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## Transradial Approach in the World

### New Zealand

#### Interventional Cardiology and the Transradial Approach in New Zealand

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New Zealand (NZ) is a country of 4.5 million people located in the south Pacific, at the southern end of the so-called "Polynesian triangle" (formed with Hawai'i to the north and Easter Island to the east). Although the population is small, it is spread over a land area that is a similar size to Great Britain, with the majority living in the upper half of the north island. According to the 2013 census, the ethnic makeup of New Zealand is: European 74%, Maori 14.9%, Asian 11.8%, Pacific peoples 7.4%, Middle Eastern/Latin American/African 1.2%.

The health system provides free hospital care to all citizens and residents, funded out of general taxation. Visits to general practitioners and dentists generally attract a fee; prescription drugs are purchased by a central buying agency on behalf of the government, which attempts to get the lowest price for pharmaceuticals and encourages the use of generic agents once patents have expired. About 30% of the population has private health insurance, which generally will not cover acute conditions (since all patients can receive emergency treatment at public hospitals). Coronary angiography is undertaken in 11 public hospitals (PCI in 9) and 5 private clinics; there are 5 cardiothoracic surgical centers located in public hospitals (and 1 pediatric cardiothoracic center).

A comprehensive national cardiac registry, funded by the Ministry of Health, was implemented in 2013, under the auspices of the New Zealand branch of the Cardiac Society of Australia and New Zealand. Since late 2013 all NZ public hospitals that provide coronary angiography have completed the web-based CathPCI registry form for every coronary angiogram performed. Complete data are available for 5 months from each of these centers, and are used in this report.

The New Zealand interventional community adopted radial access quite early (in the early 2000s) and almost all centers are predominantly radial. Of the 5,894 coronary procedures recorded, 81.4% used radial artery access; the average number per center varied from 25 to 176 procedures per month and the radial access rate averaged from 46.5% to 96.4%. Individual operators performing more than 20 procedures per month had radial access rates of 61% to 99%. The highest volume operators (>30 procedures/month) had radial access rates of greater than 80%.

Four of the 9 interventional centers had radial access rates of greater than 90%. Radial access rates in patients admitted with ST-elevation myocardial infarction (STEMI) was 79.5% for primary PCI and 71.4% for rescue PCI (n=42

for rescue PCI). In 2 centers, 100% of STEMI patients were treated via the radial artery. Using multivariate analysis, the strongest predictors of non-radial access were Maori ethnicity and previous coronary surgery. Maori are recognized as an ethnic group with high rates of vascular disease, diabetes and renal dysfunction, which may influence choice of access route (e.g. possible need for future dialysis access).

Although these are not randomized data (and it is possible that those undergoing femoral procedures may have been a higher risk cohort than those with radial procedures), they support the information from randomised trials: all cause in-patient mortality was lower (0.5% vs 2.1%,  $P<.0001$ ), and bleeding was reduced ([1.0% vs 3.5%,  $P<.0001$ ], including TIMI major bleeding 0.1% vs 0.4%). Interestingly, length of stay was not significantly different between the groups.

In summary, radial access predominates in invasive coronary procedures in New Zealand, with over 80% of cases being performed radially. Nevertheless, there is still a high degree of variability from one region to another, and from one operator to another. Even within high volume operators, defined as >20 procedures/month, rates of radial access vary from 61% to 99%.

### Uruguay

#### Coronary Interventional Cardiology and Transradial Approach in Uruguay

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Uruguay is a country with an area of 176,220 km<sup>2</sup> being the second smallest of South America. Bounded on the north and east by Brazil; west and southwest by Argentina. The population is 3,407,000 inhabitants, and has not changed significantly in the last 10 years. The economy has presented sustained growth over the last 10 years and has multiplied by 4 its gross domestic product (GDP) in this period. It is the Latin American country with the highest GDP per capita. The life expectancy at birth was 77 years at the end of 2012 (from Worldbank Data 2014, <http://www.worldbank.org/en/country/uruguay>).

Health is administered by the government in a national system that provides coverage to all inhabitants of the country on equal terms (Integrated National Health System). In turn, the high-tech and high-cost drugs are funded by a non-state public institution called National Resource Fund (FNR). Interventional cardiology (IC) is included within this coverage, ensuring that all inhabitants have access.

IC has achieved a great development in our country, mainly in coronary intervention. It is developed in only 6 centers all of high volume and with a high expertise of its operators. Learning and specialty training is done through residence in cardiology regime at the University of the Republic (UDELAR) and then as a fellowship training in any of these 6 centers. The radial approach (RA) has been used

for over 15 years, at which time some centers already performed the majority of the procedures by this approach. We are proud to be pioneers in Latin America in the widespread use of the technique and to have been boosters of the radial approach in the region, training colleagues in our centers as well as in their own countries. We have also promoted the use of RA through multiple events of the Latin American Society of Interventional Cardiology (SOLACI).

Data from the FNR show that between 2010 and 2013, 14,799 diagnostic catheterizations were performed in Uruguay, of which 14,023 (94.8%) were done by RA and 776 (5.2%) by femoral approach (FA). In that period 13,217 angioplasties or percutaneous coronary interventions (PCI) were performed, of which 12,594 (94.7%) were done by RA and 623 by FA (4.3%). The following table shows the clinically relevant variables that we found significantly associated with the choice of vascular approach in our population.

Variable	Radial Approach (%)				P
	<51	51-60	61-70	>70	
Age (yrs)	96.8	96.8	94.5	93.5	<.001
Gender	Male	Female			
	96.1	92.9			<.001
Diabetes	No	Yes			
	93.6	95.7			<.001
Renal function	Normal	R failure No HD	HD		
	95.5	89.4	59.6		<.001
STEMI	No Shock	Shock			
	96.2	82.3			<.001

HD = hemodialysis; R failure = renal failure; STEMI = ST-elevation myocardial infarction

Therefore, the most commonly used vascular approach for coronary IC in Uruguay is RA in all scenarios, especially in younger, non diabetic and male patients and in the absence of hemodialysis or shock.

## Philippines

### Transradial Approach to Coronary Interventions in the Philippines

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The Philippines has been among the dynamically emerging markets in the East Asia region with its sound economic fundamentals and highly skilled workforce. With a total population of almost 99 million and a lower middle income level, the economy posted 7.2% GDP growth in 2013. Growth momentum was maintained at 6% in the first half of 2014 and remained one of the fastest in the region.

Health insurance coverage has increased largely in the past five years from 42% in 2008 to 63% in 2013. The cost of healthcare received in private medical providers is substantially

higher than the cost of care received in public facilities. Only less than half of the average hospital bill is paid by the national health insurance provider PhilHealth, perhaps in part because not everyone has PhilHealth coverage.

The pioneers of interventional cardiology in the Philippines saw the need to gather interventional cardiologists in the country to at least exchange notes in individual catheterization laboratory experiences and at most advance the field of cardiovascular catheterization and interventions to a level that would offer maximum benefit and safety for patients needing these procedures. Thus, on 12 January 1993, the Philippine Society of Cardiovascular Catheterization and Interventions (PSCCI), an affiliate society under the umbrella of the Philippine Heart Association and Philippine College of Cardiology, was formally organized with Dr. Dy Bun Yok as its first president. Among the primary objectives of the society are to: (1) develop, optimize, promote, and regulate the practice of diagnostic cardiac catheterization and interventional cardiology in the Philippines; (2) to define the basic criteria for training and accreditation of cardiologists who wish to perform or continue to perform diagnostic and interventional cardiology; (3) to support and supervise research towards the improvement of the quality and safety of cardiovascular catheterization and interventional procedures; and (4) to develop procedures for self and peer assessment of its members. Currently, the list of membership includes 137 adult interventional cardiologists with 44 Fellows and 21 Interventional Fellows. To date, there are 31 catheterization laboratories in the Philippines with 17 of them in the greater Metro Manila area. There are 2 more catheterization laboratories opening in 2015. All catheterization laboratories are in hospitals with facilities for open heart surgery. The premiere training institution for cardiology in the country is the Philippine Heart Center which has 3 top-of-the-line cath lab machines and 1 hybrid operating room with more or less 1,160 PCIs a year. In 2013, the total number of coronary artery bypass graft surgeries at the Philippine Heart Center was 619. One has to finish a 3-year training program in internal medicine and a 3-year core curriculum in general clinical cardiology before embarking in interventional cardiology training. An aspiring training fellow also has to pass both diplomate certifying examinations in internal medicine and in adult cardiology before being accepted in the one year interventional cardiology training program (2 years in low volume centers). Some fellows pursue further training in interventional cardiology in first world countries.

