Resolving the conundrum of impediments while navigating from radial path to coronary lumen

Contornando as dificuldades para alcançar o lúmen coronário a partir do acesso radial

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DOI: 10.31160/JOTCI202331A202303

ABSTRACT - Through the efforts of dedicated interventionists, catheterization of the cardiovascular system by transradial method has been recognized as the gold standard due to the several advantages associated with it, such as early ambulation, decline in bleeding and in various other vascular complications. It has successfully turned as an alternative to femoral access. The huge experience of interventionists has helped in understanding the anatomical impediments that can result in many technical issues and complications associated with the transradial approach. A trial-and-error method adopted by the interventionists on their learning curve at the cost of increased procedural failure, complications and patient inconvenience may not be justifiable. The objective of the present manuscript was to review all these difficulties, and understand the treatment method and various preventative strategies that can be used to overcome the complications.

Keywords: Cardiac catheterization; Radial artery; Angioplasty

INTRODUCTION

"That which we persist in doing becomes easier, not that the nature of the thing is changed, but that our power to do is increased.”  
Ralph Waldo Emerson (1803-1882)

In 1989, Campeau1 submitted the report of transradial (TR) method for coronary angiography. Further, as from 1993, TR method was extended to percutaneous coronary intervention (PCI) by the Kiemeneij and Laarman. 2 In comparison to transfemoral technique, several advantages, such as reduction in bleeding and vascular complications,3,4 improvements in patient compliance, and reduction in length of hospital stay of patients,5,6 have been reported regarding TR intervention. Due to all these advantages, TR approach might be explored as the gold standard for PCI. However, specific skill set and significant learning curve are required considering the route to the coronary lumen is potentially far more varied and complex for TR approach as...
compared to femoral.\textsuperscript{1-2} As a result, the interventionist is confronted with several complexities and potential anatomic variations while navigating through the arm and chest vasculature. Understanding these issues may lead to standardization of solutions for a higher success rate, shorter procedure time, and lower radiation dose. This article sheds light on in-depth discussions of the anatomical variations and challenges encountered during TR catheterization, from the wrist to the coronary ostium, their prevention and treatment strategies.

**NORMAL RADIAL ARTERY ANATOMY**

The radial artery (RA) runs distally on the anterior part of the forearm, after the bifurcation of brachial artery in the cubital fossa. There, it serves as a landmark for the division between the anterior and posterior compartments of the forearm, with posterior compartment beginning just lateral to the artery. The RA extends from the neck of the radius to the front part of the styloid process. The upper part is deep and lied below the muscle (brachioradialis) in most cases. The lower part is superficial and covered by skin and superficial and deep fascia. Further from the brachial artery, ulnar artery originates and ends superficially at the palmar branch of the RA. It is palpable on the anterior and medial aspect of the wrist. Variations in the path of RA to coronary ostium is common occurring in 14\% of the patients.\textsuperscript{7} The variations in the RA anatomy is the major factor behind the technical failure associated with the TR catheterization in clinical practice.

**INITIAL APPROACH TO THE PROBLEM**

During the process of catheter navigation, resistance is likely to occur at various points in the arterial path. This is due to the fact that catheter impediment can occur at different points in the artery, and makes it quite easy to trace the exact resistance point in the vessel. Further, exact resistance point can be confirmed by angiography with fluoroscopy. Angiography can be performed at reduced pressure, employing contrast media diluted by half. Further, either by the usage of sheath or insertion of small catheter (4F), diluted contrast media can be administered and clearly indicate blockage of the artery and the reason, and it also helps in designing a specific plan of treatment.

