Comparative Renal Outcomes After F/EVAR, Ch/EVAR And Open Repair: What Is The Best Renal Protective Agent And Regimen

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Disclosures
- Cook - Consulting, Research Support, Clinical Trials
- WL Gore - Consulting, Clinical Trials
- Endologix - Consulting, Clinical Trials
- Medtronic - Consulting

Renal Dysfunction Impacts Survival
- Data suggests that renal dysfunction after open or EV repair of aortic disease results in decreased survival

Causes of Renal Dysfunction
- Open Repair
  - Every 5 minutes of renal ischemia doubles the risk of renal dysfunction
  - Data suggests that renal vein division has been shown to increase real dysfunction six fold
- Endovascular Repair
  - Embolization
  - Contrast
  - Renal Artery Dissection/Stent complications
  - Assessment: Improved definition via RIFLE criteria

Open Repair (PRAA)
- New CRF: 19% (2-40%)
- New Dialysis 5% (0-11.5%)

Open AAA Repair Review
- Review from 2004 - 2016
- Studies: 6, 658 patients (non-ruptured, IRAAA)
- Post-Op AKI: 20-37%
- Chronic RRT: 0-3%
Open Repair

- Most studies focus upon acute kidney injury (AKI) associated with the initial repair
- Long term impact largely unknown
- Two Studies:
  - Type IV TAAA: 53 patients 2007 - 2011
  - P/JRAA: 108 repairs from 2007-2015
  - CKD 3/4 risk factor for CRD

<table>
<thead>
<tr>
<th>In Hosp AKI</th>
<th>Decline in eGFR</th>
<th>Temp Dialysis</th>
<th>Perm Dialysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type IV TAAA</td>
<td>17.4%</td>
<td>28.16 ± 30 months</td>
<td>7.5%</td>
</tr>
<tr>
<td>P/JRAA</td>
<td>16.7%</td>
<td>16% @ 24 months</td>
<td>0.9%</td>
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Late Renal Results (ZFEN vs Zenith AAA)

- AKI (> 25%)
  - 1 month: FEVAR 5%, EVAR 9%

Late Renal Results

- AKI (Change in GFR> 25%)
  - 1 month: FEVAR 5%, EVAR 9%
  - No difference at 2 yrs: FEVAR 20%, EVAR 20%
  - No difference at 5 yrs: FEVAR 27%, EVAR 50%

- Progression to Stage IV-V Similar
  - At 2 yrs: FEVAR 2%, EVAR 3%
  - At 5 yrs: FEVAR 7%, EVAR 8%
  - Progression to Renal Failure: FEVAR 1.5%, EVAR 1.8%

Fenestrated Outcomes

- Zenith Prospective Trial: 134 patients
- ZFEN Prospective Trial: 67 patients
- Propensity Matching: 2:1
Is FEVAR Worse (JRAA)?

<table>
<thead>
<tr>
<th></th>
<th>Open</th>
<th>FEVAR</th>
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<tbody>
<tr>
<td>New CRI</td>
<td>26.5%</td>
<td>8.5%</td>
</tr>
<tr>
<td>Persisted</td>
<td>11.8%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Dialysis</td>
<td>3%</td>
<td>3%</td>
</tr>
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ChEVAR

- Only a few reports of significant number
  - PROTAGORAS (Endurant)
  - PERICLES (Numerous Variations)
  - Single Institution Series

PROTAGORAS
- 187 chimneys in 128 pts.
- 92% 1 or 2 chimneys
- No real discussion of AKI

PERICLES
- 898 chimneys, 517 patients
- 17.5% had AKI in the acute post-op period
- No real discussion of AKI

Renal Function after Snorkel/Chimney

- Patients: 43
- JRAA Chimney: 31 double, 12 angle
- AKI: 32.6%
- 41% had some decline in renal function
- 8% improved


ChEVAR versus FEVAR

- Similar Result in Renal Outcomes
  - AKI - FEVAR: 17.8%, Ch: 19.3%
  - More complete repairs in the FEVAR group
  - More symptomatic patients in the ChEVAR group

Renal Questions?

- Renal Embolization/Accessory Renal Coverage Impact?
- Mid-term impact of BiFEVAR on Volume and eGFR?

Incidence and Clinical Significance of Renal Infarct after Fenestrated Endovascular Aortic Repair

Lauren MB Burke MD, Jesse M Conyers MD, Charles T Burke MD, Robert Dixon MD, Hyeon YJ MD, Jeremy Kihl MD, David Reissner MD, Mark AF Fuller MD, Aj J Issa MD

UNC Chapel Hill

Results

- 124 patients
  - 114 included
  - 24 excluded
    - Lack of pre-operative contrast imaging
    - Lack of pre-operative contrast enhanced imaging
    - No accessible pre-operative imaging
- 100 total patients included for review

100 FEVAR patients included for review

- 24 patients with ≥1 renal infarct(s)
  - 10 purposeful covering of an accessory renal artery (< 4 mm)
  - 14 presumed embolic
  - 1 with increase in serum Cr
  - 3 with increase in serum Cr

Results

- Average volume reduction
  - 4.1%
  - In patients with covering of an accessory renal artery
    - 6.4%
  - In patients with presumed embolic event
    - 2.5%

Average volume reduction

4.1%

(Emb-2.5% vs Acc - 6.4%)
Renal Volumes and eGFR Changes After Fenestrated-Branched Endovascular Aortic Repair

Fernando Motta, MD; Corey A. Kalbaugh, PhD, MS; Daniel J.Luckett, BS; Jason Finc, PhD; Ioana Antonescu, MD; Elad Ohana, RT(R); Jason Crowner, MD; Mark A. Farber, MD.

