

Can thiệp qua đường mạch quay từ mô phỏng đến thực tiễn

TS.BS. Nguyễn Quốc Thái
Viện Tim mạch Việt Nam

Mô phỏng thực tế trong y học



Catheterization and Cardiovascular Interventions 51:522-527 (2000)

Equipment and Technology

Designing a Computer-Based Simulator for Interventional Cardiology Training

Steven L. Dawson,^{1*} MD, Stephane Cotin,^{1,2} PhD, Dwight Meglan,^{2,3} PhD,
David W. Shaffer,¹ PhD, and Margaret A. Ferrell,⁴ MD

Interventional cardiology training traditionally involves one-on-one experience following a master-apprentice model, much as other procedural disciplines. Development of a realistic computer-based training system that includes hand-eye coordination, catheter and guide wire choices, three-dimensional anatomic representations, and an integrated learning system is desirable, in order to permit learning to occur safely, without putting patients at risk. Here we present the first report of a PC-based simulator that incorporates synthetic fluoroscopy, real-time three-dimensional interactive anatomic display, and selective right- and left-sided coronary catheterization and angiography using actual catheters. Significant learning components also are integrated into the simulator. *Cathet. Cardiovasc. Intervent.* 51:522-527, 2000. © 2000 Wiley-Liss, Inc.

Key words: simulation; training; interventions; computer-based education; haptics

Đào tạo trên mô hình



Approval of Virtual Reality Training for Carotid Stenting What This Means for Procedural-Based Medicine

Anthony C. Gallagher, PhD
Christopher E. Cates, MD

PROCEDURAL-BASED MEDICINE HAS CLEARLY PROVIDED benefits to patients similar to those seen with minimally invasive surgery, such as minimal incision of the body cavity, reduced pain, shortened recovery time, and more rapid return to work. However, minimally invasive surgery and endovascular procedures also share similar problems. As with minimally invasive surgery, endovascular procedures require physicians to perform invasive procedures guided by 2-dimensional video images while using and manipulating tools with limited degrees of freedom. Endovascular procedures also require the operator to adapt to significantly decreased tactile sensation and avoid one similar perceptible visual conflict issues from manipulating long wires or instruments that can bulge against the body wall. These hurdles combine to create substantial challenges for physicians training to acquire these skills.

The challenge of training physicians for performance of endovascular procedures has been brought to the forefront because of the rapidly expanding application of carotid stenting for treatment of carotid artery stenosis into the broader medical marketplace. Currently, few physicians are experienced in the carotid stenting technique. However, with the recent US Food and Drug Administration (FDA) approval of carotid stents, many physicians from multiple specialties will want to learn the carotid stenting technique. Traditional training methods for new procedures include performing the procedure on animals, cadavers, or mechanical models or supervised performance of the procedure on patients. Inherent problems with these traditional training strategies include the ethical and anatomical problems of training on animals, risks posed with repeated exposure to radiation, and the expense of consuming real medical devices. However, the majority of procedural training in the United States still occurs on patients with direct mentoring

by experienced physicians during an actual clinical procedure.

This tradition of training on patients has raised concern among the profession and the public about how physicians will acquire sufficient skill to safely perform new, potentially high-risk, endovascular procedures such as carotid stenting. Because the carotid arteries are the primary blood vessels to the brain, if an embolus of thrombotic plaque dislodges and enters the brain during a carotid stent procedure, the patient could have a stroke or die on the operating table. As with other procedures, carotid stenting has a definite learning curve.¹ However, unlike many other procedures, the risk conferred to the patient in this procedure from the physicians' learning curve is unacceptably high. Traditionally, it was assumed that if a physician performed a procedure a certain number of times or trained for a period of time, then that physician became proficient in the procedure. However, essentially no mechanism for measuring posttraining skill has been used.

Both number of procedures and duration of training are at best crude surrogate measures of skill and fail to factor in the variability in individual rates of learning. This approach to training produces physicians with considerably variable skills that have been only subjectively assessed by those who trained them. This variation is particularly important with carotid stenting because this procedure crosses multiple clinical specialties with each bringing a different skill set to the training table. For example, a vascular surgeon has a thorough cognitive understanding of vascular anatomy and management of carotid disease but may lack some of the psychomotor/technical skills of wire and catheter manipulation and may be unfamiliar with management of the fluoroscope. Conversely, an interventional radiologist will have the technical skill with catheter-based

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SPECIAL COMMUNICATION

Clinical competence statement on carotid stenting: Training and credentialing for carotid stenting—multispecialty consensus recommendations

A Report of the SCAL/SVMR/IS Writing Committee to Develop a Clinical Competence Statement on Carotid Interventions

INTRODUCTION

Physicians use carotid intervention with distal embolic protection in a rapidly changing field that is being incorporated into interventional cardiology, vascular surgery, vascular medicine, and interventional radiology practices. The recently published SAPHIRE trial has established carotid stenting in high surgical risk patients as an effective alternative to carotid endarterectomy.¹

Contemporary techniques for carotid stenting and embolic protection were developed by multiple specialties, including interventional cardiologists, vascular surgeons, interventional radiologists, and vascular medicine specialists, transferring technology, interventional skills, and a positive medical therapies portfolio in their common and peripheral vascular experience.²⁻⁴

Cardiologists, as board-certified cardiovascular specialists, have recognized the systemic nature of atherosclerotic disease and appropriately taken an increasingly active role in the management of noncardiac vascular diseases, including stroke prevention. Comprehensive and coordinated management of cardiovascular disease, both cardiac and noncardiac, has become the standard of care in contemporary clinical and interventional practice. Vascular surgeons have traditionally performed the

majority of carotid endarterectomy procedures and helped validate carotid revascularization as an effective therapy for stroke prevention. Vascular surgeons have recently gained experience in percutaneous catheter-based therapies and increasingly utilize the endovascular approach to treat a wide variety of peripheral vascular disorders. As carotid stenting has emerged as an alternative for patients at increased risk for surgery, it is appropriate that vascular surgeons will have a significant role in this important therapy for carotid femoralization disease. Similarly, physicians trained in vascular medicine frequently manage extracranial cerebrovascular disease, which is an essential element in the care of their patients with generalized vascular disease. Vascular medicine physicians, trained as interventionalists, will also emerge as an alternative for treatment of carotid disease.

The purpose of this document is to provide recommendations regarding physician training and credentialing to factor in the safe and orderly dissemination of this new therapy into clinical practice. Prior to undertaking focused training in carotid angiography and carotid stenting, physicians should first comply with the recommendations outlined in the recently published Clinical Competence Statement on Vascular Medicine and Catheter-Based Peripheral Vascular Interventions.⁵ Our document should be viewed as an extension of that earlier competence statement on peripheral vascular interventions and should be considered to represent the minimum requirements for training and preparation to perform carotid angiography and carotid stenting.

RATIONALE FOR A TRAINING AND CREDENTIALING STATEMENT IN CAROTID STENTING

The emergence of carotid stent placement as an accepted alternative to high surgical risk carotid endarterectomy has been facilitated by device innovation, refinements of technique, and careful patient selection. A carotid revascularization involves interventional skills, equipment, and clinical management skills that differ significantly from

Completion of Interest note

This document was approved by the Society for Cardiovascular Angiography and Intervention Board of Trustees in September 2004, the Society for Vascular Surgery Board of Trustees in October 2004, and the Society for Vascular Medicine and Endovascular Board of Trustees in October 2004. This document was endorsed by the American College of Cardiology Foundation Board of Trustees in October 2004. This document was endorsed by the Society for Clinical Vascular Surgery Executive Council in December 2004.

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Virtual Simulator is getting recognized

Paper to prove effectiveness

Approval of Virtual Reality Training for Carotid Stenting

What This Means for Procedural-Based Medicine

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by experienced physicians during an actual clinical procedure.

SPECIAL COMMUNICATION

Clinical competence in carotid stenting: Training and recommendations

A Report of the SCAI/SVMB/Clinical Competence Statement

INTRODUCTION

Percutaneous carotid intervention with distal protection is a rapidly emerging field that is being integrated into interventional cardiovascular, vascular medicine, and interventional radiology practice. The recently published SAPHIRE trial has established carotid stenting in high-surgical risk patients as an alternative to carotid endarterectomy.¹

Contemporary techniques for carotid stenting with distal protection were developed by multiple specialties including interventional cardiologists, vascular surgery, interventional radiologists, and vascular medicine. The transfer of technology, interventional skills, and medical therapies perfected in their own peripheral vascular experience.^{1,3}

Cardiologists, as board-certified cardiovascular specialists, have recognized the systemic nature of atherosclerotic disease and appropriately taken an increasingly active role in the management of noncardiac diseases, including stroke prevention. Comprehensive and coordinated management of cardiovascular (both cardiac and noncardiac) has become the standard of care in contemporary clinical and interventional practice. Vascular surgeons have traditionally performed

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doi:10.1016/j.jvs.2004.12.009

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training on patients has raised concern among the public about how physicians learn to safely perform new, potentially minimally-invasive procedures such as carotid stenting.

