Review Article

Percutaneous coronary interventions via the radial approach—Mandatory or elective in the current circumstances—A Polish perspective

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A crucial progress in reduction of mortality and improvement of quality of life in patients with either Stable Angina (SA) or Acute Myocardial Infarction (AMI) has been made by introduction of Percutaneous Coronary Intervention (PCI) in daily treatment. Possibly we are witnessing another giant leap in invasive cardiology by the use of radial instead of traditional femoral approach. Radial route which was firstly introduced in diagnostic of Coronary Heart Disease (CHD) by Dr. Campeau in 1989 reduces the risk of bleedings and subsequently overall mortality in patients with AMI, especially when used by experienced and skilled operators. We present a critical review of data comparing radial to femoral approach seen from the Polish perspective hoping it could be useful for invasive and non-invasive cardiologists in their everyday practice.

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1. Revolution in thinking

Not very often are we witnesses of such a giant leap in medicine. Transluminal coronary angioplasty technique was first introduced by Dr. Gruentzig in 1977 and since then is considered a real breakthrough in the management of Acute Myocardial Infarction (AMI) and stable CHD. The approach for the PCI changed a lot through the years. It was predominantly caused by the use of innovative materials and subsequently by the introduction of modern antithrombotic drugs. The majority of PCI procedures were performed via the femoral artery which was characterized by the relatively short learning curve and the operator’s comfort during the procedure. The patient’s comfort was at that time a question of secondary importance.

A real revolution in thinking about PCI began in 1989 as Dr. Campeau published data concerning his experience with the radial approach [1]. The mentioned study was firstly underestimated but the door to radial approach based coronary angiography was eventually open. Despite this success coronary angioplasty via the radial route was still beyond the reach of cardiologists. This was about to change 4 years later when Dr. Kiemeneij performed the first ever transluminal coronary angioplasty with Palmaz–Schatz stent implantation via the radial route [2]. These achievements were milestones of invasive cardiology and convinced many experienced operators about the efficacy of wrist approach. To those still unconvinced we dedicate the subsequent review.

2. Access site complications

PCI procedures performed via the radial route are less commonly associated with the local complications. It is determined by smaller vessel diameter and its superficial localization which have important implications on acquiring hemostasis. It is worth admitting that it might be achieved directly after the end of the procedure, even if patient received heparin during PCI. The RIVAL study was probably the most important trial comparing transradial to transfemoral approach. It enrolled more than 7000 patients. Despite its large-scale background RIVAL was unable to prove superiority of either wrist or leg approach in all examined patients [3]. The rate of death, myocardial infarction or stroke at 30 days was 112 (3.2%) of 3507 patients in the radial group compared with 114 (3.2%) of 3514 in the femoral group (HR 0.98, 95% CI 0.76–1.28; p = 0.90). The rate of non-CABG-related major bleeding at 30 days was 24 (0.7%) of 3507 patients in the radial group compared with 33 (0.9%) of 3514 patients in the femoral group (HR 0.73, 95% CI 0.43–1.23; p = 0.23). Severe local complications consisting of large hematomas and pseudoaneurysms occurred significantly more often in the femoral than in the radial group. At 30 days, 42 of 3507 patients in the radial group had large hematoma compared with 106 of 3514 in the femoral group (HR 0.40, 95% CI 0.28–0.57; p < 0.0001). Pseudoaneurysm needing closure occurred in 7 of 3507 patients in the radial group compared with 23 of 3514 in the femoral group (HR 0.30, 95% CI 0.13–0.71; p = 0.006). Superiority of radial vs. femoral approach was however proved in the isolated ST Elevated Myocardial Infarction (STEMI) group of patients where it reduced the primary outcome defined as death, myocardial infarction, stroke and non-coronary artery bypass graft-related major bleeding compared with femoral access (3.1% vs. 5.2%; hazard ratio [HR]: 0.60; p = 0.026) [4]. For Non-ST Elevated Acute Coronary Syndromes (NSTEACS), the rates were 3.8% and 3.5%, correspondingly (p = 0.49). Moreover radial in comparison to femoral approach reduced all-cause mortality in STEMI group of patients (1.3% vs. 3.2%; HR: 0.39; p = 0.006), with no difference in NSTEACS group of patients. Interestingly operator radial experience was greater in STEMI versus NSTEACS patients (400 vs. 326 cases/year, p < 0.0001). Many experts in the field of interventional cardiology punctuate the fact that the minimal number of 50 procedures for the operators who took part in the RIVAL trial in the previous year could not be considered as excessive. Many experienced “radialists” declare that a minimal number of procedures per operator per year should be at least 100. This was a probable cause of blurred benefits in the field of primary and secondary endpoints of the RIVAL trial and significant differences in outcomes between the low and high volume centers. Another extremely valuable trial performed by Professor Romagnoli and colleagues concerned the results of treatment in patients with ST Elevated Acute Coronary Syndrome (STEACS) submitted to PCI procedure who were randomized to radial or femoral access site [5]. Contrary to the RIVAL trial the mentioned RIFLE-STEACS trial enrolled a smaller amount of around 1000 patients; however investigators were able to prove the statistically significant reduction in the NACE (Net Adverse Clinical Event defined as MACCE and bleeding), MACCE (Major Cardiac and Cerebrovascular Event) and bleedings alone occurrence. Furthermore radial access significantly lowered risk of cardiac mortality in comparison to femoral (5.2% vs. 9.2%, p = 0.020). According to another compelling study performed by Dr. Ivo Bernat et al. called STEMI-RADIAL the final results of which have been presented during Transcatheter Cardiovascular Therapeutics in San Francisco in 2012 radial approach reduces by 80% the rate of 30-day bleeding and access-site complications (7.2% in the femoral group vs. 1.4% in the radial group; p < 0.0001) evaluated during clinical follow-up. In addition the NACE, which included major adverse cardiac events (MACE) plus major bleeding, was 58% lower in the radial in comparison to femoral group of patients (11.0% vs. 4.6%; p = 0.0028) [6]. The MACE rate alone did not show statistical significance between the radial and femoral puncture sites. The hospitalization in the wrist group of STEMI patients was significantly shorter than in femoral group (2.5 vs. 3.0 days accordingly; p = 0.0016).