Most interventional cardiologists in the Philippines were trained with the femoral access. But today, the radial artery default access to coronary angiography and interventions is gaining popularity and support within the local interventional community. However, the rate of default transradial approach still varies widely from one operator to another across the country with an approximately 15% overall rate. One private medical center has a TRA rate of 87%. The new

training fellows are now being exposed to both radial and femoral approaches.

Aside from less vascular and bleeding complications requiring blood transfusions and even surgery, there is a cost-effective benefit with the transradial approach as a result of early ambulation and discharge which can translate to significant savings for the patient, especially in the Philippine setting. Transradial procedures are now being done on an outpatient basis in low risk patients and in those with no other serious illnesses that require in-hospital monitoring. The transradial approach to coronary interventions underscores efforts to further improve the quality of patient care as well as enhance patient experience in terms of comfort, safety, and cost.

## Training and Learning Curve

### Impact of the Learning Curve and the Time of Day on the Procedure in STEMI Patients Undergoing Primary PCI with Left Radial Approach

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**PURPOSE:** Since 2011 the primary setup of our catheterization lab has been changed to left radial, and nowadays approximately 95% of all procedures are performed with either left or right “wrist access.” Primary PCI in STEMI patients (pts) are the most demanding and operators need to be well trained before they begin using the radial approach. The aim of the study was to establish whether the operator’s experience in left radial approach and the time of day when the procedure was done had any influence on the success of the procedure, or on patient and operator safety in STEMI pts undergoing primary PCI with left radial approach.

**METHODS:** In this retrospective analysis we included 596 pts with STEMI, treated in our center from January 01, 2011 to June 01, 2014 with primary PCI with left radial approach. We did not include pts treated with right radial or with femoral access. To analyze the learning curve variability we divided pts into 6 month period groups, with the total of 7 groups. The second analysis was according to the time of day when pts arrived to the catheterization lab and so pts were divided into three groups (A: 8-16h, B: 16-24h and C: 24-8h).

**RESULTS:** We found that fluoroscopy time was significantly longer and that a larger amount of contrast was used in the first year after changing the setup from femoral to left radial. During that time some of the operators were just finishing the training for the radial approach. Even so, the procedure radiation dose was significantly higher in the first year and a half. On the other hand, there was no significant difference in procedure success, “door to balloon” time or total procedure time in all analyzed groups. In the sub analysis

we did not find that the time of day when the procedure was done had any significant influence on any of the analyzed parameters.

**CONCLUSION:** Fluoroscopy time, amount of contrast used and fluoroscopy dose are higher in STEMI pts treated with primary PCI in the first year after changing the setup of the catheterization lab to left radial. In time and with more operator experience, these measures can be expected to be significantly decreased.

## Transradial Approach in Iran

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**PURPOSE:** To assess use of the transradial approach in Iran and its growth in recent years.

**METHODS:** Sampling from centers across the country on the percentage of coronary angiographies and percutaneous coronary interventions done through radial route.

**RESULTS:** Although transradial approach usage has increased four-fold in previous 4 years it still remains below 30%.

## Hemostasis, Radial Artery Injury and Occlusion

### New Retrograde Arterial Access for Repeat Radial Catheterization in Case of Late Radial Artery Occlusion

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**PURPOSE:** Late radial artery (RA) occlusion occurs in 3-9% of transradial interventions limiting our ability of same RA repeat catheterization. The purpose of this study was to examine feasibility and safety of new radial arterial access for late radial artery occlusion (RAO) recanalization.

**METHODS & RESULTS:** We demonstrate the possibility of retrograde RA recanalization, dilatation and restoration of the lumen of occluded RA through new vascular access – deep palmar arterial arch (branch from radial artery). This new puncture point located in wrist portion of radial artery distally of origin ramus palmaris superficialis just over the bone trapezium that makes good platform for compression hemostasis of puncture site. We used this new approach in 14 cases of RAO. In all cases puncture of deep palmar arterial arch was successful and in 12 cases RAO recanalization and restoration of RA lumen for repeat transradial intervention (TRI) was achieved. We used “Dotter-type” recanalization (4 cases), balloon dilatation after wire crossing (3 cases) or mixed technique (5 cases). No major access site complications occurred; there were minor hematomas around puncture site in two cases without clinical consequences. In all 14 cases deep palmar arch puncture artery was patent at moment of patient discharge (1-2 days later TRI).

**CONCLUSIONS:** New access through the deep palmar arch (branch from distal RA) is feasible and safe. It provides more space (enlarges distal postocclusion segment) for safe and effective manipulation for further recanalization of

RAO. Moreover, caliber of access artery allows us to use same instruments for catheterization as we usually use in traditional RA entry point.

### **Incidence of Radial Artery Injury After PCI for Non-STEMI ACS and 9-Month Follow-Up Re-Catheterization Assessed by Optical Coherence Tomography**

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**PURPOSE:** To study the frequency of an acute injury of the radial artery (RA) caused during the percutaneous coronary intervention (PCI) and during subsequent 9-month follow-up re-catheterization (9M FU reCAG) in patients treated for non-STEMI acute coronary syndrome (ACS). We used frequency-domain optical coherence tomography (FD-OCT, Ilumien, St. Jude Medical) for the assessment.

**METHODS:** Since Dec 2012, we have performed FD-OCT of the RA in 100 patients admitted to the PCI center for the non-STEMI ACS. None of these patients had had radial PCI in the past. 49 of these subjects underwent 9M FU reCAG and radial OCT examination. Having pulled the 6-French radial sheath (Radifocus introducer, Terumo, 7cm long) 4-5cm back out of the artery, we used automated pull-back (54mm) starting 7cm from the tip end of the sheath with the manual injection of the contrast fluid. All the FD-OCT recordings were assessed by two analysts, evaluating intimal tear (not affecting media), acute dissection (affecting media) and perforation occurrence of the RA.

**RESULTS:** Right after the index PCI procedure, we found 2 cases of intimal tear and 1 dissection (all together 3% of patients), after the 9M FU reCAG there were 5 cases of intimal tear, 4 dissections and 1 perforation in 9 of 49 radial arteries (18.4% patients). No occlusions were found. All complications were without sequelae.

**CONCLUSION:** Acute radial injury during the first-time radial access PCI is very rare (3%). Only minor injuries of no clinical importance were found. Chronic changes (intimal proliferation, fibrosis etc) of the artery are the subject of our further research, but acute radial injuries after subsequent re-catheterizations are much more common (18.4%). Both acute and chronic changes/injuries may play a role in future utilization of these arteries for surgical purposes.

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### **How Feasible is it to Reuse the Radial Artery for Intervention**

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**BACKGROUND:** We report our experience with reuse of the same radial for repeat intervention- the safety, feasibility and further patency of this artery in follow-up.

**METHODS:** Data from patients undergoing coronary angiography (CAG) and percutaneous coronary intervention (PCI) at our center between Aug 1, 2013 to May 31, 2014 were analysed. Data was analysed in terms of total radial CAGs requiring a repeat intervention (most often PTCA to the culprit artery) and the safety and feasibility outcomes.

