POCUS and Anatomy of Radial Artery Canulation Technique from GAX-specimens with BriteVu Contrast

Lee, Maui[1], Dennis NGYUGEN[1] and Brion BENNINGER[1,2]. Medical Anatomy Center[1], Western University of Health Sciences, COMP–Northwest, Lebanon, 97355, OR. USA. Faculty General Surgery[2], Samaritan Health Services, Lebanon and Corvallis, 97355, OR. USA.

Medical Anatomy Center — Where Education and Science Meet Medicine

World Congress Ultrasound in Medical Education

Western University of Health Sciences — College of Osteopathic Medicine of the Pacific COMP-Northwest

ABSTRACT

INTRODUCTION. Of the 3 vascular hand arches (2 palmar, 1 dorsal) the superficial palmar arch has received significant attention due to the varied number of clinical skills and invasive procedures associated with 3 segments of the radial artery (RA1, RA2, RA3). The authors delineate the segments as RA1-8cm length pre styloid process, R2-Distal to styloid process and/or where superficial palmar artery branches from radial artery at the styloid process site inferiorly through anatomical snuffbox, R3-Distal to outer border of anatomical snuff box along extensor pollicis longus. RA1 segment is used for pulse monitoring, arterial blood gas draw, renal dialysis autogenous fistula, forearm grafting and harvesting. RA1 was initially the alternative site for angiography of coronary vessels versus femoral artery, but now is the gold standard. However, during the past decade RA2 and RA3 segments are popularly referred to as the distal radial artery (DRA). Studies demonstrated RA access in ST-elevation myocardial infarction patients had decreased risk of local complications and systemic bleedings. Providing detailed descriptive anatomy of RA1, RA2, RA3, Radial superficial palmar artery (RSPA) is important for invasive procedures using POCUS revealing structural morphology. Study objective was to investigate POCUS imaging and dissections of RA1, RA2, RA3 segments and RSPA from novel GAX-specimens with BriteVu contrast (BVc) versus formalin-fixed cadavers (FFC). METHODS. Literature search revealed no GAX-specimen with BVc of RA1, RA2, RA3, RSPA studies. GAX-specimens (n=6:3-Male:3-Female:12-sides: average age 67) were MRI/CT scanned with BVc and FFC (n=15:9-Male:6-Female:30-sides: average age 78) all had POCUS (GE Vscan Air probe) imaging. A total of 42 sides was dissected assessing RA1, RA2, RA3, RSPA. RESULTS. GAX-specimen with BVc demonstrated lifelike palpation and full range-of-motion of wrist and 1st MCP joints leading to successful POCUS with GE Vscan Air of RA1, RA2, RA3, RSPA (12/12-100%). GAX-specimen dissections demonstrated lifelike structural orientation, tissue resistance, color, and texture of RA1, RA2, RA3, RSPA vs FFC. RSPA branched within 2mm of styloid process on both GAX-specimens and FFC (42/42 sides-100%). FFC had minimal joint movement, increased tissue resistance, collapsed vessels revealing poor quality RA2, RA3 POCUS images (30/30-100%). FFC RA1 (16/30-53%) were identifiable with POCUS. Despite collapsed vessels from FFC, RA1 POCUS images could be identified probably due to atherosclerotic plaque causing vessel rigidity. GAX-specimens and FFC (42/42 sides-100%) confirmed RA1, RA2, RA3, RSPA segment borders. CONCLUSION. This study using GAX-specimens with BVc demonstrated the RA1, RA2-RSPA, and RA3 segments excellent lifelike dissections with successful POCUS imaging from GE Vscan Air probes while positioning the joints of the wrist and thumb for ideal imaging and canulation thus an excellent medium for training. The RSPA was identified to branch within 2mm of the styloid process from all 42 sides of GAX-specimen and FFC dissections which is consistent with current studies. FFC was a poor medium for POCUS imaging of the RA1, RA2-RSPA, and RA3 segments.

OBJECTIVE

Study objective was to investigate POCUS imaging and dissections of RA1, RA2, RA3 segments and RSPA from novel GAX-specimens with BriteVu contrast (BVc) versus formalin-fixed cadavers (FFC).

AIM - INTRODUCTION

Figure 1: Lucien Campeau. First publishing for the proposal of radial artery use in PCI.

In 1989 a study regarding trans-radial vascular access for percutaneous coronary intervention (PCI) proposing the use of radial artery as replacement for the femoral artery as a safer and less invasive option was published by esteemed cardiologist, Lucien Campeau. He performed the first radial angiogram and started the transition towards using the radial artery for PCI as the new standard of care. The use of the radial artery for PCI continues to grow internationally (most notably in Germany and Sweden) and within the US (49.8% radial artery use in 2018 for non-dialysis patients) thanks to fellow cardiologist Ferdinand Kiemeneij, who was the first to use the techniques as a new standard of care. The use of the radial artery for PCI is continuing to grow, including branching into fields such as nephrology for dialysis patients (22.3%).Of the 3 vascular hand arches (2 palmar, 1 dorsal) the superficial palmar arch has received significant attention due to the varied number of clinical skills and invasive procedures associated with 3 segments of the radial artery (RA1, RA2, RA3).

AIM CONTINUED

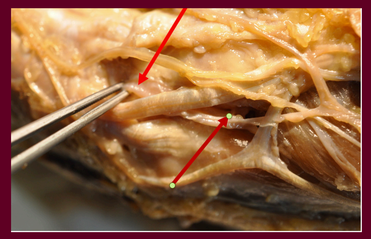

Figure 2: GAX-Specimen showing RA2 and RA3 in proper positioning for use in PCI.