From the Society for Vascular Surgery

Computer simulation as a component of catheter-based training

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Introduction: Computer simulation has been used in a variety of training programs, ranging from airline piloting to general surgery. In this study we evaluate the use of simulation to train novice and advanced interventionalists in catheter-based techniques.

Methods: Twenty-one physicians underwent evaluation in a simulator training program that involved placement of a carotid stent. Five participants were highly experienced in catheter-based techniques (>300 percutaneous cases), including carotid angioplasty and stenting (CAS); the remaining 16 participants were interventional novices (<5 percutaneous cases). The Procedicus VIST simulator, composed of real-time vascular imaging simulation software and a tactile interface coupled to angiographic catheters and guide wires, was used. After didactic instruction regarding CAS and use of the simulator, each participant performed a simulated CAS procedure. The participant's performance was supervised and evaluated by an expert interventionalist on the basis of 50 specific procedural steps with a maximal score of 100. Specific techniques of guide wire and catheter manipulation were subjectively assessed on a scale of 0 to 5 points based on ability. After evaluation of the initial simulated CAS procedure, each participant received a minimum of 2 hours of individualized training by the expert interventionalist, with the VIST simulator. Each participant then performed a second simulated CAS procedure, which was graded with the same scale. After completion, participants assessed the training program and its utility via survey questionnaire.

Results: The average simulated score for novice participants after the training program improved significantly from 17.8 ± 15.6 to 69.8 ± 9.8 ($P < .01$), time to complete simulation decreased from 44 ± 10 minutes to 30 ± 8 minutes ($P < .01$), and fluoroscopy time decreased from 31 ± 7 minutes to 23 ± 7 minutes ($P < .01$). No statistically significant difference in score, total time, or fluoroscopy time was noted for experienced interventionalists. Improvement was noted in guide wire and catheter manipulation skills in novices. Analysis of survey data from experienced interventionalists indicated that the simulated clinical scenarios were realistic and that the simulator could be a valuable tool if clinical and tactile feedback were improved. Novices also thought the simulated training was a valuable experience, and desired further training time.

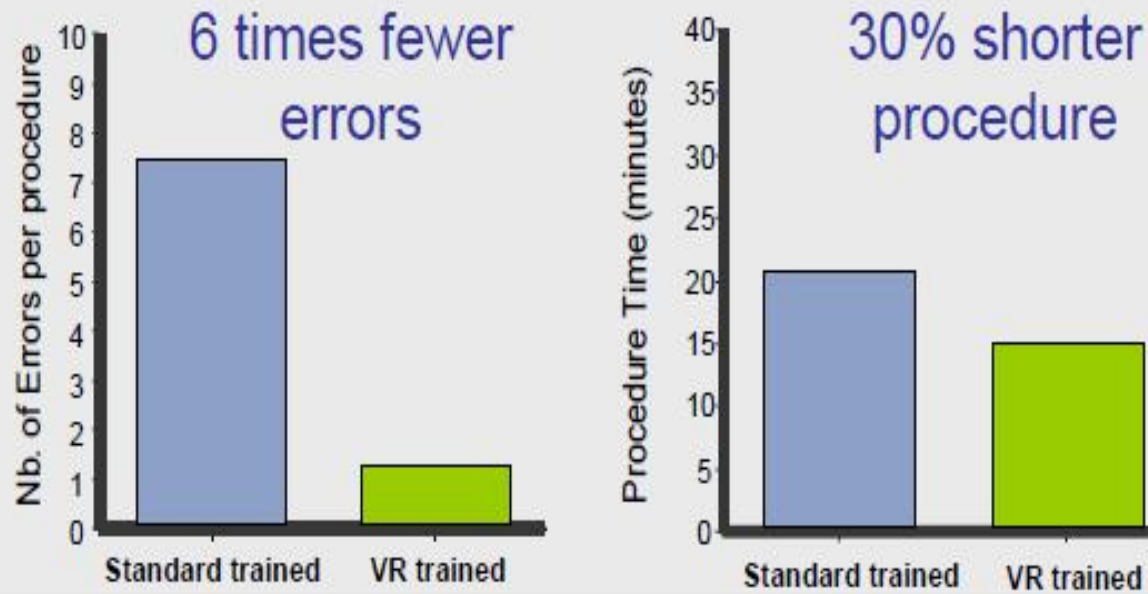
Conclusions: An endovascular training program using the Procedicus VIST haptic simulator resulted in significant improvement in trainee facility with catheter-based techniques in a simulated clinical setting. Novice participants derived the greatest benefit from simulator training in a mentored program, whereas experienced interventionalists did not seem to derive significant benefit. (J Vasc Surg 2004;40:1112-7.)

Since 2003, the EAES has started to offer a CME-accredited training course that uses a simulator that was built and designed to their specification.



Đào tạo trên mô hình trong y học

Benefit of training on a simulator before performing a first intervention on a real patient:



Ưu điểm của đào tạo trên mô hình

- ✓ **Không gây nguy cơ cho bệnh nhân và không gây áp lực cho người thực hành**
- ✓ **Có thể thực hiện lại trên nhiều ca và các tình huống khác nhau.**
- ✓ **Thực hành đến khi đạt được mức an toàn và nhanh**
- ✓ **Đánh giá mục tiêu cần đạt**
- ✓ **Linh hoạt trong thiết lập các chương trình đào tạo**

TRI Computer Simulator

The first virtual simulator dedicates for TRI training

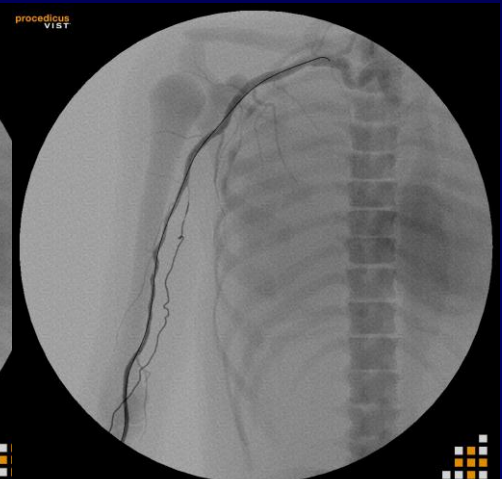
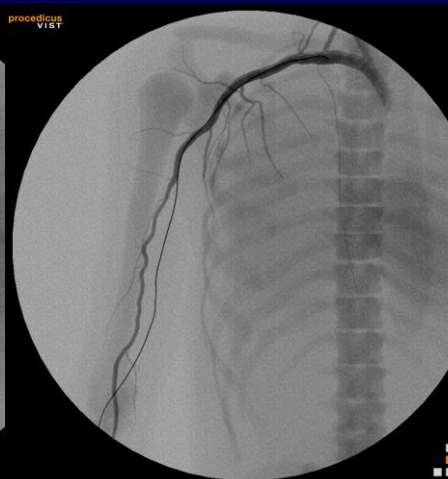
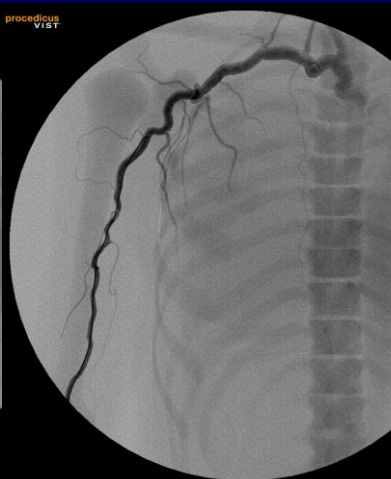
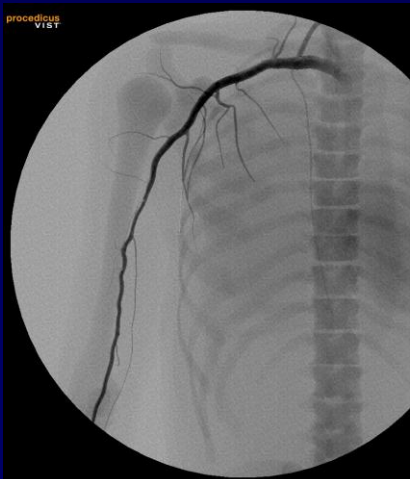
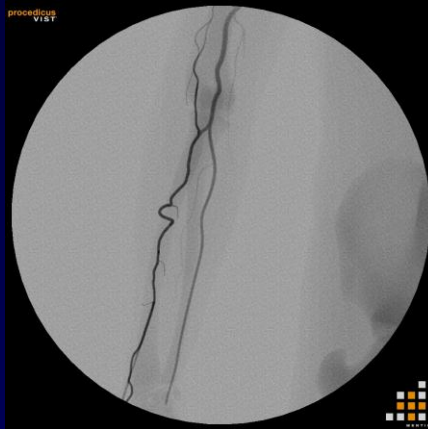


Lý do thực hành can thiệp qua đường mạch quay trên mô hình

- ✓ Qua đường mạch quay trong chẩn đoán và can thiệp tim mạch giảm thiểu biến chứng tại vị trí chọc mạch đặc biệt ở những BN nguy cơ cao và đem lại sự thoải mái cho BN.
- ✓ Tuy nhiên can thiệp qua đường ĐM quay khó hơn qua đường ĐM đùi nên cần có sự đào tạo từng bước
- ✓ Một số biến chứng nặng có thể xảy ra do thiếu kinh nghiệm.