**ANATOMICAL VARIATIONS ENCOUNTERED TILL SHEATH INSERTION**

Radial artery tortuosity

The RA tortuosity is characterized as a problem faced in navigating the guidewire and catheter. It is often observed in elderly short women, diabetic and hypertensive patients. Various ultrasonography and angiographic studies demonstrated prevalence of the RA tortuosity is 2 to 6.1\%.\textsuperscript{4} Different definition of tortuosity (presence of a bend or angulation of more than 45° to 90°) have been used in different studies. When the diameter is smaller and angulation is more in RA tortuosity, risk of spasm is increased, which further makes the TR procedure more cumbersome (Figure 1). Usage of 0.025” or 0.032” J-shaped hydrophilic guidewire, or a 0.014” soft-tip coronary wire is necessary in case RA is small and tortuosity segment is long. Slow corkscrew movement should be used for the efficient negotiation of catheter over the wire. The interventionists should refrain from pushing the catheter directly to prevent reactive spasm. Formation of spasm in the tortuous RA is the tough situation which may respond to repeat dose of spasmolytic cocktail. The balloon-assisted technique (BAT) should be used to manage the complex situations. It consists of a technique in which an inflated balloon is partially protruded through the distal end of a guide catheter, and deployed at 3 to 6 atmosphere. It is recommended to use a 1.5 mm balloon for a 5F catheter, and a 2 mm balloon for a 6F catheter. A balloon length of 15 to 20 mm is preferred. The assembly is advanced over a soft 0.014” angioplasty guidewire once the balloon is partially protruded from the catheter and deployed.\textsuperscript{8} The author prefers to use uninflated balloon (modified BAT) to prevent damage to the vessel wall.
Hypoplasia

Hypoplasia is an anatomical variation in which RA is palpable, but hinders inserting the sheath. Homolateral ulnar, femoral or contralateral TR approach should be adopted by interventionists in this situation. Artery with hypoplasia and spasm are different situations, and the latter is a more focal event. However, generalized spasm may occur. Further, due to superficial nature of the radial artery, its puncture is slightly tough. Therefore, it is advised to hold the artery between two fingers. Small arteries, defined by Chugh et al. as any access artery less than 1.7mm in size, have been associated with higher crossover rates, procedure failures, and access site occlusions on 30-day follow up. For radial arteries smaller than 1.5 mm, Chugh et al. began to use compression of ulnar artery, a technique to enhance the size of access artery.

ANATOMICAL VARIATION FOUND UP TO ASCENDING AORTA

Nowadays, there are several options for selection of wire and fluoroscopic control during navigation of the catheter from RA to the ascending aorta. The risk of perforations is very less with the ordinary 0.035” J-tip spring wire, but the limitation associated is the difficult navigation process with this wire. The 0.035” J-tip Radifocus™ wire with hydrophilic coating is the easiest method to navigate, but may lead to perforation if not done under fluoroscopic guidance. The author prefers to use a 0.032” J-tip spring wire as it carries almost no risk of perforation and has excellent crossability. Sometimes the use of a 300-cm wire is recommended to facilitate exchange of catheter, but an ordinary 180-cm wire is often enough. When wire or catheter cannot be negotiated, additional force should never be applied, and angiographic evaluation of the area should be performed to identify possible anatomical variations like radio-ulnar loop, a high RA take-off, a tortuous brachial artery, or an arteria lusoria (right retro-esophageal subclavian artery).

Radio-ulnar loop

Radio-ulnar loop is considered as the most common congenital anomaly associated with the RA. The prevalence rate of radio-ulnar loop abnormality is 0.8 to 2.3%, but, when present, it poses a great challenge to the interventionists as it can be responsible for TR failure rate of 17% to 37%. When resistance is observed during a wire and/or catheter navigation, an RA angiography is performed to define the anatomy and a working solution through vast majority of these challenges. Navigation with the radio-ulnar loop is difficult only if artery caliber is small and loop diameter is large. Alpha loop in antero-posterior view is mistaken for small aneurysm. It is associated with the remnant vessel persistence in most of the cases. Even if it permits guidewire, it is difficult to pass the catheter due to its small size (Figure 2). Most of the times, to characterize the exact anatomy, oblique angiographic views are required. Distal and proximal omega loops, and S loop (Figure 3) are various other types of the radio-ulnar loop, some of which are very complex and require conversion to femoral or contralateral TR approach. Downsizing of guide catheter, use of 0.035” hydrophilic wire technique (Figure 4), downsizing the guidewire to 0.025”, the use of 0.014” coronary wire (Figure 5), coronary buddy wire technique and exchange with 0.035” J-tip spring wire, and also with low profile balloon support may be useful to facilitate crossing these loops. Crossing can also be facilitated by shaping the tip of the guidewire to the angle of loop. The guidewire is...
parked to the high extent and negotiation of catheter is done over it, once loop is crossed by it. To overcome any kind of resistance, the interventionists can keep the tip of wire as high as possible (i.e., high brachial, axillary, or subclavian region), can push the catheter to the maximum extent and can pull back the entire assembly. Such steps potentiate the catheter advancement and opens up the loop. If the catheter is unable to cross the loop entirely, then extra support can be provided by the standard 0.035 guidewire. A supper stiff guidewire is avoided unless the loop has been crossed and catheter tip is well into higher segment. Balloon-assisted technique should be attempted in case of failure of negotiation of a catheter through 360° loop (Figure 6). A high radial artery take-off with 0.035” hydrophilic wire.