**RESULTS:** A total of 795 CAGs and 206 PCI were done during this period. Out of the 771 CAGs that were done using the radial route, 55 patients underwent PTCA to the culprit lesion, not in the same sitting (next day in 34 patients, between days 2-7 in 13 and after the first week in 8). In 51 of the 55 patients, the same radial access (right) could be employed for a successful PTCA. The most frequent complications after the initial CAG in these patients were all local [small hematoma in 6 patients (11.7%), superficial bruising in 8 (15.7%) and local tenderness in 29 (56.8%) patients out of 51]. The local tenderness in most of these patients (25 of 29) could be controlled with SOS analgesics. After the second procedure (PTCA), hematoma was seen in 9 (17.6%), superficial bruising in 17 (33.3%) and local tenderness in 44 (86.3%) of the 51 patients. Pain and tenderness necessitated a short course of analgesics in 26 patients while 18 could be managed with SOS analgesics. None of the hematomas again was of any hemodynamic significance. Pain and local tenderness were most marked in the patients who had required the procedures in quick succession. Three of these 51 patients required a third procedure, all within 48 hours of the PTCA. In all of these, the same access was uniformly employed and procedure could be completed successfully.

**CONCLUSION:** If measures are taken to ensure patency of the radial artery, it is feasible to employ it for repeat procedures if required for future procedures. The only potential problems is a slightly increased risk of local complications particularly superficial bruising which is self-limiting and pain and tenderness at the local site which can be managed with oral analgesics.

### **Technical Aspects**

#### **Placement of Amplatzer Vascular Plug 4 via Transradial Approach in the Visceral Arteries**

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**PURPOSE:** To determine the technical success and effectiveness of placing the Amplatzer Vascular Plug 4 (AVP4) in the visceral arteries from a transradial approach.

**METHODS:** A retrospective single center review from April 2012-June 2014 was performed of 845 patients undergoing transradial intervention. Of these patients, AVP4 placement from a radial approach was attempted in 20 patients in 21 vessels. The technical success of placing the AVP4 and effectiveness (as defined by complete vessel occlusion at the

time of deployment and at follow-up) of the embolization was evaluated. The Barbeau waveform, device size, embolization adjunct, catheter selection, sheath size, target vessel, fluoroscopic time, and major and minor adverse events were also recorded.

**RESULTS:** 21 vessels embolized included: gastroduodenal artery (GDA) (n=15), right gastric artery (n=2), left hepatic artery (n=1), right inferior phrenic artery (n=1), splenic artery (n=1), abdominal aortic Type I endoleak (n=1). AVP4 diameters included: 6mm (n=10) and 8mm (n=11). Technical success was 100%. 1 case required additional embolization for complete occlusion. Effective embolization occurred in 15/18 (83%) vessels on follow-up DSA/CT/MRI. Median follow-up interval was 23 days. 2 of 3 recanalized vessels were GDA and 1 included a small but significantly reduced persistent endoleak in the abdominal aneurysm. Mean fluoroscopy time was 28 minutes (range 8-40). Radial sheath size included: 4F (n=1), 5F (n=18) and 6F (n=1). There was no evidence of radial artery occlusion or major or minor adverse events at 30 days.

**CONCLUSION:** AVP4 placement in the visceral arteries via a transradial approach is technically feasible and effective without complication.

### The Incidence of Anatomical Variations from Wrist to Aorta and their Impact on Transradial Interventional Procedures

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**PURPOSE:** To assess the incidence of arterial anomalies from wrist to aorta and their impact on the success of primary chosen transradial access site in a large series of patients.

**METHODS:** 10,502 consecutive patients from March 2011 to July 2013 were examined at the University Clinic for Cardiology in Skopje. Preprocedural radial artery angiography was performed in all patients. Clinical and procedure characteristics, type of vascular anatomy variants and transfer direction were analyzed. Primary endpoint of the study was the occurrence of transradial approach failure due to anatomical variants and need to crossover to another access to finish the procedure. All other causes of TRA failure were excluded. Secondary endpoints were presence of access site bleeding complications and radial artery spasm.

**RESULTS:** From 10,502 consecutive transradial procedures, anatomical variants were present in 1,114 (10.5%) patients. The most frequent variant was high-bifurcating radial artery origin from the axillary and brachial arteries in 733 (6.6%) patients, 105 (1.0%) had a full radial loop, 152 (1.4%) had extreme radial artery tortuosity, 17 (0.16%) had hypoplastic radial artery, and 113 (1.0%) patients had tortuous brachial, subclavian and axillary arteries. Anomalies of the aortic arch (arteria lusoria) were found in 6 cases (0.05%).

From 1,114 patients with anatomic variants, failure in primarily chosen access site occurred in 52 (4.7%). We had successful crossing of anatomical variants in 1,062 patients (95.3%). The presence of a complex radial loop in 23 (22%) was the commonest cause of procedural failure. Access site crossover due to spasm of the radial artery without anomalies occurred in only 12 cases (0.01%). All other TRA procedures were successfully performed through the primary chosen transradial access site with overall procedural success rate of 99.4% in 10,450 patients.

**CONCLUSION:** Radial artery variations are relatively common and a cause of transradial procedure failure even for experienced radial operators. Pre-procedural radial artery angiography helps to delineate underlying variations and successfully plan the strategy for crossing the anomaly. High volume transradial centers with experienced transradial operators have low transradial crossover rates due to anatomical variations.

### Transradial Percutaneous Coronary Interventions Using a Sheathless Eaucath Guiding Catheter Compared to Standard Guiding Catheter: a Randomized Study

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**BACKGROUND:** Guiding catheter (GC) characteristics play an important role in the success of transradial (TR) percutaneous coronary intervention (PCI). We compared TR PCI with Sheathless Eaucath GC to standard GC in women and patients with complex lesions requiring large bore GC.

**METHODS:** Between 2011 and 2013, we prospectively randomized men with ostial or bifurcation lesions and all women undergoing TR PCI at a single tertiary academic center between standard 6 Fr in women and 7 Fr in men GC (Medtronic) and the Sheathless Eaucath (Asahi Intecc, Japan) GC (6.5 Fr in women and 7.5 Fr in men). The procedures were performed by three trained radialists. Our primary endpoint was procedural success (successful PCI without GC-induced coronary complications) and procedural safety (absence of hematoma, radial occlusion assessed by duplex scanning, PCI complications and vascular complications). Secondary endpoint was the efficacy of the Sheathless Eaucath GC considering procedural time, amount of contrast media, crossover to additional techniques (e.g. mother and child technique) or to transfemoral approach.

**RESULTS:** We randomized 213 patients (110 (52%) women and 103 (48%) men), who were treated using 116 Sheathless Eaucath GC and 117 standard GC for a total of 233 PCIs. The procedures were performed in the setting of stable angina in 73% of the cases and acute coronary syndromes in 27%. Lesion types were B2 and C in 60% of the cases. PCI were performed for LAD (60%), LCX (22.5%) and RCA (17.5%) lesions. In the standard GC group, despite the use of the mother and child technique in 25%, crossover

to the Sheathless Eaucath GC was necessary in 8.5% of the cases in order to complete the PCI by TR approach. In 1.3% of the cases (0.8% in the GC group and 1.7% in the Sheathless group) crossover to transfemoral approach occurred. No PCI complications were directly related to the GC type. Radial occlusion was found overall in 3% of the cohort equally distributed between both GC.

**CONCLUSIONS:** The use of Sheathless Eaucath GC in TR PCI was feasible, safe and effective compared to standard GC. Crossover to Sheathless Eaucath GC after standard GC failure allowed successful TR PCI to be performed in most patients of the studied population (i.e. women, men requiring large bore GC).