Methods

• Renal Volume Calculation: Aquarius iNtuition software (TeraRecon Inc., San Mateo, Ca)
  \[RV = \text{selected area} - (\text{peri-renal fat} + \text{renal vessels/pelvis})\]

Results

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N (%)</th>
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<tbody>
<tr>
<td>Mean Age at Procedure, SD</td>
<td>71 (8)</td>
</tr>
<tr>
<td>Gender, % Female</td>
<td>42 (30)</td>
</tr>
<tr>
<td>Race, % Black</td>
<td>25 (18)</td>
</tr>
<tr>
<td>Smoking history</td>
<td>130 (94)</td>
</tr>
<tr>
<td>COPD</td>
<td>82 (58)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>128 (92)</td>
</tr>
<tr>
<td>Renal Insufficiency</td>
<td>70 (54)</td>
</tr>
<tr>
<td>CAD</td>
<td>70 (54)</td>
</tr>
<tr>
<td>Congestive Heart Failure</td>
<td>21 (15)</td>
</tr>
<tr>
<td>Diabetes Medicines</td>
<td>23 (18)</td>
</tr>
<tr>
<td>Max. Aneurysm diameter in mm</td>
<td>62 (47)</td>
</tr>
<tr>
<td>Presence of Accessory Renal Artery</td>
<td>31 (22)</td>
</tr>
<tr>
<td>Mean baseline eGFR, ml/min/1.73m²</td>
<td>70 (27)</td>
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30-day mortality: 2.9%
Acute kidney injury: 5.0% (7/139)
Presence of ≥1 accessory renal artery: 22% (31/139)
Mean FU: 14.3 months
Survivors:
  • 48.7% - 1 year
  • 36.7% - 11 month
  • 26.7% - 13 month
  • 16.7% - 24 month
  • Logistic regression model covariates found no factor associated with increased risk of death


Changes in eGFR:

<table>
<thead>
<tr>
<th>Time of Follow-up</th>
<th>Mean ∆ in eGFR, ml/min/1.73m² (SD)</th>
</tr>
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<tbody>
<tr>
<td>6 months</td>
<td>-4.6 (15.5)</td>
</tr>
<tr>
<td>12 months</td>
<td>-3.9 (15.4)</td>
</tr>
<tr>
<td>18 months</td>
<td>-5.0 (16.5)</td>
</tr>
</tbody>
</table>

16.1% (9/56) of patients with CKD had improvement in eGFR to > 60 ml/min/1.73m²
eGFR change over time was similar to published age related changes
Results

- Changes in eGFR:
  - eGFR decreased over time
  - Decline @ 18-month post-op: 5 units
  - eGFR was estimated to decrease at a rate of 2.88 ml/min/1.73 m²/year.
  - Patient age ↑ 5 years was estimated → ↓ eGFR of 2.9 units, adj for risk factors.
  - 16.1% (9/56) of patients with CKD had improvement in eGFR to > 60 ml/min/1.73 m².
  - eGFR change over time was similar to published age related changes.

Discussion

- Change in eGFR:
  - 225 patients from Oct 2004 to Oct 2012
  - Mean follow up 3.1 years
  - Acute Renal Failure: 29%
  - Changes in mean eGFR: -19.9% (13.1%–26.2%) at 3 years Fu
  - Mean BVR: decreased 9.9% (5.5%–14.6%) at 3 years Fu
  - Association between total RV and eGFR: increase in total volume of 19.4% (12.8%–26.3%) per log mL/min/1.73 m² increase of eGFR, p < .0001.

Conclusions

- Open, FEVAR and CHEVAR procedures are associated with AKI in a proportion of patients ~20%
- Causes of deterioration are likely multifactorial and may be different for each technique.
- Renal infracts from coverage of accessory renal arteries and embolization occur in ~25% of patients and is a small contributor to renal decline.
- Renal decline after FEVAR is similar to changes associated with aging.

Discussion

- Kidney function is a concern after F-BEVAR repair.
- Decrease in renal function impacts outcomes.
- This study demonstrated continued decrease in eGFR and RV over time, similar to published reports.
- A subgroup of patients with pre-existing CKD had improvement of renal function after procedure.
- Coverage of accessory renal artery did not impact outcomes.

References

Limitations

• Single center study.
• Retrospective Analysis.
• Sample Size.
• No control group (patients with CAA managed clinically).
• Length of Follow up.

Conclusion

• Renal volume and eGFR decreased in patients undergoing repair at similar rates to natural history progression.
• The majority of the decline in renal function occurred within the first six months post-operatively.
• Most accessory renal arteries can be excluded without significant impact on renal function.
• The eGFR was found to moderately correlate with renal volume.
• F-BEVAR had little impact on renal function during the initial 18 months after treatment.