Figure 4. Overcoming of radial alpha loop with 0.035” hydrophilic wire.

Figure 5. A 0.014” coronary angioplasty wire technique in navigating the radio-ulnar loop.

High radial artery take-off

High origin of RA is rarely diagnosed since it generally causes no problem if the artery caliber is of sufficient value. At this level, an atheromatous lesion is a rare phenomenon. Radial artery takes off from the brachial artery in most cases and rarely from the axillary artery. Type 3 high radial take off is linked with a hypoplastic or remnant RA according to the standard classification. In maximum cases, RA diameter precludes passage of catheter, which, in a remnant RA, is painful for the patient and associated with spasm and risk of perforation. If during the insertion of catheter in the brachial artery, any unexpected resistance is experienced by physicians or impossible transmission of torque is observed, anatomical variations may be the cause. In this scenario an alternative contralateral TR or femoral approach is preferable.

Figure 6. Management of radial and brachial loops.
Atherosclerotic lesion

Atherosclerotic RA lesions impart resistance to the navigation of guidewire and/or catheter. It is critical to perform a radial angiogram to define severity of the lesion in case of resistance. The assembly can be negotiated under fluoroscopic guidance through the affected segment, if the obstruction is mild. The severe lesion may require PCI to enable to work through the affected segment. The BAT technique should be reserved for difficult situations.9

Arteria lusoria or retro-esophageal right subclavian artery

It is a congenital abnormality observed in the aortic arch, with reported prevalence rate of 0.4 to 2% in right TR approach.14-17 It generally arises from the distal and posterior margin of the horizontal part of the aortic arch, at its junction with the descending aorta, and, less frequently, from the proximal descending aorta, and thus the catheter is preferably oriented towards descending aorta. It is recommended to adopt a left TR approach in this scenario to reduce radiation exposure. In the anteroposterior view, orientation of the retro-esophageal right subclavian artery is more towards the left direction than usual, and is responsible for the peculiar angulation (Figure 7) in right TR approach. Left main coronary artery (LMCA) selective catheterization is quite easier with the usage of Tiger (TIG) catheters, internal mammary artery (IMA), and with Judkins left for diagnostic purpose. For right coronary artery, the standard Judkins right catheter is the best option, followed by an Amplatz right. For interventions in the LMCA, an extra back-up guide catheter is the first choice, followed by an Amplatz left or a wider Judkins left catheter (Figure 8). Amplatz right catheter is the first choice for right coronary interventions. Judkins right or Amplatz left catheters may be used in case of failure. A long exchange 0.035” wire is preferable to perform all catheter exchanges.11

Despite using the usual technique, repeated entry into the descending aorta of both guidewire and catheter should prompt the interventionists to suspect the presence of retro-esophageal right subclavian artery. Withdrawal of guidewire and catheter should be done as an assembly if repeated entrance of these both two is observed in the descending aorta. When a deep breath is taken by the patient, a 0.035” standard guidewire is gently pushed followed by negotiation of the catheter into the ascending aorta once the guidewire enters into it. If the guidewire remains in the descending aorta, the guide catheter is replaced with 5F IMA diagnostic catheter, and is placed in the descending aorta over the guidewire. Repeated usage of the 5F IMA leads to successful movement of catheter into ascending aorta. A 5F Simmons-1 catheter can be used if IMA catheter also failed to produce the required effects. If 0.035” standard guidewire repeatedly slips into the descending aorta, it should be replaced by a 0.032” or a 0.025” hydrophilic guidewire for easier navigation into ascending aorta even through challenging anatomy. Once the standard guidewire enters into the ascending aorta, a loop is made by replacing it with another very stiff guidewire. After this replacement, in the next step, slow negotiation of catheter is done with the objective of crossing the aortic loop with the assembly made. Cannulation of LMCA is enabled by slowing rotating the assembly clockwise.

Figure 7. Left anterior oblique projection revealing the characteristic L-angle of the catheter in arteria lusoria.