### Complex PCI

#### A Case of Embolic Inferior Wall Myocardial Infarction Secondary to a Thrombus in the Right Coronary Sinus of Valsalva Originating from the Left Atrial Appendage. A Complex Case Tackled via Radial Approach

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**CASE:** An 84-year-old woman with hypertension presented with epigastric pain lasting for three hours. Her heart rate was 35–45 beats per minute, blood pressure was 190/80. She had normal cardiac and pulmonary exam. She had no electrolyte derangement and a normal Troponin-I. EKG showed a junctional rhythm at rate of 40 and 2 mm inferior ST elevations with lateral ST depressions. She was taken emergently to the catheterization lab. Coronary angiography was performed via a right radial access. Attempts to engage the right coronary artery (RCA) were unsuccessful despite using multiple guide catheters. The left coronary system showed no angiographic evidence of coronary artery disease with left to right collaterals. Contrast injection in the right coronary sinus suggested ostial total occlusion of the RCA. Probing of a coronary wire near the potential ostium location was associated with an accelerated idioventricular rhythm and resolution of ST elevation. The RCA was then easily engaged with angiography showing a smooth vessel and abrupt termination of the distal PL2 branch. Left ventriculogram showed inferior and posterior-basal hypokinesis. A CT angiogram showed aortic root thrombus (21x16 mm) with extension into the right coronary sinus and a large left atrial appendage (LAA) thrombus. Subsequent EKGs demonstrated paroxysmal atrial fibrillation. A brain MRI showed multiple embolic cerebral infarcts.

**DISCUSSION:** Coronary artery embolism is a known etiology for acute coronary syndromes. There are very few reports in the literature about ascending aortic thrombi causing coronary sinus compromise and coronary artery occlusion leading to acute. Initial attempts to engage the

RCA were unsuccessful secondary to the large thrombus in the right coronary sinus completely obliterating the ostium. Contrast injection in the right coronary sinus dislodged part of the thrombus and revealed the RCA ostium. Attempts to pass the coronary wire resulted in distal embolization of the. The ascending aortic thrombus has likely originated in the LAA secondary to undiagnosed atrial fibrillation. Other evidence of systemic emboli was detected on further workup.

**CONCLUSION:** This case shows clear association between coronary artery embolism with a well-documented right coronary artery sinus and LAA thrombus. It reflects the importance of a thromboembolic etiology of MI and its influence on therapeutic strategies. It also demonstrates that such a complex case can be successfully performed through radial access.

#### Transradial Approach and Distal Buddy-in-Jail Technique: a Series of 28 Cases

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**BACKGROUND:** Difficult coronary anatomies mixing tortuosity, bending, lesions and vessels calcifications added to plurifocal long and or severe stenosis are challenging cases, often addressed either by CABG surgery or “aggressive” PCI strategies, using large guiding catheters, atherectomy devices and adjunctive materials like mother and child catheters. Transradial access is often denied due to requirement of large bore catheters. We developed a new technique around the buddy wire technique, using a distal “Buddy-in-Jail” technique. The technique traps a buddy wire during a distal stenting. The technique thereafter allows additional stenting of proximal lesion(s) over either the jailed or the free wire. The added support of a jailed wire allows use of 5 or 6 Fr catheters even for tough anatomies. We report here our preliminary experience.

**METHODS:** From December 2011, difficult cases were recruited from 498 consecutive PCIs (ad hoc 423). We graded the diseased vessel anatomy according to a local score for ease of angioplasty. The score uses patient, aorta, coronary and lesions characteristics. A score of 3 or less is for easy cases, 4 to 6 for intermediate difficulty and more than 7 for tough cases.

**RESULTS:** The technique was applied to stent 28 patients, 6 LM/LAD/diagonal tree, 5 LM/CX tree, 16 RCA and one SVG. 20 cases were ad hoc procedures. The mean population age was  $69 \pm 10$  y (min 39, max 89), included 4 female and 24 male patients with a mean BMI of  $28 \pm 5$ . All cases except one were performed through right TRA (16) or left TRA (11). 5 Fr guiding catheters were used for 19 and 6 Fr GC for 9. Of the 28 cases, 3 were intermediate (mean 5.67), 25 were scored as difficult, score of  $9.20 \pm 1.55$ . All cases were successful and uneventful except for one case of myocardial suffusion treated medically (post CABG patient). The suffusion was related to a wire used as anchor

in a non-treated vessel. Mean volume of contrast was  $226 \pm 90$ , mean fluoroscopy time was  $11 \pm 11$  min and mean DAP was  $173 \pm 76$  Gy/cm<sup>2</sup>. The trapped wire was used for proximal stenting(s) in 10 cases and the free wire was used for the remaining 18.

**CONCLUSION:** The Distal Buddy-in-Jail technique allowed successful stent delivery in difficult anatomies without requiring large catheters or special material. The technique should safely be integrated in the available solutions for tough PCI.

### Evaluation of the Safety and Efficacy of the Novel Svelte™ Acrobat Integrated Delivery System via a Radial Approach with 5-French Catheters

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**PURPOSE:** To evaluate the safety and efficacy of the Svelte Acrobat Integrated Delivery System (IDS) via a radial approach with 5-French catheters. The direct stenting (DS) system enables easy delivery, deployment, and post-dilatation of a cobalt-chromium stent.

**METHODS:** Patients with coronary artery disease (CAD) were prospectively enrolled at three centers in Sao Paulo, Brazil to undergo PCI with DS via a radial approach using 5-French catheters. The primary endpoint was IDS success, which was defined as DS without post-dilatation and final stenosis <20% with TIMI 3 flow.

**RESULTS:** Fifty consecutive patients with 55 lesions were included. The procedural success was 98%. The device could not cross the lesion in 2 cases, so DS success was 96%. Fifty lesions met the primary study objective; thus, IDS success was 91%. The procedure duration was 21 min (SD = 9); fluoroscopy time, 437 sec (SD = 280); and contrast volume per vessel, 103 cm<sup>3</sup> (SD = 33). The final residual stenosis, by quantitative coronary angiography, was 3.4% (SD = 4). The reduced need for additional catheters resulted in a 20% procedural cost saving. There were no bleeding or vascular complications. At 8 months, the event-free survival was 84%.

**CONCLUSIONS:** DS using the Svelte Acrobat IDS via a radial approach and low-profile catheters is safe and efficacious in select CAD patients, and its use is associated with potential procedural cost savings.

### Total Wrist Access for Primary Percutaneous Coronary Intervention: A Real World Single Center registry of 2624 Consecutive Patients with Acute STEMI

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**PURPOSE:** Transradial access for primary percutaneous coronary intervention (TRA PPCI) in patients with acute ST elevation myocardial infarction (STEMI) is associated with reduced complications and mortality rate. However,

there is a paucity of data regarding total transition towards radial or wrist access for PPCI. Our center completely transferred access strategy to default TRA for all interventions.

**METHODS:** From January 2010 to December 2013, 2,624 consecutive all-comers STEMI patients underwent PPCI within first 12 hours of symptoms onset. TRA was used as the first choice default access strategy by all 7 experienced high volume radial operators. Interventions were done according to international guidelines with or without thrombus aspiration according to operator's decision. Primary outcomes were: access site transfer rate, secondary outcomes were mortality and major adverse cardiovascular events rates (MACE: death, reinfarction, stroke target vessel revascularisation) at 30 days and 6 months.

**RESULTS:** Crossover from default radial was low 5.4% (144 patients). We treated 98.7% (2,589) patients by wrist access and only 1.3% (35) patients with transfemoral access (TFA). Access site transfer occurred towards left radial in 2.6 % (69 patients), ulnar 1.6 % (40 patients) and in only 1.3 % (35 patients) towards TFA. Secondary outcomes at 30 days were: MACE rate of 6.6% (174 patients), mortality rate of 5.0% (131 patients). At six months MACE rate was 8.6% (226), mortality rate was 5.6% or additional 16 deaths were observed.

**CONCLUSION:** Default TRA strategy is associated with low crossover rate in experienced high volume radial center. Total wrist access for STEMI interventions is linked with low mortality and MACE rate in unselected all-comers cohort.