To learn safe transradial approach

→ include variety of anatomies



32 simulators are active in the world

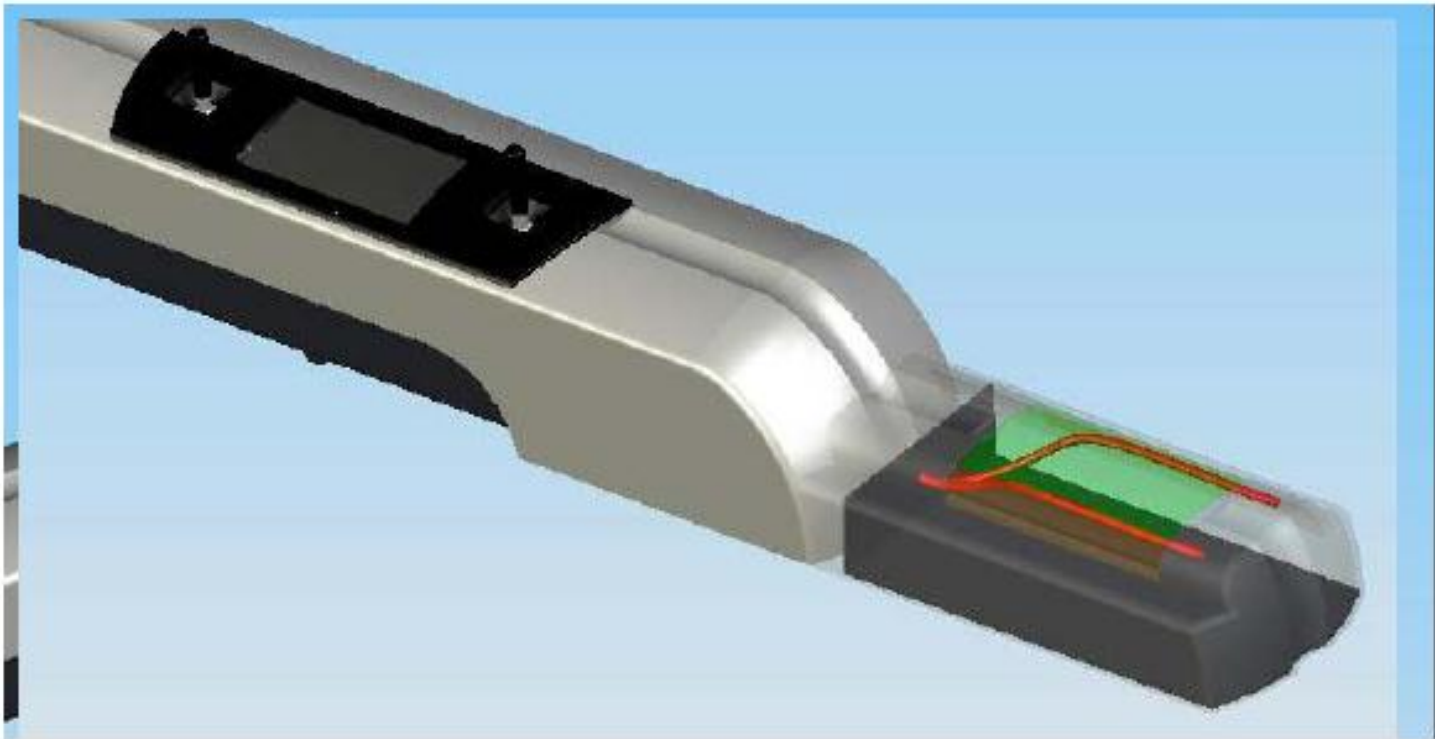


- **Fellows, TRI beginners training**
- **Inter company training (Sales, engineers ...)**

Cấu tạo mô hình can thiệp qua đường ĐM quay

TRI Simulator Features

1. Puncture: pulsatile air compressed flow



TRI Simulator Features



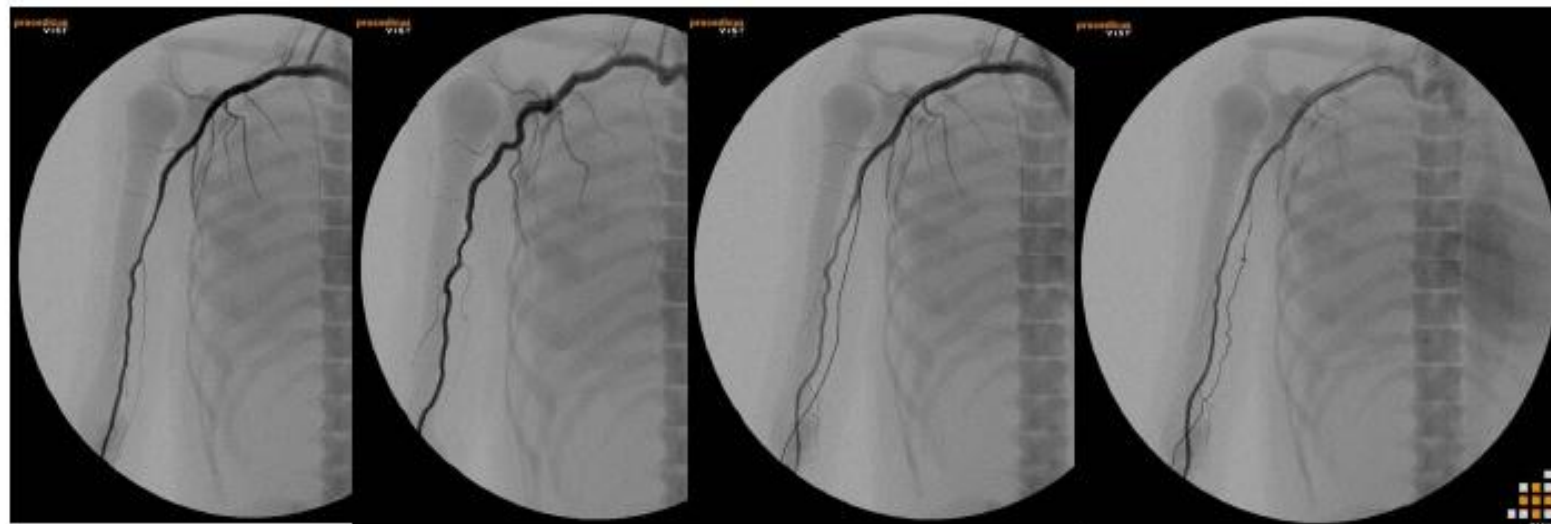
Different radial anatomies
To learn typical difficulties with TRA