Figure 8. A loop was made using 0.025” guidewire to enter the ascending aorta with 6F extra backup guide catheter in arteria lusoria – left anterior descending artery.
Brachiocephalic trunk tortuosity

The innominate artery-aortic arch junction is unique to TR procedures. In cases of normal anatomy, the turn is smooth and does not pose challenges to performing diagnostic or interventional procedures. In cases of abnormal anatomy due to dilation, distortion, or aberrancy of aorta or distal innominate artery, the procedure requires judicious use of equipment. Various side branches are present at this level, and to reduce the risk of entry of the wire into mammary or vertebral artery, it is very important to monitor the wire progression under fluoroscopy guidance. Manipulation of the guidewire and catheter with a deep inspiration generally allows easy entry into the ascending aorta, by pulling the diaphragm down along with thoracic contents, resulting in favorable change in course of the vessel. Congenital or acquired subclavian loops are most commonly observed in patients with chronic hypertension, obese and elderly individuals. These loops may have a 90° angle or be Z-shaped or very complex, as depicted (Figure 9). It is usually possible to traverse a simple loop (a 360° large diameter turn of the artery) using a standard 0.035” or 0.032” guidewire. In case of failure, 0.025” or 0.032” hydrophilic guidewire may help to navigate the complete course of the loop to enter the ascending aorta. Sometimes guidewires in parallel may be recommended to cross the loop. If resistance is encountered in spite of this, a soft-tipped 0.014” coronary wire is negotiated under fluoroscopic control to enter the ascending aorta. The BAT technique is predictably successful, if all other methods fail.

COMPLICATIONS OF TRANSRADIAL APPROACH

Information about the various complications, their treatment and preventative strategies are described here (Table 1).

Radial artery spasm

The major challenge of TR approach is RA spasm (RAS), which is the main reason for procedure failure.\textsuperscript{18,19} According to the recent literature, RAS is reported in 5 to 30% of cases.\textsuperscript{18,20,21} Lower body weight, diabetes, small circumference of wrist, female sex, multiple exchanges of catheter, large size of sheath, and unexperienced operator are some factors that raise susceptibility of patients for RAS.\textsuperscript{18,21} There are alpha-1 adrenoreceptors in the medial layer of the RA,\textsuperscript{22} which cause increased levels of catecholamines in systemic circulation leading to RAS. Pain from RAS increases vasomotor tone resulting in further spasm. Radial artery spasm makes catheter exchanges and manipulations difficult, causing undue procedural delay, pain and discomfort to patients. Nowadays, anxiolytic, local anesthetics and spasmolytics agents, sheaths with hydrophilic coating and careful puncture techniques can be used to prevent RAS (Figure 10).\textsuperscript{23} A preventive approach would improve procedural success and decrease procedure duration.\textsuperscript{20} Chugh et al.\textsuperscript{10} demonstrated an ultrasound procedure of brachial arteries determines the precise size of arterial diameters and help exclude arterial anomalies, minimizing catheter exchanges and manipulations. A sheath to artery diameter of less than 1.1 is ideal to reduce stretching during catheter manipulations, thus, very effective in preventing RAS. Sheathless guide system and slender techniques could be used to minimize radial stretching, reducing RAS. Decli-

Table 1. Complications of radial access

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Figure 9. Negotiation of subclavian loops using 0.035” extra-stiff guidewire.

Figure 10. (A) Radial artery spasm; (B) normalization of radial spasm after use of intraarterial nitrates and diltiazem.
ne in the prevalence of RAS with the administration of spasmytics medications by intraarterial route has been reported.\textsuperscript{23-25} Various therapeutic drugs, such as alpha-agonists, local anesthetics, nitrates, and calcium channel blockers are used with the objective to prevent RAS.\textsuperscript{26} As compared to placebo, combination of verapamil 5mg and nitroglycerin 200µg has a significant therapeutic effect in reducing spams in RA. In the prevention of RAS, a more pronounced effect is produced by the 2.5mg of verapamil compared to phentolamine at the same dose.\textsuperscript{27} Further, it was reported that no significant therapeutic effect is produced by the combination of verapamil and nitroglycerin as compared to nitroglycerin alone.\textsuperscript{28} In patients presenting with left ventricular dysfunction, verapamil should be used with great caution.\textsuperscript{29} In another study, addition of nitroglycerin 100µg, nitroprusside 100µg, or both to a basic cocktail (unfractionated heparin 2,500U, lidocaine 20mg, diltiazem 5mg) did not show any benefit in RAS prevention.\textsuperscript{29} An equal therapeutic effect is achieved with 4mg of nicorandil, similar to that produced by the combination of 200µg of nitroglycerin and 100µg of verapamil.\textsuperscript{29} While there is no consensus on the exact regimen or dose, the routine use of a "cocktail" containing a calcium channel blocker, with or without a nitrate, is an effective modality to decrease occurrence of RAS.

