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## SHORT COMMUNICATION

# Cone-beam CT acquisition during transradial TACE made easy; use of the swivel arm board

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**Objective:** Transradial access for peripheral intervention often requires certain modification from its coronary counterparts. One of the challenges during transradial transarterial chemoembolization (TACE) is the need for the access arm to be repositioned during cone-beam CT (CBCT) acquisition to allow for C-arm rotation. We recently introduced a swivel arm board to allow seamless repositioning of the access arm during and after CBCT acquisition. The purpose of this study is to detail the technique and feasibility of this useful adjunct to transradial TACE.

**Methods:** We performed a retrospective study of consecutive cases of transradial TACE between November 2015 and March 2016, which represented the period where we introduced the swivel arm board to our transradial procedure. A total of 20 transradial TACE using the swivel arm board was performed in 17 patients. There were 13 males and 4 females. The mean age was 69.5 years old (range 48–82 years). Indications

for TACE included hepatocellular carcinoma ( $n = 14$ ) and metastatic liver disease ( $n = 3$ ).

**Results:** Transradial TACE was successful in all cases. A total of 40 successful arm repositioning using the swivel arm board for CBCT acquisitions were performed (100% success rate). There was no catheter or sheath dislodgement associated with the arm movements. No change in the microcatheter tip position was detected as a result of the arm repositioning. Hemostasis was successfully achieved in all the patients. There was no access related complication.

**Conclusion:** The swivel arm board is a useful adjunct to enable CBCT acquisition during transradial TACE.

**Advances in knowledge:** Transradial TACE is a novel technique, and adaptation to allow for CBCT acquisition is currently challenging. This manuscript illustrates how to overcome the positioning difficulties with the use of the swivel arm board.

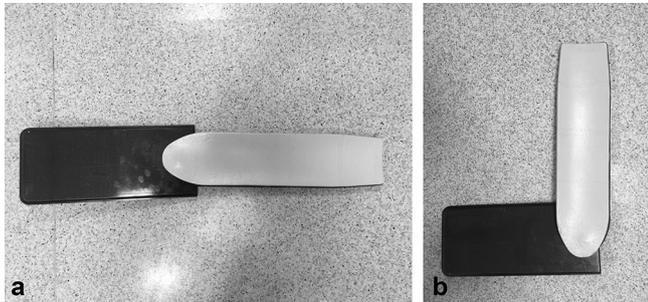
## INTRODUCTION

Transradial access for visceral intervention is an area of increasing interest, with feasibility and technique being recently described.<sup>1,2</sup> While the safety and techniques of radial access could be drawn from the coronary intervention literature,<sup>3</sup> significant differences in requirements, however, exist between visceral and coronary interventions. To this end, modifications for interventional radiology procedures, to ensure similar technical comparability to the conventional femoral approach is required and deserves mention.

One such challenge is the use of cone-beam CT (CBCT) during transradial transarterial chemoembolization (TACE) of liver tumours. For visceral intervention, the left radial artery is preferred over the right, due to the proximity to the target organ, length limitation imposed by catheter

lengths and the theoretical risk of crossing the supraortic vessels with right radial access. As such, one of the preferred arm for the right-handed operator is with the left arm abducted (70–90°) and immobilized in an arm board, with the operator standing between the patient and the abducted left arm.<sup>1,2</sup> This position, however, hampers CBCT acquisition as the abducted arm is within the rotational trajectory of the c-arm during image acquisition. As such, prior to CBCT acquisitions, abducting the left arm into the side of the body or more commonly further abducted to achieve a “hyperabduction” position (>90–135°) is required. Such arm movement is nevertheless cumbersome as the left wrist contains both the access site and the catheter assembly, which must be kept stable and sterile during movement.<sup>1</sup> To facilitate this manoeuvre, we introduced a swivel arm board to ensure catheter stability and ease of CBCT acquisition. We hereby study the feasibility and describe our technique.

Figure 1. (a) Picture of the swivel arm board consisting of a base plate (black), which is positioned under the patient's torso/left shoulder and an arm board (white) connected by a rotating hinge joint. The arm board is capable of 360° rotation. (b) the arm board rotated 90° to illustrate the pivot point between the baseplate and the white arm board.



## METHODS AND MATERIALS

This was an ethics board approved study with a waiver of informed consent. Included in this study were consecutive patients from our prospective transradial TACE registry.

### Patient positioning and technique

The patients are positioned in the supine position with the left arm abducted (between 45–80°) on the swivel arm board (Figure 1a,b). The swivel arm board is a commercially available, radio-lucent accessory consisting of an arm board capable of 360° rotation mounted by a hinge joint onto a baseplate. The baseplate is positioned under the patient's torso/left shoulder and the left arm position is fixed by taping the patient's supinated and dorsiflexed hand to the distal end of the arm board.