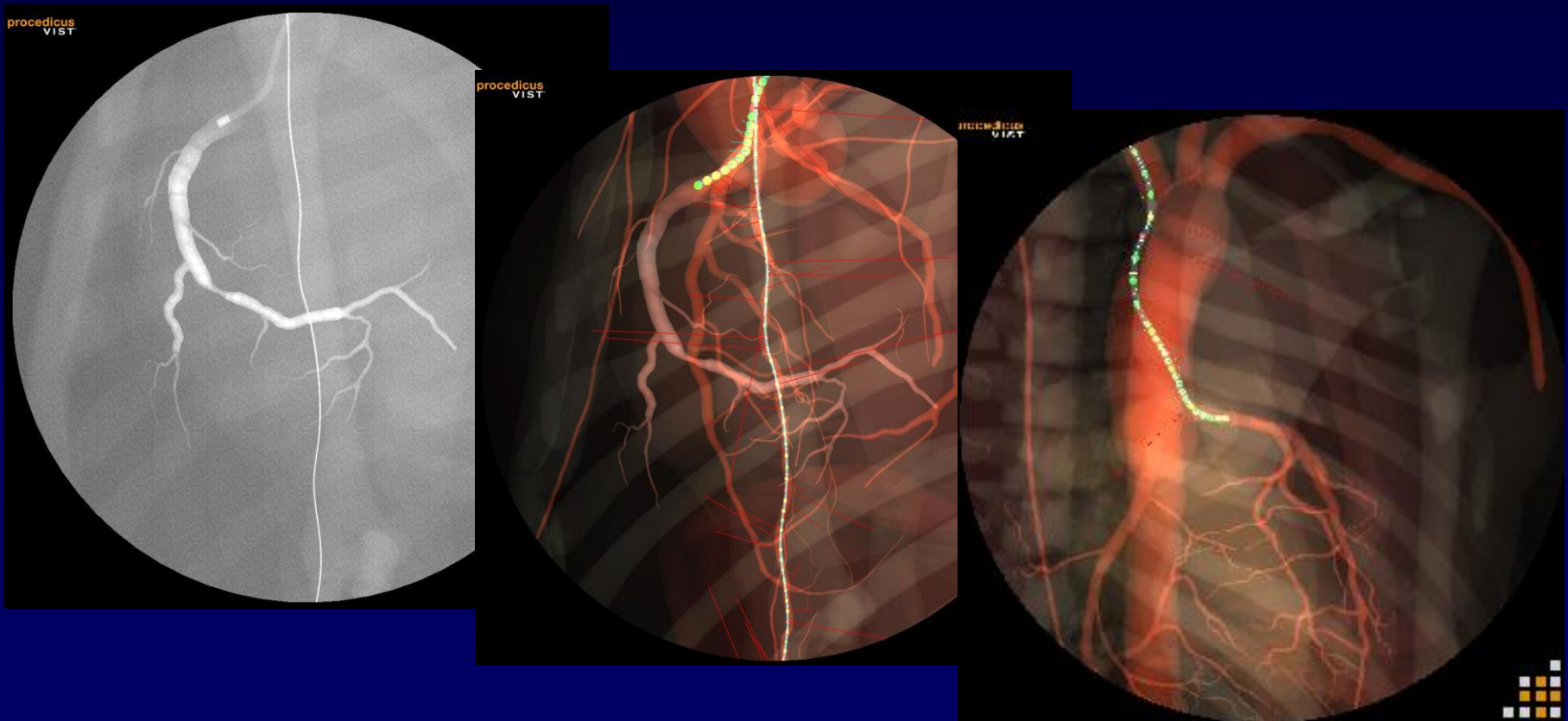
TRI Simulator Features

Different humeral and axillary anatomies

To learn typical difficulties with TRA



Hai dạng hình ảnh (Cine and 3D) Học cách nhìn các góc độ và vị trí hỗ trợ của Guiding Catheter



VR TRI Simulator by TERUMO®



Easy to use, close to the real world PCI

Journal | **Table/Fluoro** | **Tool Selection** | **Cineloop** | **Roadmap** | **About** | **Exit**

CASE 1
TRANSRADIAL APPROACH

PATIENT DESCRIPTION

Patient ID: MST-TERC001
Age: 42 years
Gender: Male
Height: 69.3 in, 176 cm
Weight: 209 lbs, 78kg

RISC FACTORS WITH PROCEDURE

Current smokers,
Hypercholesterolemia


CLINICAL PRESENTATION

De novo angina pectoris, during effort 3 times during the 2 last weeks, spontaneous chest pain after dinner last night, lasting 10 minutes. Cardiologist consultation this morning, negative T wave in V5-V6 ECG leads, Troponin I = 4.2 ng/ml.


Clinical examination normal.

Angiography showed a LCX lesion.


Projection 1 AP



Projection 2 RAO 30



Projection 3 LAO 90




Contributing to Society Through Healthcare

VR TRI Simulator by TERUMO®



Journal **Table/Fluoro** Tool Selection Cineloop Roadmap About Exit



Fluoroscope, C-arm

UP DOWN CRA LAG CAU RAO

Table

LAO 30 AP RAO 30 Save Load

Fluoroscope Mode

- Positive XRay
- Negative XRay
- 3D view

Zoom

Auto

Gamma

VR TRI Simulator by TERUMO®



Journal | Table/Fluoro | **Tool Selection** | Cineloop | Roadmap | About | Exit

Guide Wires

-0.035"

RADIFOCUS®

-0.025"

RADIFOCUS®

-0.014"

Runthrough NS
PTCA Guide Wire

Balloon Expandable Stents

-0.014"

CORONARY STENT SYSTEM
Tsunami™

Nobori™

Catheters

-5F Guiding Catheters

Heartrail™

-6F Guiding Catheters

Heartrail™

-7F Guiding Catheters

Heartrail™

Dilatation Catheters

-0.014"

PTCA Dilator Catheter
RyujinPlus

Cancel

Những hạn chế của mô hình

✓ Ống thông can thiệp nhìn mềm hơn so với thực tế

Hãy:

✓ Đưa các dụng cụ chậm

✓ Không rút bằng tay phải

✓ Không đưa 0.014" GW đến tận cùng mạch máu để tránh biến chứng

TRI basic tips & tricks

Các bước chuẩn bị cho can thiệp qua đường ĐM quay

- Allen's test
- Giải phẫu của ĐM dưới đòn và ĐM cảnh?
- Kiểm tra HA hai tay có khác biệt?
- Phân tích các sai số có thể gặp sau này?
- Khả năng dùng ĐM quay cho CABG?
- Nếu cần dùng Guiding catheter hỗ trợ tốt hơn?
- Raynaud's Disease

Allen's test

Positive:

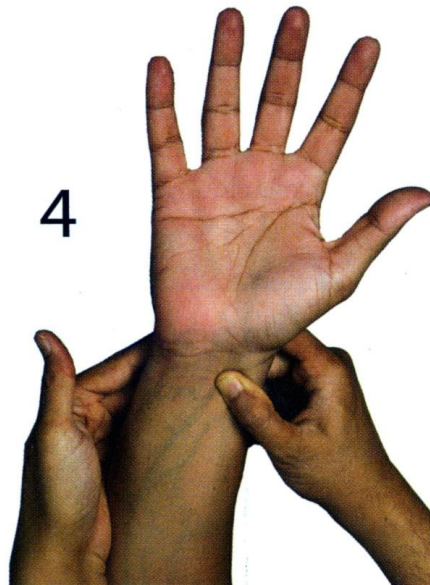
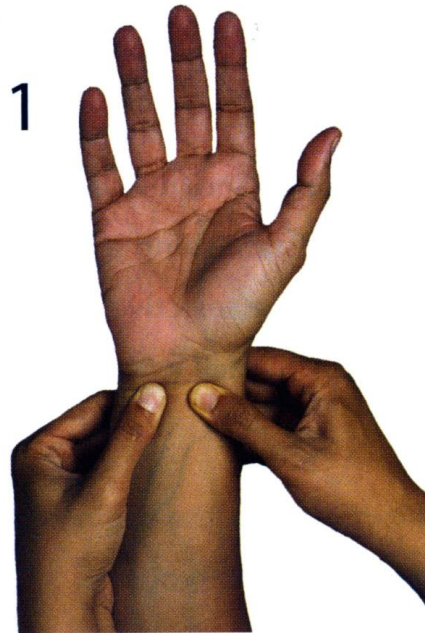
The normal palm color return within 5sec

Negative (Borderline) :

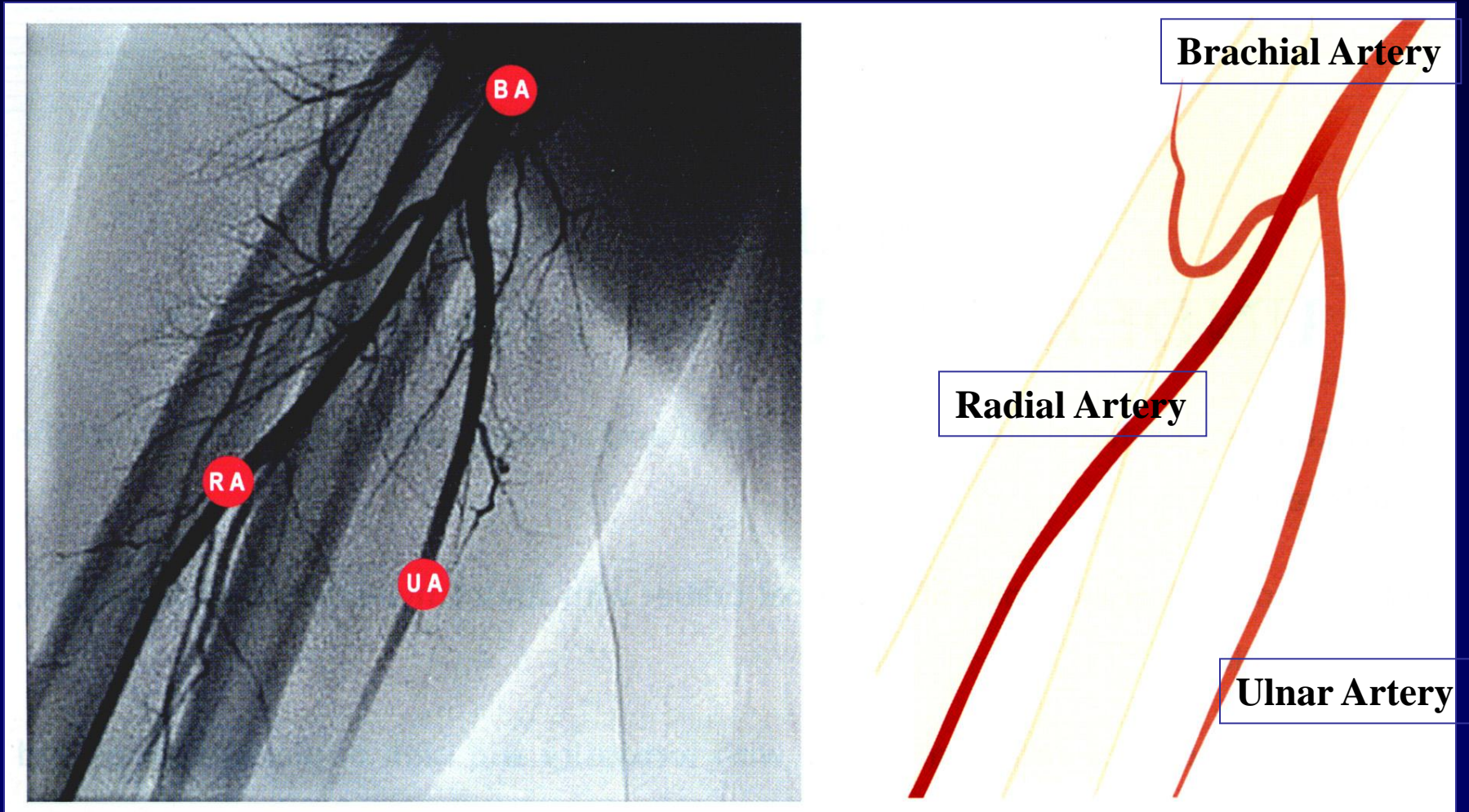
The normal palm color return within 5sec – 9Sec