Many studies demonstrated the prevalence of RAS decreases with use of various sheaths with hydrophilic coating, which provide patients with comfort during the removal and insertion of catheter.\textsuperscript{18,30-32} Sheath length, in spite of coating, does not have any significant effect on RAS reduction.\textsuperscript{18} Repeated dose of intraarterial vasodilators, and longer analgesia and sedation can be adopted to manage severe spasm. Deep sedation with propofol, axillary nerve block, or even general anesthesia have been employed to allow sheath removal.\textsuperscript{33,34} Utmost care should be taken by the interventionists during equipment removal, otherwise forcibly removal may be responsible for transection or erosion endarterectomy of RA.\textsuperscript{35}

**Radial artery occlusion**

In 2 to 10% of patients, a complication named RA occlusion (RAO) occurs after TR procedure.\textsuperscript{36} It may be related to small RA diameter, improper anticoagulation, cannulation for prolonged period of time, and inadequate ratio of diameter of RA to outer diameter of sheath.\textsuperscript{36-39} Other factors predisposing patients to RAO include female sex, low body weight, prolonged occlusive pressure, and advanced age. The presence of RA pulse does not rule out RAO due to the presence of collateral circulation through palmar arches, which is an extremely protective mechanism. Yet, some interventionists stress the importance of normal Barbeau’s test,\textsuperscript{40} also referred to as the modified Allen’s test, which is controversial. In addition, abnormal results of the modified Allen’s test provide evidence about ischemia in hand as compared to patients with normal results.\textsuperscript{41} Radial artery occlusion is often clinically quiescent.\textsuperscript{42} However, its presence makes repeat RA access difficult.\textsuperscript{42}

Sufficient anticoagulation with unfractionated heparin significantly reduces the incidence of RAO.\textsuperscript{36,43} A dose of 5 thousand units of unfractionated heparin reduced its incidence from 71 to 4.3%.\textsuperscript{44} Intravenous (IV) or intraarterial routes can be used for administration of unfractionated heparin and both present the same therapeutic efficacy.\textsuperscript{45} Many operators prefer the IV route or aorta for its administration, due to burning sensation effects caused by intraarterial route.\textsuperscript{46} Bivalirudin could also be used for prevention of RAO in patients.\textsuperscript{47} The size of catheter is also predictive of post-procedural RAO. Saito et al. demonstrated a ratio of inner diameter of RA to the sheath’s outer diameter of less than 1.0 predicts severe flow reduction after TR intervention.\textsuperscript{47} Therefore, to prevent the RAO, small-sized sheath and guide catheter can be used. Good procedural success rate of 95% and low RAO (2.5%) were achieved by using the sheathless approach, according to reports submitted by Kwan et al.\textsuperscript{25} Patent hemostasis guided by plethysmography or mean arterial pressure by using a hemostasis device that allows adjustable levels of compression appears to reduce the incidence of RAO. Even if it is usually asymptomatic, RAO may limit future TR catheterization. Symptomatic RAO can be resolved with the usage of low molecular weight heparin.\textsuperscript{48} Moreover, angioplasty can be performed for management of hand ischemia.\textsuperscript{49} To recanalize an acute RAO, transient (1 hour) ulnar compression can be used.\textsuperscript{49}

**Hematoma**

Due to the fact RA is superficial, hematoma is usually apparent during the TR procedure. Blood transfusion is rarely required during the TR procedure. Transradial approach does not impact non-access site bleeding rate, which is more related to the patient body and anticoagulation regimen.\textsuperscript{50} A classification of hematoma was described by Bertrand, in which the puncture site issues were kept as grade I and II, and intramuscular bleeding was classified as grade III and IV (Table 2). The study provides evidence that local hematoma is reduced by hydrophilic coated sheaths; however, the effect produced is not significant in comparison to uncoated sheath.

**Radial artery perforation**

Perforation in the RA is a rare complication with reported incidence of 1%.\textsuperscript{51,52} Severe hematoma in the forearm may occur if not treated properly. In old patients and in hypertensive patients, manipulations of guidewires and catheters forcefully lead to RA perforation. Risk of perforation is potentiated by various anatomical aberrations, such as RA tortuosity, loops, high radial take off, and shorter ascending aorta.\textsuperscript{53} Perforation in the RA should be suspected if patient complains about pain, and resistance is observed during navigation of guidewire.\textsuperscript{54}
Timely control of bleeding from perforation helps in tackling expanding hematoma. Manual pressure on the site, for 30 minutes, may help. With further expansion of hematoma, inflate the blood pressure monitor cuff to a value above systolic pressure, keeping it for 5 to 10 minutes, followed by release of the cuff. This may be repeated depending upon the situation. When the hematoma expands rapidly, the effect of heparin should be reverted. If the perforation is large and non-restrictive, long balloon inflation (for 5 to 10 minutes), at low pressure (3 to 6 atm), on the affected site, may seal the perforation. In case of failure, consider performing several balloon inflations or using a covered stent.