The authors delineate the segments as RA1-8cm length pre styloid process, R2-Distal to styloid process and/or where superficial palmar artery branches from radial artery at the styloid process site inferiorly through anatomical snuffbox, R3-Distal to outer border of anatomical snuff box along extensor pollicis longus. RA1 segment is used for pulse monitoring, arterial blood gas draw, renal dialysis autogenous fistula, forearm grafting and harvesting. RA1 was initially the alternative site for angiography of coronary vessels versus femoral artery, but now is the gold standard. However, during the past decade RA2 and RA3 segments are popularly referred to as the distal radial artery (DRA). Studies demonstrated RA access in ST-elevation myocardial infarction patients had decreased risk of local complications and systemic bleedings. Providing detailed descriptive anatomy of RA1, RA2, RA3, Radial superficial palmar artery (RSPA) is important for invasive procedures using POCUS revealing structural morphology.

METHODS

Literature search revealed no GAX-specimen with BVc of RA1, RA2, RA3, RSPA studies. GAX-specimens (n=6:3-Male:3-Female:12-sides: average age 67) were MRI/CT scanned with BVc and FFC (n=15:9-Male:6-Female:30-sides: average age 78) all had POCUS (GE Vscan Air probe) imaging. A total of 42 sides was dissected assessing RA1, RA2, RA3, RSPA.

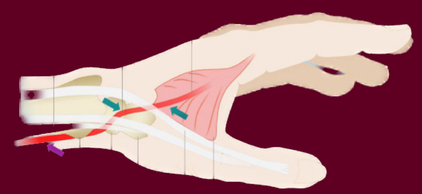

Figure 3: Diagram of the positions for radial artery entry options. RA1 (purple arrow), RA2 (left green arrow), RA3 (right green arrow).

RESULTS

GAX-specimen with BVc demonstrated lifelike palpation and full range-of-motion of wrist and 1st MCP joints leading to successful POCUS with GE Vscan Air of RA1, RA2, RA3, RSPA (12/12-100%). GAX-specimen dissections demonstrated lifelike structural orientation, tissue resistance, color, and texture of RA1, RA2, RA3, RSPA vs FFC. RSPA branched within 2mm of styloid process on both GAX-specimens and FFC (42/42 sides-100%). GAX-specimen with BVc demonstrated lifelike palpation and full range-of-motion of wrist and 1st MCP joints leading to successful POCUS with GE Vscan Air of RA1, RA2, RA3, RSPA (12/12-100%).

Figure 4: Longitudinal POCUS and GAX-Specimen dissection RA1 (red arrows).

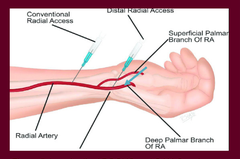

Figure 5: Longitudinal POCUS and GAX-Specimen dissection RA1 (red arrows).

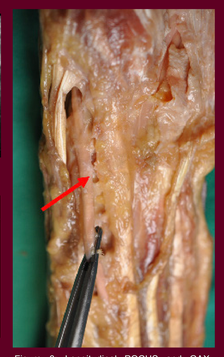

Figure 6: Longitudinal POCUS and GAX-Specimen dissection RA1 (red arrows).

RESULTS

Figure 7: Longitudinal POCUS and GAX-Specimen dissection RA2 (red arrows).

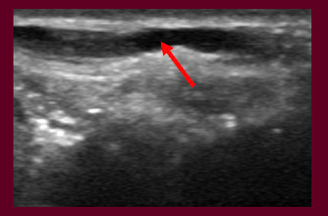

Figure 8: Longitudinal POCUS and GAX-Specimen dissection RA3 (red arrows).

GAX-specimen dissections demonstrated lifelike structural orientation, tissue resistance, color, and texture of RA1, RA2, RA3, RSPA vs FFC. RSPA branched within 2mm of styloid process on both GAX-specimens and FFC (42/42 sides-100%). FFC had minimal joint movement, increased tissue resistance, collapsed vessels revealing poor quality RA2, RA3 POCUS images (30/30-100%). FFC RA1 (16/30-53%) were identifiable with POCUS. Despite collapsed vessels from FFC, RA1 POCUS images could be identified probably due to atherosclerotic plaque causing vessel rigidity. GAX-specimens and FFC (42/42 sides-100%) confirmed RA1 (see Figures 3, 4, 5, and 6), RA2 (see Figures 2, 5, 7 and 8), RA3 (see Figures 2, 3, 5, 9, and 10), RSPA segment borders (see Figures 3 and 5). With the ability to utilize full joint mobility and lifelike orientation of the radial artery, the GAX-specimens are an option ofr training future physicians with the intent to use the radial artery for increasing amounts of procedures and interventions.

Figure 9: Longitudinal POCUS and GAX-Specimen dissection RA2 (red arrows).

Figure 10: Longitudinal POCUS and GAX-Specimen dissection RA3 (red arrows).

CONCLUSION

This study using GAX-specimens with BVc demonstrated the RA1, RA2-RSPA, and RA3 segments excellent lifelike dissections with successful POCUS imaging from GE Vscan Air probes while positioning the joints of the wrist and thumb for ideal imaging and canulation thus an excellent medium for training. The RSPA was identified to branch within 2mm of the styloid process from all 42 sides of GAX-specimen and FFC dissections which is consistent with current studies. FFC was a poor medium for POCUS imaging of the RA1, RA2-RSPA, and RA3 segments.

ACKNOWLEDGEMENTS

We would like to thank the Medical Anatomy Center, Brian Ireland - Kingsman Lab for preparing specimens and the University of Oregon Clinical Anatomy Research Lab, and to the McDaniel Surgical, Radiology, and Medical Anatomy Lab in Lebanon, OR. This research was made possible due to the amazing gift from the donor cadaver patients, thank you.

REFERENCES

References available upon request