After cleaning the forearm in the sterile fashion, a sterile lithotomy drape is used to cover the mid-upper arm down to the hand, with exposure over the designated puncture site. A long

sterile drape is then used to cover the patient's body from the neck down to the feet, overlapping with the lithotomy drape over the upper left arm. This fashion of draping is important as it allows the drape on the left arm to move independently from the main drape covering the patient when the arm board is rotated.

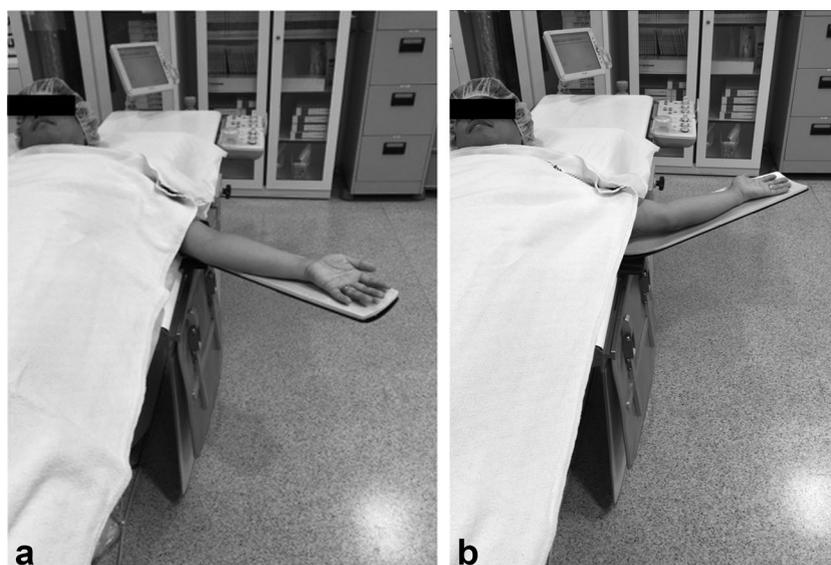
Radial access was obtained using standard technique and medications ("radial cocktail") as described elsewhere,<sup>1,2</sup> and hydrophilic 5F transradial sheaths were used (Prelude, Merit Medical Systems, Inc., South Jordan, Utah) or Radifocus (Terumo, Tokyo, Japan). Patients were eligible for transradial access if the left radial artery was >2 mm in diameter and had a Barbeau type A-C waveform.

In our practice, 45–80° abduction is the main "working" position throughout the procedure (e.g. catheter manipulation and embolic delivery) and swiveled into "hyperabduction" (>90–135°) by rotating the arm board only for CBCT acquisition (Figure 2). Typically, once the catheter/microcatheter is in position, the arm is hyperabducted for the dual phase CBCT angiography. The arm is rotated back into the working position for delivery of the embolic. After complete delivery of embolic, the arm is again swiveled into a hyperabducted position to allow completion of CBCT acquisition and then returned to the working position for hemostasis of the access site.

### Cone-Beam CT protocol

All CBCTs were performed on a commercially available angiographic system (Allura Xper FD20; Philips Healthcare, Best, Netherlands) with Emboguide and XperCT software. Briefly, our protocol utilizes a dual phase CBCT protocol,<sup>4</sup> which obtains two sequential scans following contrast injection with delays of 3 and 20 s. During each acquisition, the C-arm rotates from -120° to +120° (closed arc cone-beam CT) position. The undiluted contrast was injected through a 2.7F microcatheter in a selective position (segmental) using a power injector with injection

Figure 2. Mock-up pictures without the sterile drapes to show the arm positions: (a) working arm position; 45–80° abduction, (b) CBCT arm position; >90–135° "hyperabduction". CBCT, cone-beam CT.



rate of  $3 \text{ ml s}^{-1}$  with 15 ml of Omnipaque 350. In Tan Tock Seng Hospital, we also acquire additional completion CBCT images to document distribution of the embolics. Our CBCT imaging protocol therefore requires two arm repositioning in every session of transradial TACE; once during dual phase CBCT protocol and the other for the completion of CBCT after embolic delivery.

### Study design

We performed a retrospective study of consecutive cases of transradial TACE between November 2015 and March 2016. This was the period when we first introduced the swivel arm board into our practice. Patients were identified using the picture archiving and communication system and their medical records on the electronic medical record system reviewed. Patient demographics such as age, gender, body mass index, pre-procedural findings such as site and size of the lesion(s) and technical information such as catheter details and embolic agent used were recorded. Access related complications up to 30 days were recorded. Technical success was defined as successful CBCT acquisition after swiveling the arm out of position without the need for ancillary actions. The fluoroscopic images before and after arm movement were also reviewed for catheter position change by two interventional radiologists with at least 6 years of experience.

### RESULTS

During the study period, a total of 67 TACE procedures were performed, including 20 transradial TACE using the swivel arm board in 17 patients. These 17 consecutive cases of transradial TACE in our institution were included for analysis. There were 13 males and 4 females. The mean age was 69.5 years old (range 48–82 years), mean height was 1.61 m (range 1.47–1.70 m), mean weight was 66.7 kg (range 50.7–96.4 kg), with a mean body mass index of 25.7 (overweight,  $n = 10$ ; obese,  $n = 2$ ; range 21.5–33.4). Indication for TACE included hepatocellular carcinoma ( $n = 14$ ) and metastatic liver disease ( $n = 3$ ).