Negative :

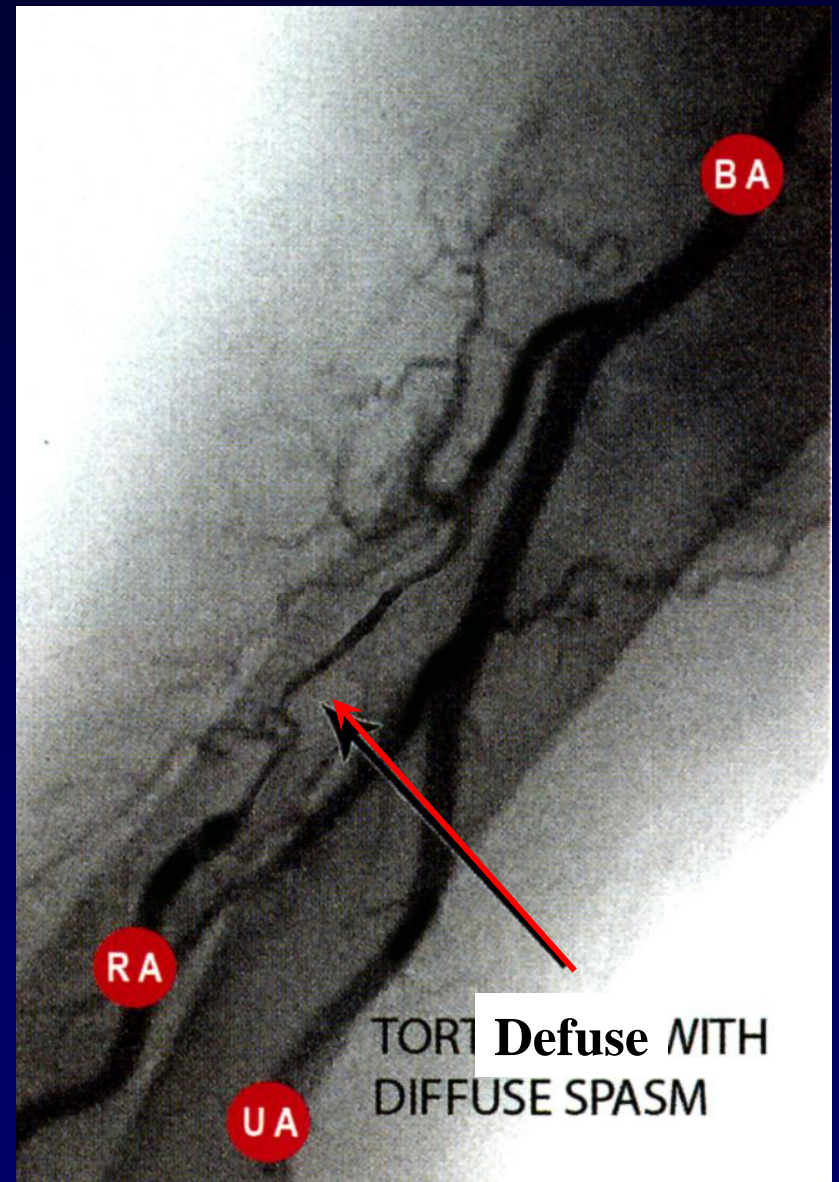
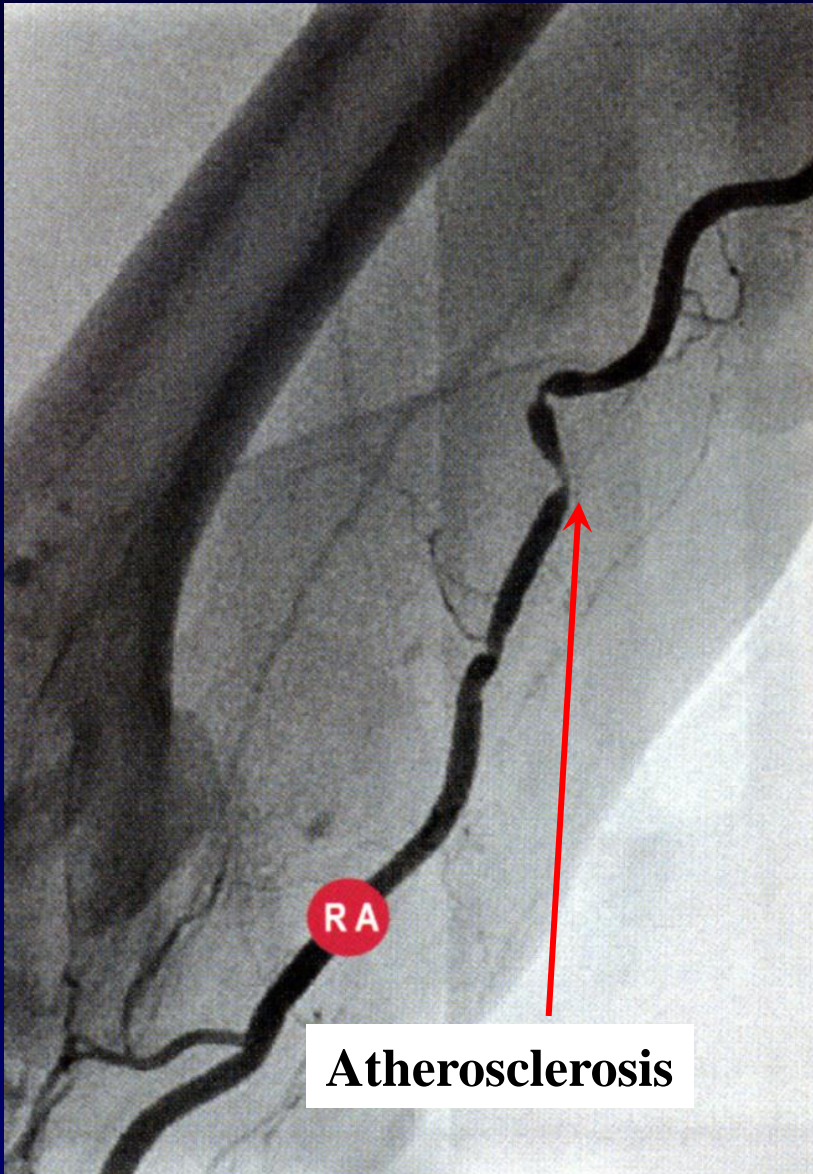
The normal palm color return within more than 10 min.