3. Dose of radiation

There have been a few studies whose aim was to assess the existence of statistically significant difference in radiation exposure of operators depending on chosen point of access—radial vs. femoral [7–9]. It is worth mentioning the recent work of Brasselet and his colleagues who estimated the radiation exposure of operators which was significantly higher when using the radial compared with the femoral approach for both coronary angiography alone and coronary angiography followed by ad hoc PCI: 29.0 [1.0–195.0] microSv vs. 13.0 [1.0–164.0] microSv; P < 0.0001 and 69.5 [4.0–531.0] microSv vs. 41.0 [2.0–360.0] microSv; P = 0.018, respectively. As the increasing distance reduces dose due to the inverse square law the source
of previously mentioned observations seems to be rather obvious. There exist a few ways of operator’s radiation dose reduction either in radial or femoral approach. One of them is pelvic lead shield which has proved to be highly effective in reduction of normalized operator dose. Despite the fact that the reduction of total operator exposure by the use of mentioned device is crucial the disproportion between the two approaches remains striking in favor of femoral approach [10]. What is particularly worth emphasizing is that there is currently no evidence of statistically significant differences between patients exposure for radiation depending on the puncture site [11,12]. Moreover radial approach has a few potential disadvantages. Spasm of the artery could be considered as one of the most demanding for the cardiologist. There are some techniques which enable to proceed with the desired approach although in most of the cases they turn out to be insufficient. Those techniques might be divided into chemical (drugs) and mechanical which are defined as operations performed in the artery. As far as chemical assessment is concerned none of the known drugs has the sufficient vasodilating potential to cause remission of a mechanically provoked spasm. Hand maneuvers tend to worsen the local state and are strictly dependant on the operator’s experience and skills [13].