### A New Over-the-Wire Support Catheter for Radial Treatment of CTOs: The Prodigy Balloon

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Chronic total occlusion (CTO) interventions continue to be challenging for interventionists despite the advent of multiple devices and techniques. The anchoring balloon technique has been described for several years as an aid in opening CTOs using the antegrade approach. The anchoring balloon technique in radial CTO intervention is effective but limited because the over-the-wire balloons are too long and can result in barotrauma to the origin of the treated vessel. We introduce a shorter length and tip and less traumatic elastomeric balloon to aid in support for treating CTOs.

**METHODS:** We have utilized the Prodigy balloon in 5 radial cases; 4 right coronary artery CTOs and 1 circumflex CTO.

**RESULTS:** All procedures were successful. All cases were done with less than 40 min of fluoro time. Three patients were discharged 4 hrs after procedure (outpatient).

**CONCLUSION:** The Prodigy support catheter may be an improvement in anchoring techniques to aid in complex PTCA and CTO intervention. The device has been particularly effective in radial CTO cases.

### Bioresorbable Vascular Scaffold Implantation in a Real World Population Using the Radial Approach as a Default Route

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**PURPOSE:** To assess the feasibility and early safety of bioresorbable vascular scaffolds (BVS) implantation, including complex disease in a real-world setting using the radial approach as the default vascular route.

**METHODS:** Single center registry (inclusion October 2012–June 2013), lesions deemed suitable for BVS implantation, at operator's discretion. Patient and lesion characteristics and procedural data were recorded. Procedural and in-hospital outcomes are described.

**RESULTS:** 124 patients (133 procedures, 143 lesions). Age  $61 \pm 10$  years, 57% of patients were diabetic, 34% had multivessel disease. The most frequent indication for the procedure was acute coronary syndrome. The left anterior descending was the vessel most frequently treated, 5 lesions (3.5%) were located on a bypass graft. The median lesion length was 24 mm (range 7–85, interquartile range: 15.5–32.5). 58% lesions involved a branch of at least 1.5 mm, 11 lesions (8%) were chronic total occlusions, 17 (12%) were ostial lesions, 8 lesions (6%) were restenotic. 21 lesions (15%) were moderately or severely calcified. 2 lesions (1.1%) involved the left main. 74% lesions were ACC/AHA type C. Radial approach was used for 97% of the procedures (of these, 98% 6Fr sheath, 2% 7Fr sheath). In 17% cases an extra support PTCA wire was used. 85% lesions were predilated. Cutting balloon was used for 43% lesions. Rotational atherectomy was used for 4 lesions (2.8%). The average number of BVS/lesion was 1.4. In 29% lesions, there was overlapping of BVS. Postdilation with a non-compliant balloon was performed in 85% cases. IVUS guidance was used in 22%. Success delivery of the scaffold 97%. In-hospital outcomes: No cases of acute stent thrombosis or in-hospital death. Periprocedural MI requiring prolongation of hospitalisation  $n=6$  (4.5%). No vascular complications requiring prolongation of hospitalisation, transfusion or surgery.

**CONCLUSIONS:** It is feasible to implant BVS via a radial approach in a real-world setting, including lesions of a wide range of complexity, with a high device delivery success and favourable in-hospital outcomes.

### Bleeding and Anticoagulation

#### The Impact of Bleeding at Different Sites and Risk of Subsequent Mortality and Major Adverse Cardiovascular Events Following Percutaneous Coronary Intervention: A Systematic Review and Meta-Analysis

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**PURPOSE:** To evaluate the impact of bleeding at different sites on mortality and major adverse cardiovascular events (MACE) in contemporary percutaneous coronary intervention (PCI).

**METHODS:** We conducted a systematic review and meta-analysis of PCI studies that evaluated site-specific peri-procedural bleeding complications and their impact on MACEs and mortality outcomes. We searched MEDLINE and EMBASE to identify relevant studies and random effects meta-analysis was used to estimate the risk of adverse outcomes with site-specific bleeding complications.

**RESULTS:** We identified 25 relevant studies with 2,400,645 patients who underwent PCI. Both non-access site (RR 3.70 95%CI 2.92– 4.69) and access site-related bleeding complications (RR 1.65 95%CI 1.37–1.99) were independently associated with an increased risk of peri-procedural mortality. There were differences in the prognostic impact of non-access site related bleeding events on mortality outcomes according to the source of anatomical bleeding. There were significant increases in mortality for gastrointestinal bleed (RR 2.78 95% CI 1.25–6.18), retroperitoneal bleed (RR 7.55 95% CI 2.33–24.45) and intracranial bleed (RR 22.71 95% CI 12.53–41.15), but not femoral bleed (RR 2.17 95% CI 0.07–69.22). The risk of MACE was not significantly increased with intramyocardial bleed (RR 1.65 95% CI 0.66–4.13) and gastrointestinal bleed (RR 1.23 95% CI 0.55–3.05) but did increase with the composite of intramyocardial bleed, pericardial bleed or cardiac tamponade (RR 2.96 95% CI 1.07–8.17).

**CONCLUSIONS:** Site-specific bleeding complications following PCI are independently associated with increased mortality and the prognostic impact of bleeding complications on mortality depends on the anatomical site.

#### Impact of Access Site on Bleeding and Ischemic Events in Patients with Non-STEMI Treated with Prasugrel at the Time of Percutaneous Coronary Intervention or as Pretreatment at the Time of Diagnosis: the ACCOAST Access Sub-Study

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**PURPOSE:** Radial artery access for angiography and percutaneous coronary intervention (PCI) in acute coronary syndromes has been associated with lower risk of bleeding and reduced mortality in both observational and randomized studies, although less consistently in non-ST-segment elevation myocardial infarction (NSTEMI) than in STEMI.

**METHODS:** We evaluated the impact of access site on clinical outcomes of NSTEMI patients from the ACCOAST study. The ACCOAST study evaluated a prasugrel loading dose of 60 mg given at the start of PCI versus a split loading

dose of 30 mg given immediately at the time of diagnosis of NSTEMI (prior to coronary angiography), followed by 30 mg given at the start of PCI. In the study, choice of access site was at the investigator's discretion.

**RESULTS:** Patients who received radial (vs femoral) access in the overall cohort were younger, more often from Western Europe, and had lower GRACE and CRUSADE bleeding risk scores. TIMI major bleeding in the PCI cohort through 7 days was significantly higher in those patients with femoral access than with radial access (21 [1.34%] vs 5 [0.42%]; HR [95%CI] 3.19 [1.20, 8.47],  $P=.014$ ). Baseline characteristics of the PCI cohort are presented by access site in the Table.

Variable	Radial (n=1191)	Femoral (n=1571)	P-value
Age $\geq 75$ years, %	15.6	18.2	.074
Female, %	22.6	25.0	.149
Western Europe, %	56.9	52.9	.016
CRUSADE score, mean $\pm$ SD <sup>a</sup>	33.5 $\pm$ 12.0	35.0 $\pm$ 11.8	.002
GRACE score, mean $\pm$ SD <sup>b</sup>	118.9 $\pm$ 26.7	121.6 $\pm$ 26.4	.010
Prior CABG, % <sup>c</sup>	2.4	7.7	<.001
Prior PCI, % <sup>d</sup>	14.4	18.9	.002
PPI use at base-line, %	46.6	35.6	<.001

Baseline characteristics of PCI patients in the ACCOAST study for radial vs femoral access site. PPI= proton pump inhibitor.  
<sup>a</sup>n = 1131 and 1509; <sup>b</sup>n = 1132 and 1539; <sup>c</sup>n= 1187 and 1565; <sup>d</sup>n=1187 and 1565 for Radial and Femoral, respectively.

In propensity adjusted analysis in PCI patients, the effect of access site lost statistical significance [HR=2.36,  $P=.089$ ]; similar results were seen for all patients. The results of the impact of access site will be presented at the meeting separately for PCI and all patients including predefined STEEPLE and GUSTO definitions for bleeding.

**CONCLUSIONS:** For PCI patients, femoral access was associated with significantly more TIMI major bleeds, however, the effect was attenuated after adjustment.

