



procedure information and patient demographics pertaining to gender, age, history of smoking, Avastin usage, and history of diabetic diagnosis were provided due to necessity for analysis. All other de-anonymizing information was withheld for patient anonymity and safety.

Each CT scan image for each procedure was reviewed for analysis. Measurements of the femoral artery diameter were performed by leveraging the radiologic imaging software, Synapse® by Fuji Film Global. We validated the measurements by repeating the measuring step, blinded to the initial results, and reporting the mean femoral artery diameter between the two measurements steps if a difference was present. The final results of the femoral artery diameter were reported in millimetres.

From the records, total percentage of Y90 administration relative to the prescribed dose and procedure access site (femoral or radial artery) were recorded.

Analysis

Results of each procedure, (access site, total percentage uptake, femoral artery size, smoking history, diabetes, Avastin, age, and gender) were reported in Table 1. Figure 1 compares procedure access site to femoral artery dimension. Statistical analysis was performed on the collected data via the open-source computer language, Python (Version 3.9.1) [22], and the open-source, web-based interactive computational environment, Jupyter Notebook (Version 7.19.0) [23]. Using the statistics, Python-based module, Scipy (Version 1.6.0), characteristics of the transradial artery procedure group and Trans femoral artery procedure group were revealed and compared [24]. Characteristics such as minimum femoral artery diameter within the transradial artery group, femoral artery diameter variability when compared to age and an

unpaired t-test of the mean Y90 tumor uptake between the radial artery procedure group and femoral artery procedure group were performed. All statistical results and methodology were reported [22,23].

Of the 47 patients recorded in Table 1, 14 were excluded due to unreliable data collection, lack of pre-operative CT availability, or loss to follow up. The 33 analysed procedures contained 19 men and 14 women. The mean age of the patients was 63 years old (range 45-82 years old). It was found that 9 patients had a history of smoking, of which 5 were active smokers. 4 patients were found to have a diagnosis of diabetes and 2 patients received Avastin. The group was subdivided into patients who received Radioembolization via transradial artery or Trans femoral artery procedure. 20 patients (12 males, 8 females) received transradial artery Radioembolization, while 13 patients (7 males, 6 females) received Trans femoral artery Radioembolization.

The transradial artery procedure group was found to have a mean Trans femoral artery diameter of 10 mm. The Trans femoral artery procedure group was found to have a mean femoral artery diameter of 10 mm. The minimum femoral artery diameter for the transradial artery procedure group was found to be 6 mm.

Comparative analysis of Y90 liver tumor uptake was performed via unpaired t-test. It was revealed that there was no statistical difference between the transradial artery procedure group and Trans femoral artery procedure group when comparing mean Y90 uptake ($p > 0.81229$).

Further analyses were performed via stratification of patient groups based on diabetes history, smoking history, and procedural access

point, either transradial or Trans femoral. Figures 1 and 2 illustrate the differences in mean femoral artery diameter based on prior diagnosis of diabetes and prior smoking history, respectively. Figure 1 illustrates

the mean femoral artery diameter for patients with a prior diagnosis of diabetes was reported to be 9.8 mm with a standard deviation of 1.6 mm, while the mean femoral artery diameter for patients without a

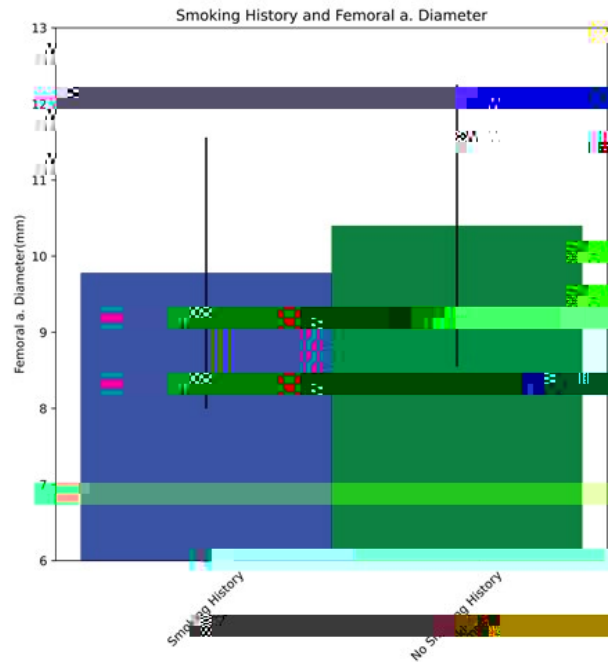


Figure 2: Comparison of mean femoral artery diameter with no respect to patient diabetes diagnosis history.
Note: ■

prior diagnosis of diabetes was reported to be 10.3 mm with a standard deviation of 1.9 mm. Figure 2 illustrates the mean femoral artery diameter for patients with a smoking history was reported to be 9.8 mm with a standard deviation of 1.8 mm, while the mean femoral artery diameter for patients without a smoking history was reported to be 10.4 mm with a standard deviation of 1.9 mm.

