostasis

Incidence of Radial Artery Occlusion

- Traditional Hold (Group I)
  - Early occlusion (24h): n=27
  - Persistent Occlusion (30d): n=11
  - P < 0.05

- Patent hemostasis (Group II)
  - Early occlusion (24h): n=16
  - Persistent Occlusion (30d): n=4
  - P < 0.05


Wilson SJ et al Int J Cardiol 2017
Beware of Rebound Bleeding

Rebound Bleeding = Revengeful Pressure

Rebound Bleeding = Revengeful Pressure

RAO

How to compress?

Duration in Minutes

P < 0.0001

Dressing  Balloon Band  Pad Band

1650 patients RANDOMIZED to 3 groups

Cong X et al, J Cardiov Nurs, 2016
How to compress?

RAO %

Dressing  Balloon Band  Pad Band

1650 patients RANDOMIZED to 3 groups

Cong X et al, J Cardiov Nurs, 2016

Eliminate residual spasm

Dharma S, Kedev S, Patel T et al, CCI 2014
Radio-Ulnar circuit

RA

UA

Radio-Ulnar circuit

RA

UA
Radio-Ulnar circuit

Ulnar compression

UA compressed

UA released
Radial VTI with Ulnar compression

![Graph](image)

Baseline | N = 150 | Ulnar compression
---|---|---
VTI (m.s²) | 8.4 | 12.8

P < 0.0001

Pancholy S et al, J Inv Cardiol 2015

PROPHET-II
(Prevention of Radial Artery Occlusion – Prophylactic Hyperperfusion Evaluation Trial)

Figure 2: CONSORT Diagram

Pancholy S et al, JACC Interv 2016
PROPHET-II
(Prevention of Radial Artery Occlusion – Prophylactic Hyperperfusion Evaluation Trial)

Figure 3: Incidence of Radial Artery Occlusion

Pancholy S et al, JACC Interv 2016

• Prophylactic Ulnar compression lowers RAO
Figure 1: Ipsilateral Ulnar Compression During Radial Artery Hemostasis

PROPHET-II
(Prevention of Radial Artery Occlusion – Prophylactic Hyperperfusion Evaluation Trial)

ULnar Artery Transient Compression Facilitating Radial Artery Patent Hemostasis (ULTRA):
A Novel Technique to Reduce Radial Artery Occlusion After Transradial Coronary Catheterization

Michael J. Kontzouris, MD, PhD; Christos D. Maniotis, MD, PhD; Grigoris Aridakos, MD; Andreas Tsoumeleas, MD; Constantinos Androu, MD, PhD; Zenon S. Kyriakides, MD, PhD
### Table 3. Radial artery patency after intervention.

<table>
<thead>
<tr>
<th></th>
<th>Conventional Method (n = 121)</th>
<th>ULTRA Method (n = 119)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pulsation</td>
<td>15 (12.4%)</td>
<td>3 (2.5%)</td>
<td>.01</td>
</tr>
<tr>
<td>No duplex flow</td>
<td>6 (5.0%)</td>
<td>0 (0.0%)</td>
<td>.01</td>
</tr>
</tbody>
</table>

Data presented as number [%].

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Koutouzis et al, J Inv Cardiol 2016

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Have we made a difference?
Recanalization
Why recanalize?

• Never to re-establish patency (risk exceeds the potential benefit)
• Consider the dangers of embolization, especially down the ulnar artery.

Why recanalize?

• If the involved radial artery the only viable access.
• If unequivocal evidence of digital ischemia
Beware of the risks

• Digital arteries are end-arteries.
• Digital ischemia / necrosis usually disabling.

Methods

• Traditional “antegrade” approach, with TF or UE (ipsilateral ulnar or contralateral radial access)
• Retrograde recanalization
Retrograde recanalization

- Radial artery “stump” has > 70% MAP
- Introducer in the distal radial artery stump provides occlusive distal protection.

Doppler mapping

- Using a bedside doppler probe, map along the radial artery looking for a signal and cut-off, demarcating the thrombosed segment.
Caution

- Do not inject ANY fluid FORWARD till pulsatile flow is established
- Use either a 5-6 F sheath or 5F multipurpose guide catheter to “core” out the thrombus.
- DO NOT advance the Sheath/Catheter past the proximal third of the radial trunk.

CAUTION

- Maintain negative suction
- Remove the Sheath/Catheter after 1-2 cm passes and flush it out. Open side arm valve of the introducer to look for pulsatile flow
- If no pulsatile flow, repeat the “coring” process.
- DO NOT cross brachial bifurcation
Difficult to hurt the hand

Thrombus migration
Thrombus migration

Digital emboli
Thank you