4. Impact on patient’s comfort

We lack evidence based data on patient’s comfort during PCI procedure. Probably many researchers and interventional cardiologists stay so focused on the final result of PCI that they underestimate the patient’s point of view and treat it as an issue of secondary importance. As more and more patients demand an understanding and partnership based relation with the doctor in the healing process this attitude needs to be redefined. Radial approach is the finest and most desired from the patient’s point of view. Not only is it adaptable according to patient’s left or right hand dominance which has important implication on reduction of the negative effects of potential complications but also obligatory bed confinement after the procedure is unnecessary in most of the cases. It is worthy of mention that quite often the side of the radial access is determined by the type of the procedure and the anatomical circumstances. Visualization of the left internal mammary artery (LIMA) by the use of the right radial artery is possible not only by the use of dedicated devices; however left radial artery might be in this case preferable mainly due to anatomical issues [14,15]. Moreover fewer patients after angiography performed via the radial route require analgesic management. As the discomfort is limited to the absolute minimum this extremely elegant technique appears to be highly beneficial to the majority of the patients [16].

5. Advantage due to equipment

Radial access guided PCI evolved from pioneer technique into a reliable tool successfully used in the routinely performed cardiac examination and treatment. This was mainly achieved due to development of modern equipment which often profited from the use of “nano” technology and fellow trainings all over the world. Moreover radial approach in diagnostic catheterization and PCI procedures seems to be not only safer but also less expensive than femoral [17,18]. According to Dr. Kiemeneij each diagnostic procedure or coronary angioplasty can be divided into three areas of interest: (1) procedural cost, (2) post-procedural cost and (3) length of hospital stay [19]. As the prices of access and cannulation sets start to equalize in both radial and femoral approach the major cost-saving advantage of radial approach is demonstrated by the reduction of serious complications that needs expensive treatment and the length of hospital stay. According to the data provided by the Polish Section of Cardiovascular Interventions the trend to increase the number of procedures performed by the use of radial approach grows constantly which was presented in the figures below. Interestingly the number of all coronary angiography procedures performed in 2009 by the use of radial approach was 22% to reach 47% in 2012 (Fig. 1). As far as the PCI is concerned the percentage of all radial access PCI augmented from 22% in 2009 to 42% in 2012. The observed growth of the percentage of radial guided PCI procedures in the STEMI group of patients was 22% in 2009 to 37% in 2012. The same tendency held in NSTEMI group in which the percentage augmented from 23% to 44%, unstable angina group (UA)—20% to 40% and stable angina group (SA)—24% to 43% (Fig. 2). This growth was even greater when considering diagnostic procedures. It is worth noticing that in the year 2012 for the first time ever the majority (52%) of coronary angiography procedures in the stable angina group of patients were performed via the radial approach.

6. Learning curve

Transfemoral approach is considered to be the one with the shortest learning curve of all despite the fact that it can
generate very serious complications. Only to mention retroperitoneal hematoma which is able to initiate an immediate threat for the patient’s life. It explains why sometimes the potential accessibility of the femoral artery might be considered as apparent. Additionally, what has to be firmly emphasized is that the wrist approach generates less local complications and what is even more important does not reduce the total PCI success rate. The 3-year assessment of clinical outcomes performed by Natsuaki et al. did not reveal any statistically important differences between transfemoral and transradial groups apart from 30-day puncture site bleeding reduction in the second accordingly (0.2 vs. 0.6%, P=0.005) [20]. Despite the systematic extension of the list of potential beneficiaries there still exist some crucial frontiers difficult to overcome. One of them is the utilization of Intra aortic Balloon Pump (IABP) via the radial artery which has not been so far reported in the literature, contrary to the transbrachial IABP implantation which has shown to be very promising especially in patients suffering from aortoiliac atherosclerosis [21,22]. The operator’s conscience that the radial artery is very narrow and sensible for mechanical irritation should be an issue of great importance as avoiding excessive risk might be crucial for patient’s health and further existence.

7. Conclusions

The radial approach in transluminal coronary diagnostic and therapy is non-inferior to femoral approach as far as the final angiographic effect is concerned. It offers better comfort for the patient and operator on condition of adequate experience and training gained on the basis of elective PCI procedures. There are no differences in fluoroscopy time and the radiation dose acquired by the patient. Difference in radiation exposure of operators are waiting for final evaluation in randomized large-scale trials. Last but not least radial approach reduces risk of death in patients with acute myocardial infarction as well as total cost of the procedure and time of hospitalization mainly due to reduction of bleeding complications. We think that the radial approach should be the access of choice during diagnostic and therapeutic coronary procedures in all heart centers worldwide.

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References