### Safety and Efficacy of Intracoronary Thrombolysis in STEMI Setting with Large Burden Thrombus

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**PURPOSE:** Large burden thrombus in STEMI setting confers a poor prognosis. Even with double antiplatelet therapy and thrombus aspiration, distal embolisation and non-reflow are common. Intracoronary thrombolysis may be an effective and safe treatment option in patients with STEMI.

**METHODS:** Retrospective review of all patients with STEMI and large burden thrombus that were treated with intracoronary thrombolysis in the period 2006–2014.

**RESULTS:** 36 patients with STEMI were treated with intracoronary thrombolysis (age  $61.4\pm 13.5$ , 33% females, 95% received loading dose of double antiplatelet therapy). In 47% of cases the RCA was the culprit artery, 25% LCx, 14% LAD, 14% secondary branches. Initial TIMI Flow Grade (TFG) was 0 in 81% of cases. Initial TIMI Thrombus Grade (TTG) was 4 (22%) and 5 (78%). Radial access was used in 89% of patients. During the procedure, heparin was given (median 33.6UI/kg (31.9–36.7)). Thrombolytic therapy used was TNK (78%) and rTPA (22%) with dosage 33.7U/kg (31.9–36.7) and  $0.36\pm 0.9$ U/kg, respectively. Glycoprotein IIb/IIIa inhibitors were used in 20% of cases. Thrombectomy was used in 89% of cases. 80% of patients received at least one stent. Distal embolisation occurred in 31% of cases. ST resolution of at least 50% of initial ST elevation was observed in 69% of patients. Final TFG was  $\geq 2$  in 94% of cases, TTG decreased to  $\leq 2$  in 94% of patients and final myocardial blush grade was  $\geq 2$  in 71% of cases. During admission, TIMI major bleed was observed in 8% of cases, TIMI minor bleed in 8% and vascular access bleed non requiring intervention in 8%. Two patients died during hospitalization due to mechanical complications of STEMI. TIMI major bleed was associated with higher heparin and fibrinolytic dosage.

**CONCLUSIONS:** Intracoronary thrombolytic therapy may be an effective reperfusion therapy in selected patients with STEMI and large thrombus. The safety of this therapy may be related to weight adjustment of the thrombolytic agent and heparin dosage, and to vascular access.

### Non-Coronary Intervention

#### Surefire Catheter Deployment via a Transradial Approach: Feasibility and Technical Outcomes

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**PURPOSE:** The Surefire catheter (Surefire Medical) is an anti-reflux microcatheter (ARM) recently introduced for more precise and directed infusion of selective internal radiation therapy (SIRT) and trans-arterial chemoembolization (TACE). We present our initial experience of deploying this novel ARM via a transradial approach (TRA).

**METHODS:** Patients who underwent SIRT or TACE with the ARM via TRA were retrospectively reviewed. In all cases, a Barbeau Test was performed. A 5 Fr Glidesheath (Terumo) was placed in the left radial artery using ultrasound guidance. Following sheath placement, a standard solution of 3000U heparin, 2.5mg verapamil and 200mcg nitroglycerin was administered intra-arterially. A 5 Fr guiding catheter with minimum 0.054 inner lumen diameter was used to perform diagnostic angiography of the visceral and hepatic arteries. The ARM was advanced to the target hepatic artery through the guiding catheter over a 0.016 Fathom wire (Boston Scientific).

SIRT/TACE infusion was administered in the target vessel under real time fluoroscopy. A TR band (Terumo) was used for hemostasis. Technical success, fluoroscopy time (FT), major and minor post adverse events and procedural details were recorded.

**RESULTS:** From November 2013 to June 2014, 13 patients, mean age of  $62.8 \pm 10.9$  years, underwent SIRT/TACE for liver tumors in which the ARM was deployed via TRA (6 SIRT, 7 TACE). Tumor pathology included: HCC (n=9), neuroendocrine (n=2), leiomyosarcoma (n=1), angiosarcoma (n=1). Technical success was 92.3% (12/13). The failure which occurred was secondary to a replaced left hepatic artery originating from the left gastric artery, creating an oblique, tortuous angle which was exaggerated when entering via TRA. Subsequently the case was successfully completed via a femoral approach. In the 12 successful cases, 100% of the intended therapeutic radiation dose/chemotherapy was delivered without evidence of reflux on real time fluoroscopy. Median (interquartile range) FT and radiation dose were 18.3 (16.4) min and 248 (325) Gy-cm<sup>2</sup> respectively. There were no post-procedural major or minor adverse events. Patients were followed for a median (interquartile range) of 21 (20.5) months and did not exhibit any signs of non-target chemo/radio-embolization.

**CONCLUSION:** The Surefire ARM can be safely deployed via a transradial approach. Pre-procedural cross-sectional imaging studies (CT/MRI) should be used to analyze patient specific differences in anatomy to guide the decision between radial or femoral approach.

### Outpatient Transradial Hemodynamic Assessment of Mechanical Aortic Valve Prosthesis Using a Coronary Fractional Flow Reserve Guidewire

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**PURPOSE:** To describe an outpatient transradial hemodynamic assessment of a mechanical aortic valve prosthesis using a coronary fractional flow reserve (FFR) guidewire in a patient who is fully anticoagulated with warfarin.

**METHODS:** Procedure was done as an outpatient on a patient fully anticoagulated without the need for heparin bridging. Right heart catheterization was completed via right brachial vein access and a 5 French Arrow Balloon Tipped catheter. Left heart catheterization was completed via right radial access. The guide catheter used was a Barbeau Guide, which was zeroed in the left ventricle. Simultaneous left ventricle and aortic pressure were collected with a coronary FFR guidewire. Baseline hemodynamics in addition to hemodynamics with dobutamine infusion were collected.

**RESULTS:** There was a mean gradient of 31.23mmHg at baseline and mean gradient of 48.73mmHg with infusion of dobutamine 40mcg/kg/min. Right-sided pressures were within normal limits with the exception of pulmonary

capillary wedge pressure of 16. The patient had no bleeding complications.

**CONCLUSION:** We have demonstrated a total radial approach to mechanical aortic valve prosthesis gradient assessment. This was an outpatient evaluation in a patient who was fully anticoagulated on warfarin. We were able to avoid a heparin bridge and also avoided transeptal and/or percutaneous left ventricle apical puncture. Additionally, we avoided the potential complication of catheter entrapment with using pigtail catheters to assess left ventricle hemodynamics. Finally, FFR assessment allowed for a direct and accurate measurement of left ventricle and aortic pressures.

### Transradial Access for Above-The-Knee Angioplasty

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**PURPOSE:** To report the results and complications of a single-center experience of above-the-knee angioplasty (ATK) via transradial access (TRA).

**METHODS:** In a prospective study, 120 consecutive patients (94 men; mean age 71 years, range 37-90) referred for critical limb ischemia (31, 26%) or claudication with ATK lesions (excluding patients with TASC D lesions of the superficial femoral artery) were eligible for lower limb arterial angioplasty via TRA.

**RESULTS:** The majority of patients were approached via left TRA (92, 77%) and with a sheathless catheter (94, 78%; Sheathless PV, Asahi). A total of 188 lesions were addressed, of which 43 (23%) were occlusions; 121 stents (73 in suprainguinal lesions; sinusSuperFlex-518, OptiMed) were positioned in 92 patients. Overall technical success (<30% residual stenosis) was achieved in 170 (90%) lesions, with a 63% success rate in occlusions and a 99% success rate in stenoses; with a 91% success rate in suprainguinal lesions and a 90% in infrainguinal lesions. No hemorrhagic or local complications requiring surgery were observed. At 1-month follow-up, 111 patients had a downward shift of at least one category in the Rutherford classification of symptoms (clinical success rate 92%); 18 (15%) patients had occlusion of their access radial artery, but none had symptoms or discomfort. However, the rate of radial artery occlusion fall to 5% when the patent hemostasis technique was systematically applied.

**CONCLUSION:** The present study demonstrates that TRA can be a safe and effective approach for lower extremity arterial revascularization, at least in selected anatomical subsets.