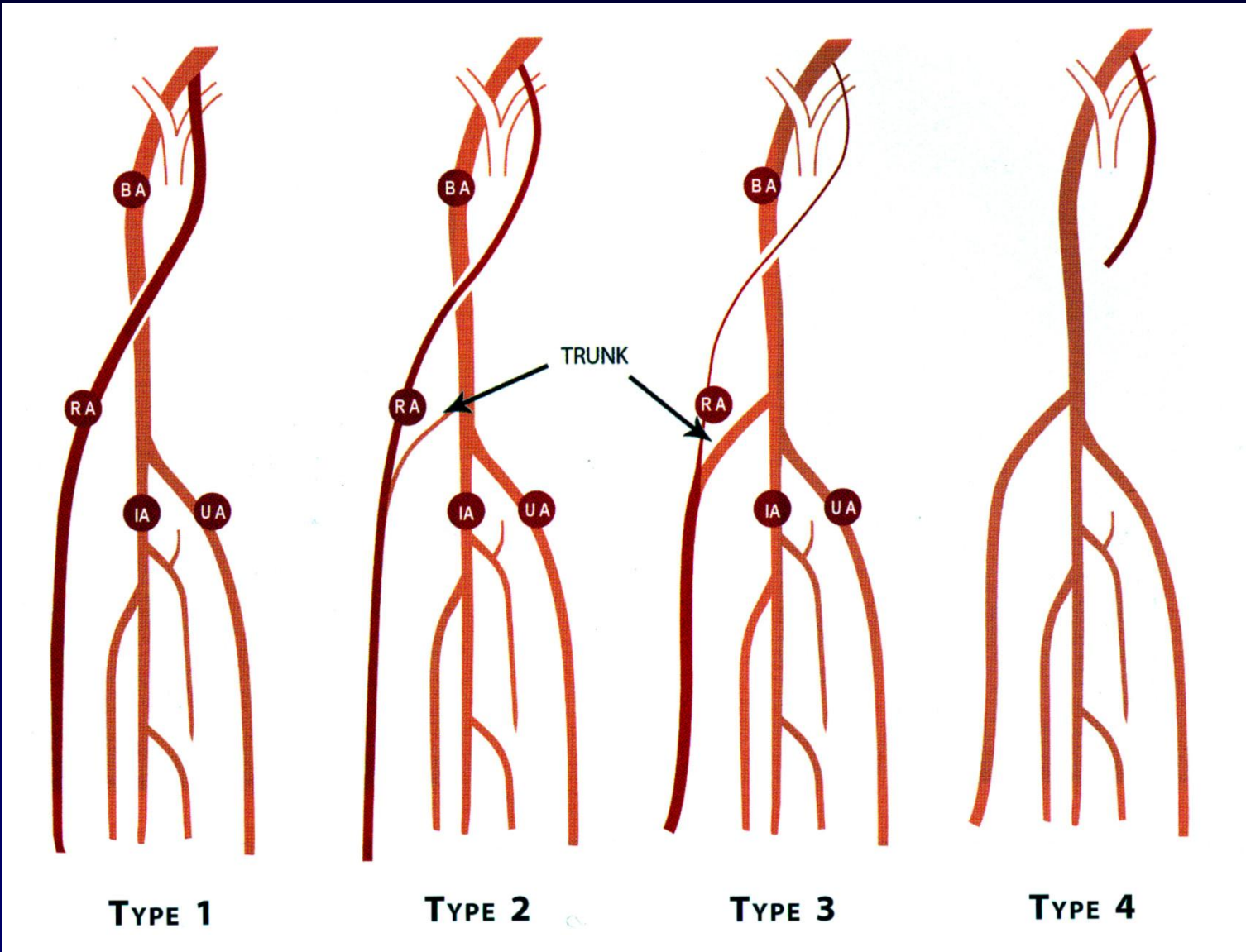
Giải phẫu ĐM quay



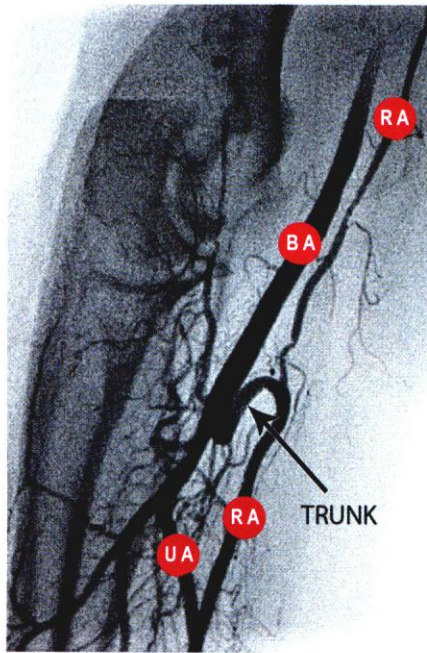
Co thắt ĐM quay



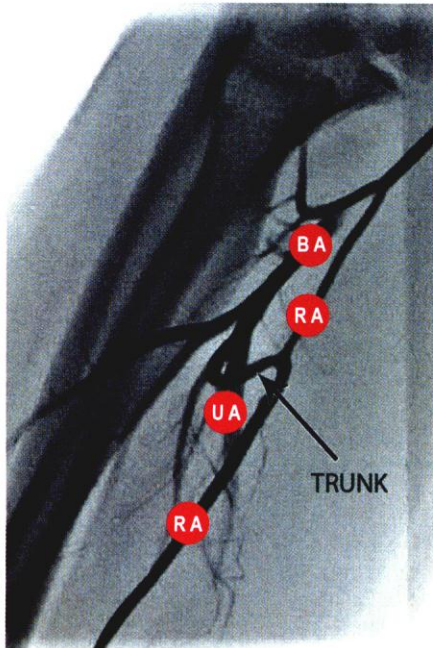
Các dạng giải phẫu của ĐM quay



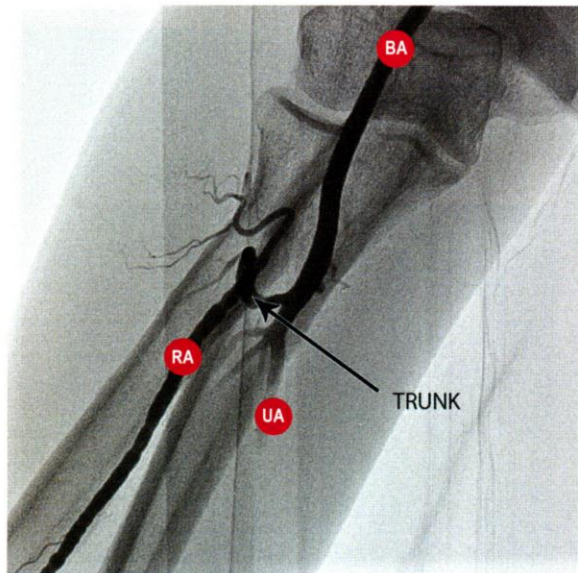
Type 2 trunk



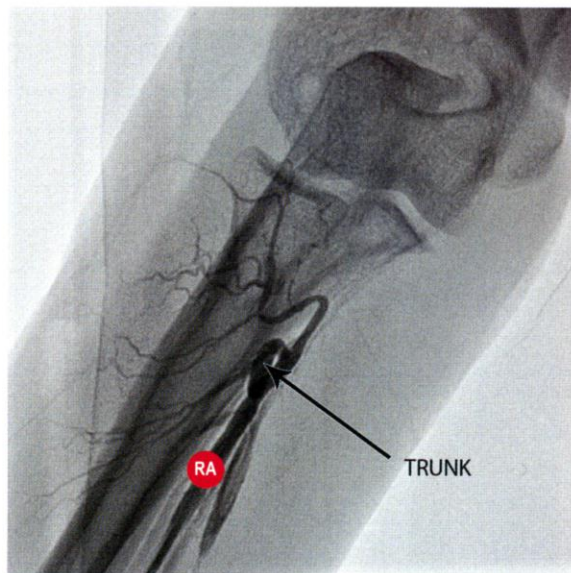
This may be aware that the Guide wire does not go through up-to the Brachial artery.



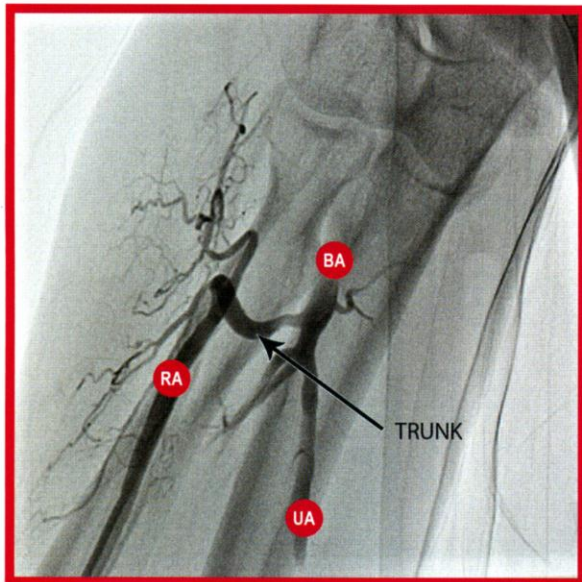
The artery will straighten by careful Guide wire proceeding under fluoroscopy



