How Are 3D Navigational Tools Helpful In Lower Extremity Interventions

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Conflict of interest

• None

Fusion imaging

• 20 endovascular peripheral arterial procedures in 17 patients
  – 15 MRA
  – 2 CTA
• 3D road-map added value in 15 procedures in 12 patients
• In half of the patients (8/17), intervention was performed relying on the fusion road-map only, without diagnostic angiography


Accuracy

• Average maximum difference in position of vasculature on angiography and MRA/CTA fusion roadmap was 6.41 mm with a standard deviation of 11.12 mm
• Excluding three patients with major leg and pelvis movement during the procedure, average maximum difference was 1.86 ± 0.95 mm (approximately 95% of differences were between 0 and 3.72 mm; 2 ± 1.96 standard deviation)


Practical aspect

• Average time needed for image registration 5 ± 2 min
• Registration can be performed on the 3D workstation while further preparations inside the angiography suite (draping the patient, preparing the table) are performed
• Actual time loss for fusion road-mapping negligible


Fusion imaging

• Fusion image road-mapping can be used for navigation, for crossing stenosis occlusions and positioning stents
• Optimal C-arm projection angles can be identified on the fusion road-map i.e. without fluoroscopy
• Kissing stenting and subsequent kissing angioplasty can be performed without any angiographic acquisition leading to reduction in contrast dose

Ierardi AM, et al, CVIR DOI 10.1007/s00270-015-1158-4
Implications

• Image fusion technology holds the potential for CM reduction (relevant for patients with renal impairment)
• Zero-iodinated-contrast interventions are possible (combination with IVUS/ultrasound control, low volume of gadolinium or CO₂)

Disadvantages

• MRA based registration requires acquisition of a cone-beam CT leading to additional radiation exposure (patient only; CTA based registration can be performed using fluoroscopy only)
• ED of abdominal CBCT corresponds to approximately half of the dose of abdominal MDCT
• Application of CBCT will result in a reduction of patients total procedural radiation exposure if a reduction of fluoroscopy time of approximately 7 min is achieved

Disadvantages

• Mean patients’ radiation dose in terms of dose area product (DAP) from CBCT in the pelvic region 14.5 Gycm² (i.e. on average 21.4 % of total procedural DAP)
• Calculated maximum risk for lifetime exposure induced cancer death is less than 0.03 % in pelvic cone-beam CT
• For the elderly PAD patient population, potential benefit from contrast savings by use of fusion road-mapping probably outweighs the negative impact of the extra radiation dose

Limitations

• Minor displacement of the fusion road-map can be corrected manually during the procedure by readjusting the MRA/CTA dataset on fluoroscopy landmarks (catheter, vessel wall calcifications)
• Risk of device misplacement in
  – Smaller size vessels diameter
  – Recanalization procedures
  – Stenting nearby side branches

Registration
Adjusting alignment

Angiography

Recanalization

PTA

Use vessel wall calcification to optimize registration/adjust alignment
Control angiography

Conclusions

• Fluoroscopy with MRA/CTA fusion guidance for peripheral arterial interventions is feasible
• This technology may contribute to increase procedural safety (radiation/contrast)