### Transradial Approach Facilitates Same-Day Discharge for Transarterial Chemoembolization to Treat Hepatocellular Carcinoma

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**PURPOSE:** Transradial access (TRA) was evaluated as a method to help facilitate same-day discharge for patients undergoing transarterial chemoembolization (TACE) to treat unresectable hepatocellular carcinoma (HCC).

**METHODS:** Retrospective review of 21 continuous patients selected for same-day TACE to treat HCC from Feb 2014 to Jul 2014, with 12/21 patients treated via TRA. Criteria for same-day TACE included Child-Pugh A or B, and ECOG performance status 0 or 1. A Barbeau test was performed using a pulse oximeter on the ipsilateral thumb to confirm dual circulation and patency of the palmar arch. Ultrasound evaluation of the radial artery was performed to ensure adequate vessel size. Contraindications to TRA included RA < 2mm and Barbeau D waveform. Following arterial puncture, a hydrophilic 5 Fr Glidesheath (Terumo Interventional Systems) was placed. A medication solution of 3000 U heparin, 2.5 mg verapamil, and 200 mcg nitroglycerin was given to minimize vascular complication. At the end of the procedure a TR band (Terumo) was used to compress the puncture site for approx. 60-90 min using patent hemostasis technique. Procedural details, technical success, 30-day major and minor adverse events, fluoroscopy time, and post-procedural time to discharge were evaluated.

**RESULTS:** Technical success via TRA was obtained in 100% of cases, with no major or minor adverse events at 30-days. Average fluoroscopy time under TRA was 25.1 min. TRA TACE patients were discharged on average approximately 2 hours after being transferred to the recovery room and were able to ambulate immediately.

**CONCLUSION:** TRA appears to be feasible and safe in HCC patients undergoing same-day TACE, and facilitates same-day discharge by minimizing post-procedural discharge times and allowing nearly immediate ambulation.

## Nursing Aspects

### Nursing Initiated Radial Artery Occlusion Screening Quality Improvement Program

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**PURPOSE:** Radial artery occlusion (RAO) is a known complication following transradial catheterization. Although RAO has been thought to be asymptomatic, detailed evaluation of the hand circulation pre- and post-transradial cardiac catheterization is rare. Determining if specific variables influence RAO, along with a definitive method of screening for RAO, will provide a more reliable post-catheterization complication rate.

**METHODS:** A total of 73 patients were prospectively screened for arterial patency before transradial catheterization using the modified Allens and Barbeau test along with arterial ultrasound evaluation. Any abnormalities in vascular

integrity were communicated to the interventional cardiologists before the procedure. At the time of submission, 63 subjects returned for follow-up and underwent evaluation for RAO by the methods listed above.

**RESULTS:** Post-procedure changes in the modified Allen or Barbeau test results in the ipsilateral access wrist were noted in 3 patients, but there were also changes noted in 10 patients in the non-accessed contralateral radial artery. By ultrasound, the average diameter of the accessed artery decreased in 24 patients, increased in 18 patients and did not change in 20 patients. There were no cases of radial artery occlusion in any of the follow up patients.

Value Pre-transradial catheterization in arm of access		Value Post-transradial catheterization in arm of access	
Right radial AP diameter	0.267 [0.13-0.37]	Right radial AP diameter	0.259 [0.14-0.36]
Left radial AP diameter	0.242 [0.2-0.28]	Left radial AP diameter	0.242 [0.15-0.28]
Right radial velocity	52.43	Right radial velocity	53.01
Left radial velocity	54.22	Left radial velocity	56.78

**CONCLUSION:** There are numerous methods of assessing the radial artery before and after cardiac catheterization. Inconsistencies in the results of the modified Allen/Barbeau tests in both the accessed and non-accessed arteries challenge the practicality of these tests for routine screening of vascular integrity. Objectively evaluating vascular status before and after transradial catheterization with open communication between the research/nursing staff and the interventional cardiologists elevates the quality of care and safety of the procedure.

### Patient Satisfaction with Radial and Femoral Access in Interventional Radiology: A Bedside Post-Procedure Assessment Utilizing iPad Technology

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**PURPOSE:** To determine the feasibility of post-procedure patient satisfaction assessment using iPad technology after radial and femoral access for interventional radiology (IR) procedures.

**METHODS:** In this single-center study performed at a high-volume academic medical center, 21 patients undergoing arterial IR procedures were given post-procedure surveys via a bedside iPad in the IR recovery unit. Patient demographic data as well as information regarding the type of procedure performed were recorded. The survey included semi-quantitative assessments of intra- and post-procedural access site pain levels (1=no pain, 10=severe pain). Survey data was analyzed using SPSS Statistics 21 (IBM Corp).

**RESULTS** Of the 21 patients, 8 (38%) had common femoral artery access (CFA) and 13 (62%) had radial artery

access (RAA) for their arterial procedure. The RAA patients reported an access site-specific intra-procedure pain score average of 3.1 (median = 2) and 2.1 post-procedure (median = 1). The CFA patients reported an access site-specific intra-procedural pain score of 2.9 (median = 1.5) and 1.5 post-procedure (median = 1). 12 patients reported having had both types of access in the past. Of those 12 patients, 8 preferred RAA and 1 preferred CFA access. 3 patients reported no preference between RAA and CFA access.

**CONCLUSION:** Post-procedure survey data acquired via iPad is feasible in a recovery unit setting. Early pilot data gathered in this setting indicates patient preference for radial access despite higher intra- and post-procedure access site-specific pain scores.

## Radial Approach and Controversies

### Radial Artery Remodeling After Primary PCI Assessed by OCT

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**PURPOSE:** Transradial approach (TRA) in percutaneous coronary interventions (PCI) is preferred in many cath-labs for its safety and comfort for the patient. Generally, the number of transradial catheterizations (TRC) is increasing worldwide comparing to transfemoral approach. Clinically significant complications in radial artery (RA) itself are extremely rare. Extent of subclinical damage of RA after TRC remains unclear due to lack of data on this topic. Optical coherence tomography (OCT) is the most sensitive method available for the evaluation of the vessel wall layers on close to microscopic level in vivo.

**METHODS:** We included 30 consecutive patients in this study. The patients were admitted to our department due to the diagnosis of non-ST elevation myocardial infarction. The early transradial coronary angiography revealed culprit vessel lesion indicated for ad hoc PCI. Immediately after PCI, we performed OCT of radial artery from the zone of the sheath tip proximally. The length of the record was 53mm. After 9 months, follow-up OCT of RA was performed and the intimal thickness and lumen area were compared to baseline OCT record. The local ethics committee approved the project and all the patients signed an informed consent with the procedure.

**RESULTS:** Out of 30 patients, 28 records had technical quality allowing us to assess vessel wall reliably. The mean intimal thickness was  $0.066 \pm 0.012$  mm in baseline OCT and  $0.082 \pm 0.014$  mm in follow-up OCT ( $P=0.0023$ ). The mean lumen area was  $7.12 \pm 1.83$  mm in baseline OCT and  $6.30 \pm 1.78$  mm in follow-up OCT ( $P=0.18$ ).

**CONCLUSION:** The transradial PCI changes the

structure of the RA, even after only one TRA procedure. The intimal layer is significantly thickened in 9 months after the first TRC. However, there was no significant effect on vessel lumen area. This observation needs to be analyzed in larger group of patients, especially in view of the fact that the number of surgical revascularization using RA is constantly increasing.

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### The Arteria Radialis Complications and Upper Extremity Dysfunction Post-PCI Study (ARCUS)

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**BACKGROUND:** The impact of access site complications on upper extremity function after transradial percutaneous coronary intervention (TR-PCI) is poorly understood. Nonetheless, TR-PCI is quickly becoming the golden standard for many intervention cardiologists, without knowing the consequence it has on upper extremity function.

**OBJECTIVE:** To assess the magnitude of this morbidity with regards to the upper extremity surrounding TR-PCI. Secondary objectives are to provide insight in the consequences for diminished function, prognostic factors, financial costs and to identify patients who might benefit from early referral and treatment.