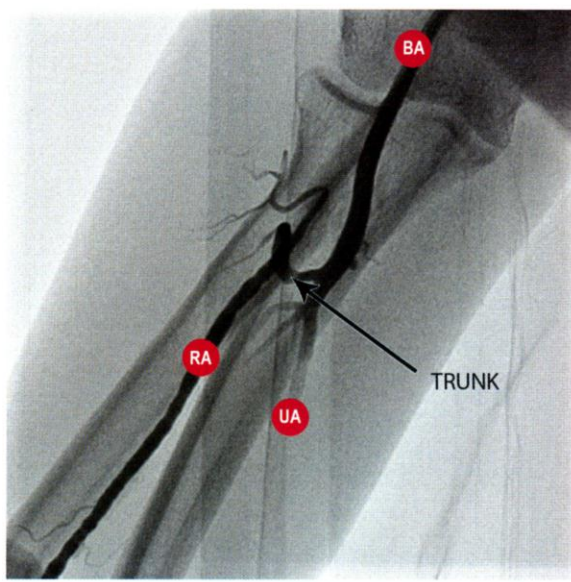
VIEW 1



VIEW 2



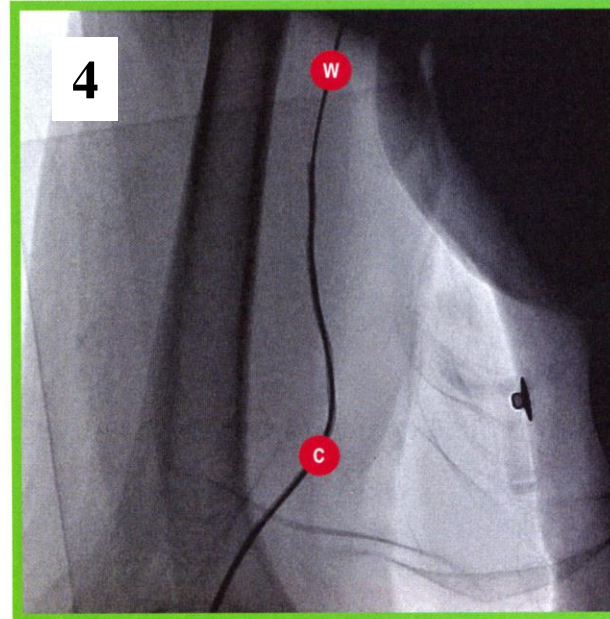
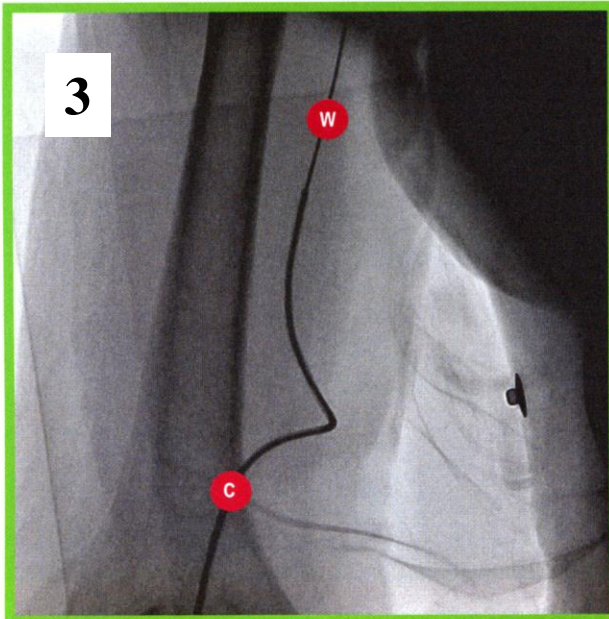
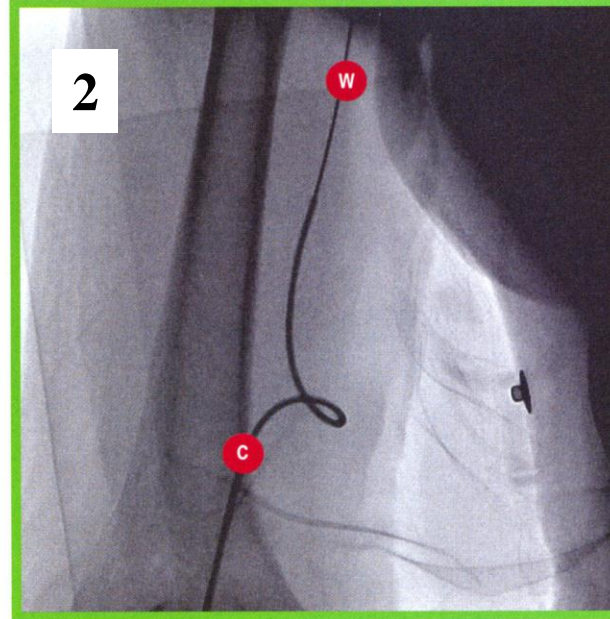
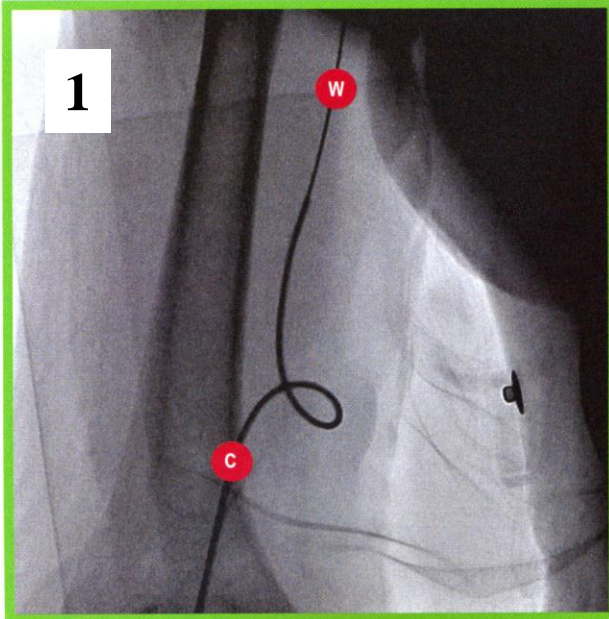
VIEW 3



VIEW 4

**Loop ⇒
Check anatomy by
changing View
angle**

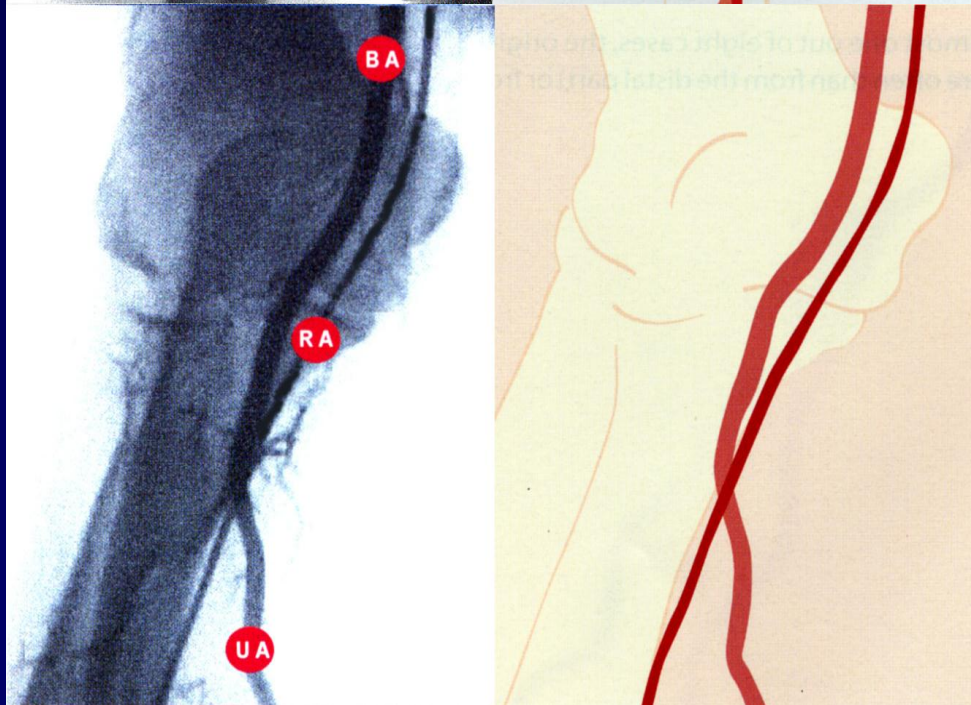
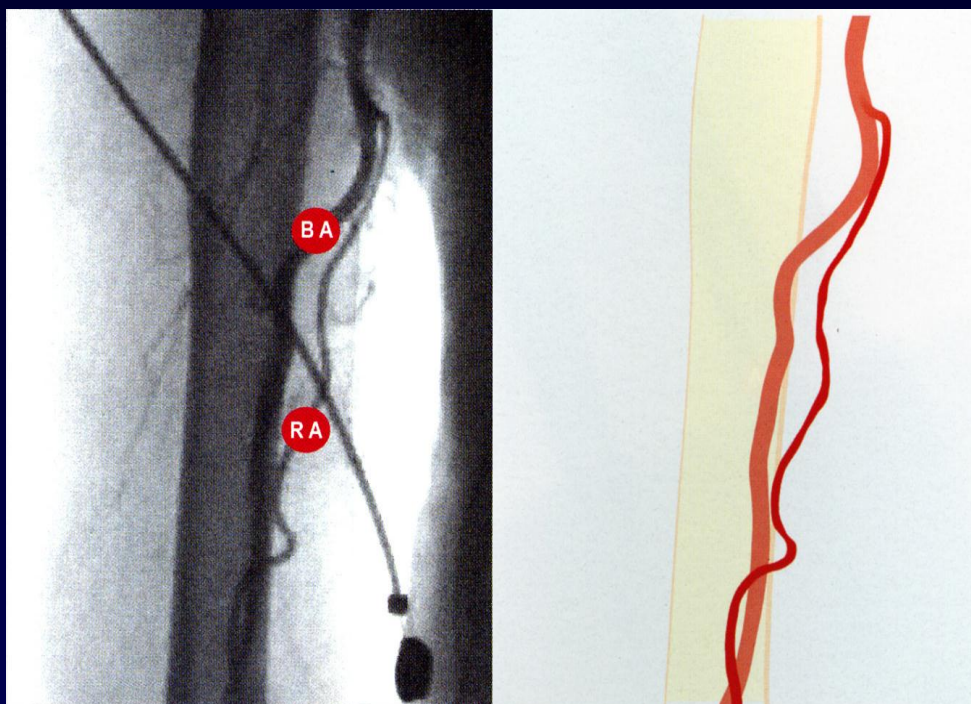
**View 3 is the best
angle to see the
straighten the
loop.**