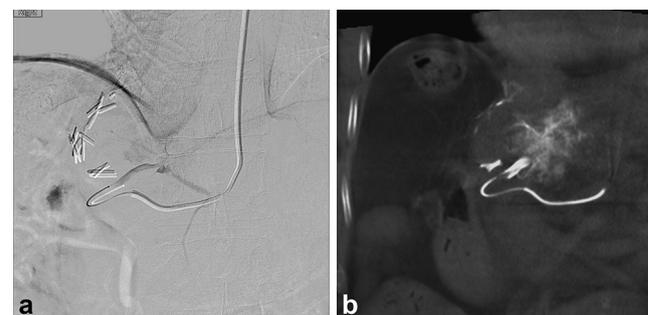
Base catheters used included (100 cm in length): Amplatz Left ( $n = 13$ ) (Boston Scientific Corporation, Natick, MA), Ultimate One ( $n = 6$ ) and Four ( $n = 1$ ) (Merit Medical System, South Jordan, UT). Microcatheters used included (125 cm in length): 2.7F ProGreat ( $n = 18$ ) (Terumo) and 2.8 F ASAHI Masters Parkway soft ( $n = 2$ ) (Asahi Intecc Co LTD, Nagoya, Japan).

Transradial TACE was successful in all cases with no case of cross-over to the femoral approach. A total of 40 successful arm repositioning using the swivel arm board for CBCT acquisitions were performed in the 20 transradial TACE procedures (100% success rate). There was no catheter or sheath dislodgement associated with the arm movements. No change in the microcatheter tip position was detected as a result of the arm repositioning. Hemostasis was successfully achieved in all the patients. There was no access related complication such as hematoma, bleeding requiring transfusion or hand ischemia within the 30-day period.

### DISCUSSION

Transradial TACE represents an attractive alternative access to conventional femoral TACE, and its safety profile could

be gleaned from coronary intervention literature.<sup>1–3</sup> Significant differences between coronary and peripheral intervention remain and the literature surrounding the latter remains limited. Various practical aspects of peripheral intervention such as the preference of the left radial by interventional radiologists *versus* the right radial by cardiologists,<sup>1,5</sup> and specific requirements such as CBCT for TACE remains to be studied.<sup>4</sup>



The impetus of introducing the swivel arm board to our transradial intervention came from the high utilization of CBCT in our TACE protocol,<sup>4</sup> which from our experience was possible but awkward with a fixed arm board. One of the concerns was the possibility of catheter position movement/dislodgement during left arm translocation even when using the swivel arm board. One strategy we utilized to fix the microcatheter was to lock the microcatheter in position by tightening the rotating hemostatic valve prior to arm movement, pinning it in position with the base catheter. We also connect the power injector tubing to the microcatheter hub only on completion of the left arm movement to the final position. This prevents inadvertent pulling of the microcatheter during the arm rotation by the power injector connection. By using these simple manoeuvres (*e.g.* separate left arm draping), we managed to maintain the microcatheter tip in position despite movement of the left arm in all the cases (Figure 3a,b).

Although we were successful in utilizing the swivel arm board in our cases, we believe that this technique may not be applicable, for instance in patients with mobility issues on the left shoulder (*e.g.* frozen shoulder), which will limit shoulder abduction. Therefore, alternative imaging positions such as placing the left wrist across the abdomen towards the right groin must also be kept in mind. More recently, advancement in CBCT technology such as “open trajectory” from Philips, which utilizes a  $+55^\circ$  to  $-185^\circ$  rotation (open arc cone-beam CT) compared to our current  $-120^\circ$  to  $+120^\circ$  rotation (closed arc cone-beam CT),<sup>6</sup> could potentially allow CBCT to be performed without moving the left arm. Additionally, “wide gantry bore” design with a 40 cm c-arm rotation

diameter (e.g. Discovery IGS 740, GE Healthcare, Milwaukee, WI) could allow CBCT to be performed in non-obese patients by adducting the left arm at the side of the patient's body. However, we do not have experience with these technologies in our institution at present.

The choice of transradial versus femoral TACE was based on the preference of the operators, and transradial TACE was yet to be widely adopted by all operators in our institution. This together with the retrospective nature of our study represent selection bias in our study. Additionally, our patients were

of relatively short stature as shown by the mean height of 1.61 m, such that we were able to perform all cases using only 100 cm base catheters (longer 125 cm catheters were available only after the study period). Nevertheless, we feel that adoption of this technique in taller patients using longer base catheters and companion microcatheters would not be significantly different.

To conclude, the swivel arm board is a feasible and useful accessory that could be used to facilitate arm movement for CBCT acquisition during transradial TACE.

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