Figure 3 illustrates the comparison of mean femoral diameter between patients that successfully received Trans femoral artery Radioembolization and transradial artery Radioembolization. It was found that the mean femoral artery diameter for the Trans femoral artery Radioembolization group was 9.9 mm with a standard deviation of 1.8 mm, while the mean for the transradial artery Radioembolization group was 10.4 mm with a standard deviation of 1.9 mm.

D. Discussion

Transradial approach is becoming the preferred method of treatment for Y90 liver tumor Radioembolization. From a clinical standpoint, studies have shown that transradial artery Radioembolization has similar clinical outcomes when compared to Trans femoral artery Radio embolization [25]. In addition, patients have shorter recovery times when using the transradial approach. As discussed by Liu, transradial artery procedures were associated with significantly lower pain scores overall during the procedure, at the access site during the procedure, and in the recovery room compared with trans femoral artery procedures [12].

Our study attempts to improve the ease of pre-procedure planning for transradial Radioembolization by providing an alternative means of assessing radial artery capacity for procedure without needing additional tests. Traditionally, ultrasound, as well as, the Barbeau test followed by radial artery ultrasound is used for radial artery assessment.

This study reports successful assessment of the radial artery by sole reliance on femoral artery measurements via CT scan.

Out of 47 patients that have undergone Y90 Radioembolization, 33 patients' femoral arteries were measured and recorded regardless of access point of procedure. 20 patients underwent the transradial approach with a mean femoral artery diameter of 10 mm. No adverse effects or diminished outcomes were found when using either artery.

Thus we conclude that a femoral artery diameter of 10 mm or greater is predictive of adequate radial artery diameter for catheter access. Moreover, statistical analysis didn't reveal a significant difference between radioisotope uptake between the different access points for the procedure ($p>0.81229$). It is acknowledged that due to limited sample size, more investigation should be performed on the variable that could influence radial artery size.

Other studies have attempted to capture contributing factors to radial artery size variability. For example, it is understood that differences in sex may also include anatomic differences, such as vasculature diameters and lengths, can have an effect on procedure times, rates of vessel spasm, and radiation exposures. However, multiple studies have found that sex is insignificant when attempting to predict radial artery size based on characteristics such as Body Mass Index (BMI), lifestyle, etc. [12,26,27] Other methods have been used to assess radial artery size differences. In Aykan it was found that radial artery diameter was correlated with wrist circumference ($r=0.539$, $p<0.001$), height ($r=0.258$, $p<0.001$), weight ($r=0.237$, $p<0.001$), body mass index ($r=0.167$, $p=0.013$), shoe size ($r=0.559$, $p<0.001$), and pulse pressure ($r=-0.161$, $p=0.016$). The right radial artery was larger in men than in women (2.73 ± 0.39 mm vs. 2.15 ± 0.35 mm, $p<0.001$), and smaller in

patients with sedentary office work than in physically active outdoor workers (2.42 ± 0.45 mm vs. 2.81 ± 0.37 mm, $p<0.001$) [28].

Further investigation of radial artery size was performed by Kis. Using ultrasound guidance for vascular access, their study performed successful transradial artery Y90 Radioembolization procedures.

Though the study size was only 27 patients, Kis found that radial arteries with a diameter of greater than 1.7 mm were indicative of transradial feasibility [29].

Regardless of procedure success, the transradial artery Radioembolization is not without its drawbacks. It was found by Kis. that the procedure required greater technical acuity and skill. Traditionally, Trans femoral artery procedures are routine for interventional radiologists [29]. Thus, expenses for continuing education must be taken into account when deciding between the two methods of Radioembolization [12,30].

C. Conclusions

These concerns have subsided due to improvements in technology and imaging modalities. In addition, more training programs are exposing their trainees to the transradial approach earlier in their careers. Physicians continue to become more precise and healthcare costs conscious which improves patient care. What may seem now as a more difficult procedure, transradial artery procedures show greater promise over Trans femoral artery procedures in a multitude of medical fields, from interventional oncology to cardiology. Since medical infrastructure has been adapting from the traditional femoral artery approach to the newer transradial approach, our research hopes to further this advancement by providing an improved method to assess radial artery size based on the pre-procedure CT.

This study acknowledges the limited retrospective cohort size with regards to the findings. Moreover, this study would benefit from measurement of the radial artery per each patient, which would provide a direct comparative analysis between the femoral and radial artery.

C. Conflicts of Interest

No conflicts of interest reported.

A. Financial Support

No financial gain or funding was provided in conducting the study.

B

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A. Author Contributions

NA

C. Ethics Approval and Consent to Participate

Retrospective study: For this type of study formal consent is not required per Banner Health Institutional Review Board.

References

1. Riaz A, Lewandowski RJ, Kulik LM, Mulcahy MF, Sato KT, et al. (2009) Complications following radioembolization with yttrium-90 microspheres: A