**Forearm compartment syndrome**

Another rare and most feared complication of hemorrhage in the RA is the forearm compartment syndrome, with reported incidence of 0.004%. Even a small volume of bleeding in the arm can lead to catastrophe, given the limited free space in the forearm as compared to upper thigh. Several clinical symptoms, such as acute forearm pain, swelling and tumefaction, with altered distal sensitivity, and distal pallor provide the basis to make diagnosis of this syndrome. The confirmed diagnosis of the syndrome is made by measuring the compartment pressure directly. For the compartment syndrome, the common predisposing factors are laceration in the RA, access site and hematoma. Most perforations result from aggressive manipulation of guidewire or excessive anticoagulation. The catheter shaft induces temporary tamponade; for this reason, forearm compartment syndrome is not always detected during the procedure. Some preventative measures, such as usage of ice, elevation of arm, and inflation of blood pressure monitor cuff, can be adopted to prevent the progression of hematoma to compartment syndrome. However, the documentation of elevated compartment pressures warrants emergency fasciotomy.

**Radial artery eversion and catheter entrapment**

Eversion of the RA has been reported with sheath removal after severe RAS. Various treatment strategies, such as administration of spasmyotics drugs by local or systemic route and sedation, are useful to control spasm. Furthermore, catheter torque in an aggressive manner or chronic RAS can also be responsible for entrapment of catheter. General anesthetics and spasmyotics drugs therapy can be used when removing an entrapped catheter.

If entrapment results from kinking or tortuosity, undoing the kink with fluoroscopic guidance, or negotiating a wire to straighten the tortuous segment almost always allows catheter removal.

**Pseudoaneurysm**

Pseudoaneurysm is another very rare complication characterized by pulsatile swelling, which occurs within days or weeks after the procedure. According to the reports submitted in one series, its incidence rate is less than 0.1%. It is caused by penetrating injury of the arterial wall during cannulation, resulting in hemorrhage and hematoma, and it is associated with multiple puncture attempts and aggressive anticoagulation therapy. Doppler ultrasound can be used as confirmatory test for diagnosis. Prolonged compression soon after the procedure can be used to treat pseudoaneurysm. However, in some severe cases, injection of thrombin and surgical therapy are also required. Early diagnosis and treatment are critical to minimize further complications, such as spontaneous rupture or hand ischemia, and to maintain sufficient circulation on the hand.

**Arteriovenous fistula**

Arteriovenous fistula is extremely rare because of superficial course of RA and relatively small veins in the surrounding area. It presents as persistent pain and edema on the access site, with visibly dilated veins and palpable thrill. Surgical repair alleviates symptoms.

**Nerve damage**

Rarely digital numbness may ensue due to repeated punctures injuring either the median or radial nerve. This is a benign situation, which gradually resolves over time.
Nonetheless, complex regional pain syndrome, is characterized by disability in extremities, recognized by several symptoms, such as pain, impaired movement, vasomotor instability and swelling. Sympathetic blockade, analgesics and physiotherapy play key roles in alleviating symptoms. The prompt recognition and appropriate treatment are very necessary to prevent this disorder.

CONCLUSION

The robust data support feasibility and safety of transradial approach adopted by interventionists. Nevertheless, interventionists face many challenges when switch on to this method of catheterization. It is critical to be able to recognize anatomical challenges and have strategies to overcome them and the various complications unique to transradial approach, to avoid unnecessary morbidity and mortality. This field has undergone rapid transformation and is likely to improve further with expertise, modifications of equipment, and drug treatment. Transradial access provides interventionists with a unique opportunity to deliver optimal care with reduced risk.

SOURCE OF FINANCING

None.

CONFLICTS OF INTEREST

The authors declare there are no conflicts of interest.

CONTRIBUTION OF AUTHORS

Conception and design of the study: DD and RM; data collection: DD, YPS and ASK; data interpretation: DD and BM; text writing: DD; approval of the final version to be published: DD, RM, ASK, YPS and BM.

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