**METHODS:** This is a multi-center prospective cohort study containing 490 patients presenting for TR-PCI in an experienced center. All patients will, after baseline examinations be treated with the intent of using the radial artery for access. After intervention patients will undergo follow-up after 24 hours, 2 weeks, 1 and 6 months.

**RESULTS:** The main study parameter is a binary score of upper extremity dysfunction after 2 weeks as compared to baseline. A positive score is defined as either a  $\geq 1$  point increase in either the symptom-severity score or the functional-status score of the Levine-Katz (Boston) questionnaire or at least 2 of the following decreased scores, 2 weeks after TR-PCI: (1)  $\geq 15\%$  decrease in the "Disabilities of the Arm, Shoulder and Hand" outcome measure. (2)  $\geq 2$  points increase in Visual Analogue Scale pain score with regard to the upper extremity. (3) Absent signal when evaluating the radial artery using Doppler ultrasound. (4)  $\geq 10\%$  decrease in active range of motion goniometry of the upper extremity with a minimum decrease of 10°. (5) Strength: a)  $\geq 60\text{N}$  decrease in palmar grip strength compared to baseline; b)  $\geq 12\text{N}$  decrease in pinch grip strength compared to baseline; c)  $\geq 15\%$  decrease in isometric strength of flexion and extension of the elbow and flexion and extension of the wrist. (6) At least one filament decrease in sensibility of the hand using Semmes-Weinstein filaments according to WEST. (7)  $\geq 1\text{cm}$  increase at volumetry of the hand, using the Figure of eight-method. (8)  $\geq 1\text{cm}$  increase at volumetry of the forearm, measured circumferentially. The secondary study

parameters will be divided in cardiac and upper extremity related endpoints and will be used to answer the secondary objectives.

**CONCLUSION:** Preliminary results show a trend towards slight hand-dysfunction after TR-PCI. However TR-PCI has great advantages compared to the femoral route and a slight risk of upper extremity dysfunction might be acceptable in certain patients. More research is needed to investigate the impact and magnitude of this morbidity.

### The Impact of Gender, Syndrome and Vascular Access Site on Clinical Outcomes Following Percutaneous Coronary Intervention

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**PURPOSE:** To determine the impact of gender, syndrome and vascular access site on clinical outcomes after percutaneous coronary intervention.

**METHODS:** We studied the impact of gender, access site and clinical syndrome on 30-day mortality, major adverse cardiovascular events (MACE) and bleeding complications in 412,122 patients who underwent PCI between 2007 to 2012 in the United Kingdom.

**RESULTS:** We found that use of radial access increased over time and the proportion of patients with radial access was greater in men (24% in 2007 to 64% in 2012) compared to women (21% in 2007 to 58% in 2012). Use of transradial access was independently associated with lower 30-day mortality (OR 0.80 95% CI 0.73-0.89; OR 0.82 95% CI 0.71-0.94) in-hospital MACE (OR 0.82 95% CI 0.76-0.90; OR 0.75 95% CI 0.66-0.84) and major bleeding (OR 0.54 95% CI 0.44-0.66; OR 0.26 95% CI 0.20-0.33) respectively. For stable angina, radial access was not associated with a significant reduction 30-day mortality but bleeding rates were significantly lower for the radial group (Men: OR 0.45 95% CI 0.25-0.80; Women: OR 0.13 95% CI 0.06-0.30). For men, there was significantly reduced risk of events among NSTEMI patients with radial access (30 day mortality OR 0.77 95% CI 0.66-0.90, in-hospital MACE OR 0.81 95% CI 0.70-0.94, in-hospital bleeding OR 0.50 95% CI 0.36- 0.70) and STEMI (30 day mortality OR 0.80 95% CI 0.70-0.91, in-hospital MACE OR 0.69 95% CI 0.61-0.79, in-hospital bleeding OR 0.59 95% CI 0.44-0.78). For women with NSTEMI, TRA was not associated with decreased 30-day mortality, although significant reductions with radial access for MACE (OR 0.67 95% CI 0.54-0.82) and bleeding (OR 0.19 95% CI 0.12-0.29) were observed. TRA was independently associated with reduced 30-day mortality (OR 0.71 95% CI 0.59-0.86), in-hospital MACE (OR 0.80 95% CI 0.66-0.97) and major bleeding (OR 0.38 95% CI 0.27-0.54) in women undergoing PCI

for STEMI. Similarly TRA in men was independently associated with decreased rates of 30-day mortality, in-hospital MACE and major bleeding in men undergoing PCI for STEMI.

**CONCLUSIONS:** Transradial approach should be the preferred access site choice for PCI especially in women who have the greatest risk of bleeding across all indications.

### Arrhythmias in STEMI Treated with Transradial PCI

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**PURPOSE:** Acute myocardial infarction with ST segment elevation (STEMI) is an emergency that needs urgent transfer of the patient to the catheterization center and immediate treatment with primary percutaneous coronary intervention (PPCI). The transradial approach performed by skilled operator allows us to significantly decrease the time of necessary immobilization of the patients. The effect of early mobilization and transradial approach on arrhythmias incidence during hospitalization remains unclear.

**METHODS:** 100 consecutive patients (pts) admitted to our center with STEMI diagnosis in 2013 were included in the project. All the patients were connected to the 12-lead continuous monitoring system immediately after PPCI procedure. 12-lead ECG was recorded for 24 to 48 hours. We compared the arrhythmias incidence with our STEMI patients' data from 2005-6. The comparison group was treated solely with transfemoral PPCI.

**RESULTS:** Records of 80 patients were suitable for analysis from 100 included pts. The incidence of arrhythmias was found as follows: 2nd block (AVB) 0.0%, 3rd degree AVB 7.50%, non-sustained ventricular tachycardia (VT) 35.0%, sustained VT 1.25%, ventricular fibrillation (VF) 3.75%. No patient needed temporary pacing in the group. We used the group of consecutive patients with STEMI diagnosis from years 2005-2006 as reference data. In this second group, all the patients were treated with transfemoral PPCI. In the comparison group there was incidence of 2nd degree AVB 1.81% ( $P=NS$ ), 3rd degree AVB 7.50% ( $P=.019$ ), sustained VT 1.81% ( $P=NS$ ) and VF 4.35% ( $P=NS$ ). 4.71% of pts needed temporary pacing ( $P=.046$ ).

**CONCLUSION:** The transradial approach for PPCI didn't increase the incidence of serious arrhythmias in the STEMI patients, except the 3rd degree AV block. However, the number of patients needed temporary pacing was significantly lower in the radial group. The transradial approach in the hands of skilled operator and early mobilization is safe and noninferior to transfemoral access regarding the incidence of serious arrhythmias during the hospitalization phase.

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## Radial Lounge and Same-Day Discharge

### Radial Makes Anything Possible: Outpatient CTO Treatment

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**PURPOSE:** Economic considerations make outpatient PCI an important consideration in many stable patients. With radial access, new antiplatelet agents and experience, many if not all stable PCI patients can be discharged several hours after the procedure. At our center, we estimate that half of our PCIs can be performed as outpatient with annual savings of over \$250,000. With improvement in equipment and experience with outpatient PCI, we can also perform outpatient radial chronic total occlusion (CTO) intervention.

**METHODS:** Five consecutive radial CTO cases were performed: age 51-78, 4 males and 1 female, 3 right coronary arteries (RCAs) and 2 circumflex.

**RESULTS:** All cases were performed via antegrade approach and were successful and discharged within 3 hours on ticagrelor.

**CONCLUSION:** With CTOs, we preferentially utilize the radial approach particularly in RCAs. If there are no collaterals, we don't use contralateral injections. If contralateral injection is needed or contralateral intervention performed, we prep the right groin and/or use 5 Fr catheters or utilize the contralateral radial. In this small series we were able to discharge consecutive CTO cases the same day.

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