**Loop⇒
It can be
straighten by
guide wire.**

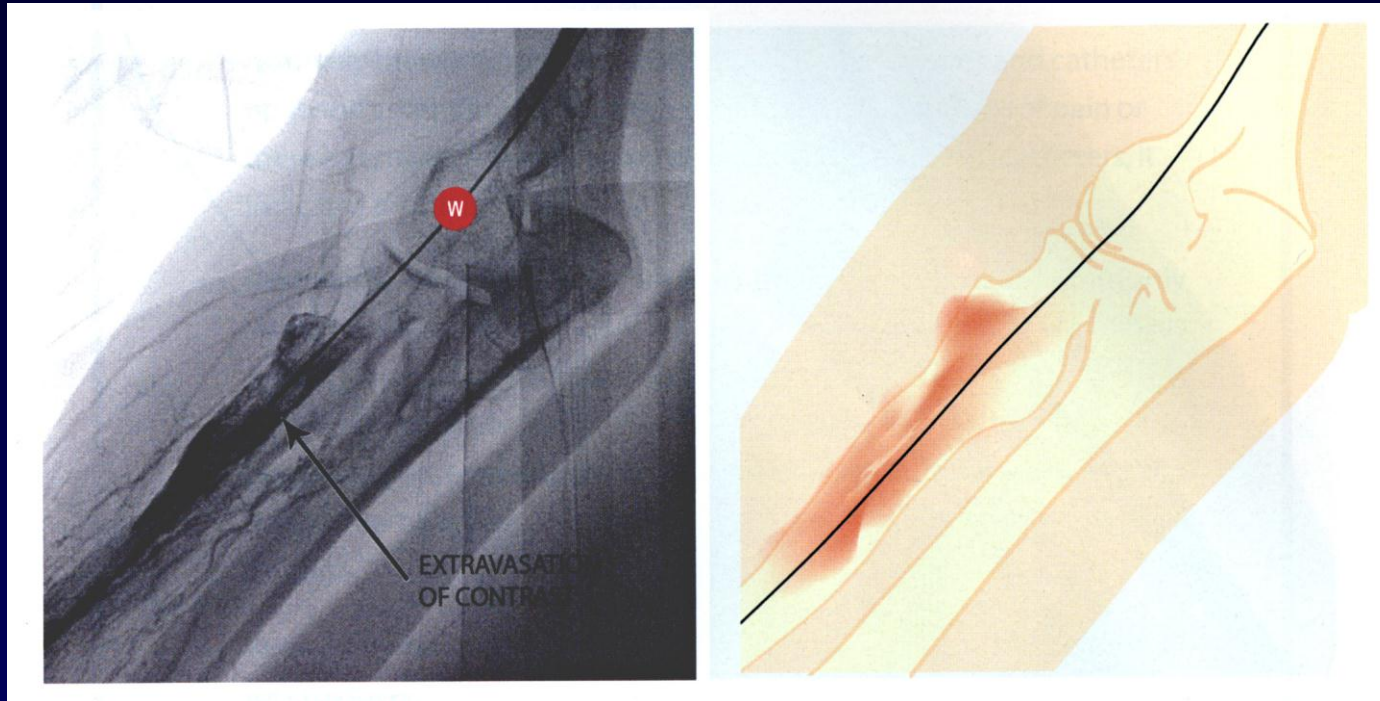
**Hydrophilic,
floppy tip type
Guide wire
should be used.**

High take-off



Guide wire can pass through as normal but you may feel resistance for the catheter. Mostly it finds by angio.

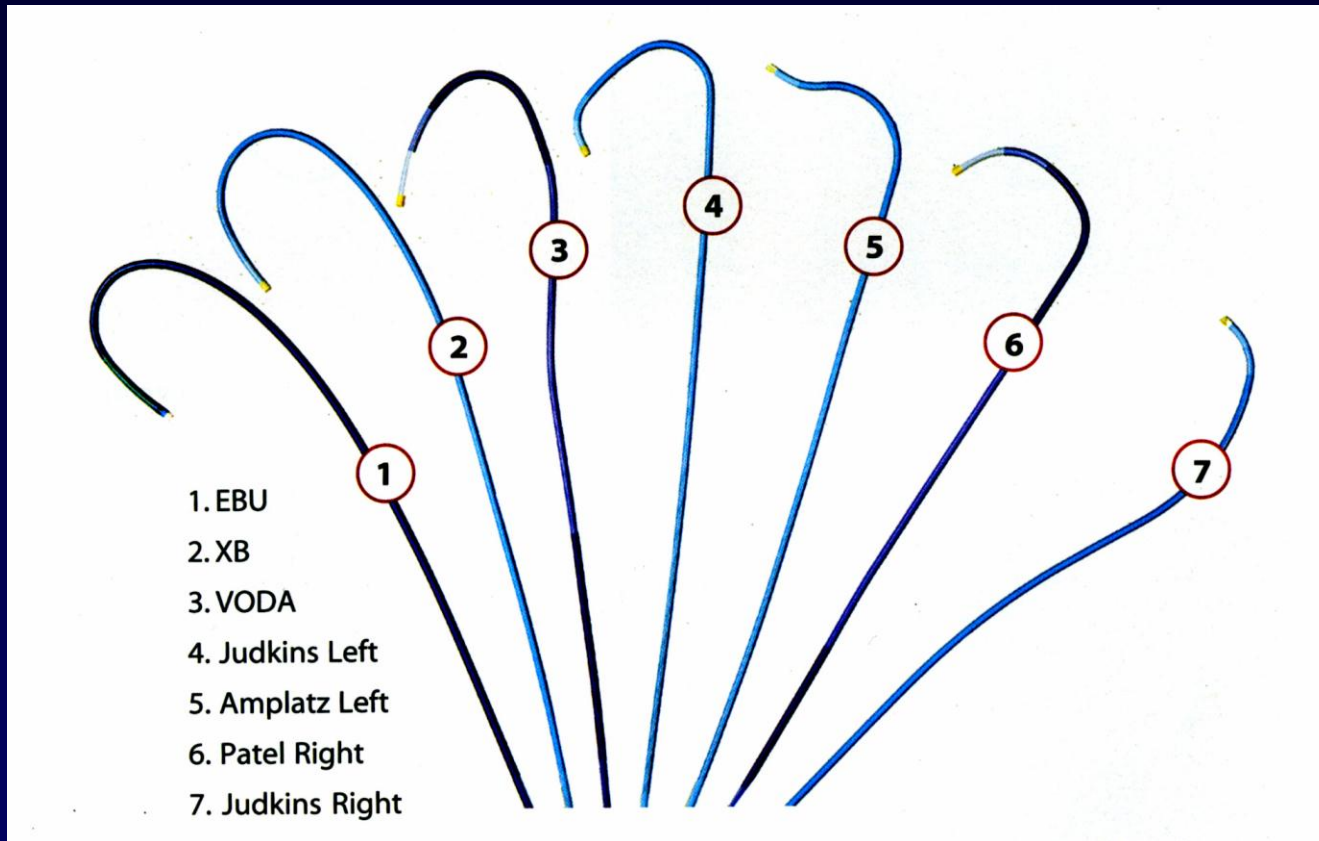
Vỡ ĐM quay



(PATEL'S ATLAS of TRANSRADIAL INTERVENTION: The Basics)

- Đưa GW dưới sự hướng dẫn của màn hình.
- Sheath đưa theo GW chỉ khi xác định đầu GW đã tới ĐM cánh tay.
- Thông thường BN sẽ không đau và đưa dụng cụ vào dễ dàng. Không tiếp tục đẩy dụng cụ và tìm nguyên nhân nếu BN đau và có lực cản khi đưa vào.
- Bơm thuốc cản quang để kiểm tra 2- 3 lần. Lần đầu bơm chậm và ngắn để xác định chắc chắn GW nằm trong lòng thật.

Các dạng Guiding Catheter



(PATEL'S ATLAS of TRANSRADIAL INTERVENTION: The Basics)

RCA

- RCA is horizontal or inferior direction at LAO view: **JR4**.
- RCA is superior direction at LAO : **Amplatz left**
- Anterior take off : **Amplatz left**

LCA

- LAD : JL 40, EBU, Voda
- LCX : Amplatz left, Voda
- Multi : Ikari, Tiger

Cách cầm và lái Catheter



- Giữ Catheter bằng hai tay ngang tầm vai và lái bằng cả hai tay cho catheter được đồng trục.
- Nếu catheter không lái được mặc dù đã xoay 90° so với lúc ban đầu thì không nên xoay tiếp để tránh hiện tượng xoắn catheter. Nên thử lái lại cùng với GW.
- Kiểm tra dưới màn hình ở các góc độ khác nhau để chắc chắn đầu catheter đồng trục.

Cách lái Guidewire



- Tay phải dùng để lái GW, tay trái dùng để đẩy và rút GW.
- Tìm góc độ nào rõ nhất bộc lộ được các nhánh bên khi lái wire qua chỗ tổn thương. Cần thận khi thao tác lái wire.
- Không tiếp tục đẩy GW khi đầu bị uốn cong lại, rút GW lại cho đầu GW được tự do và thay đổi hướng của đầu GW.
- Thay đổi các góc khác khi GW không đưa vào nhánh lựa chọn.



Now, try it for yourself !