

Vascular Access in Diabetes

3 MAY 2019

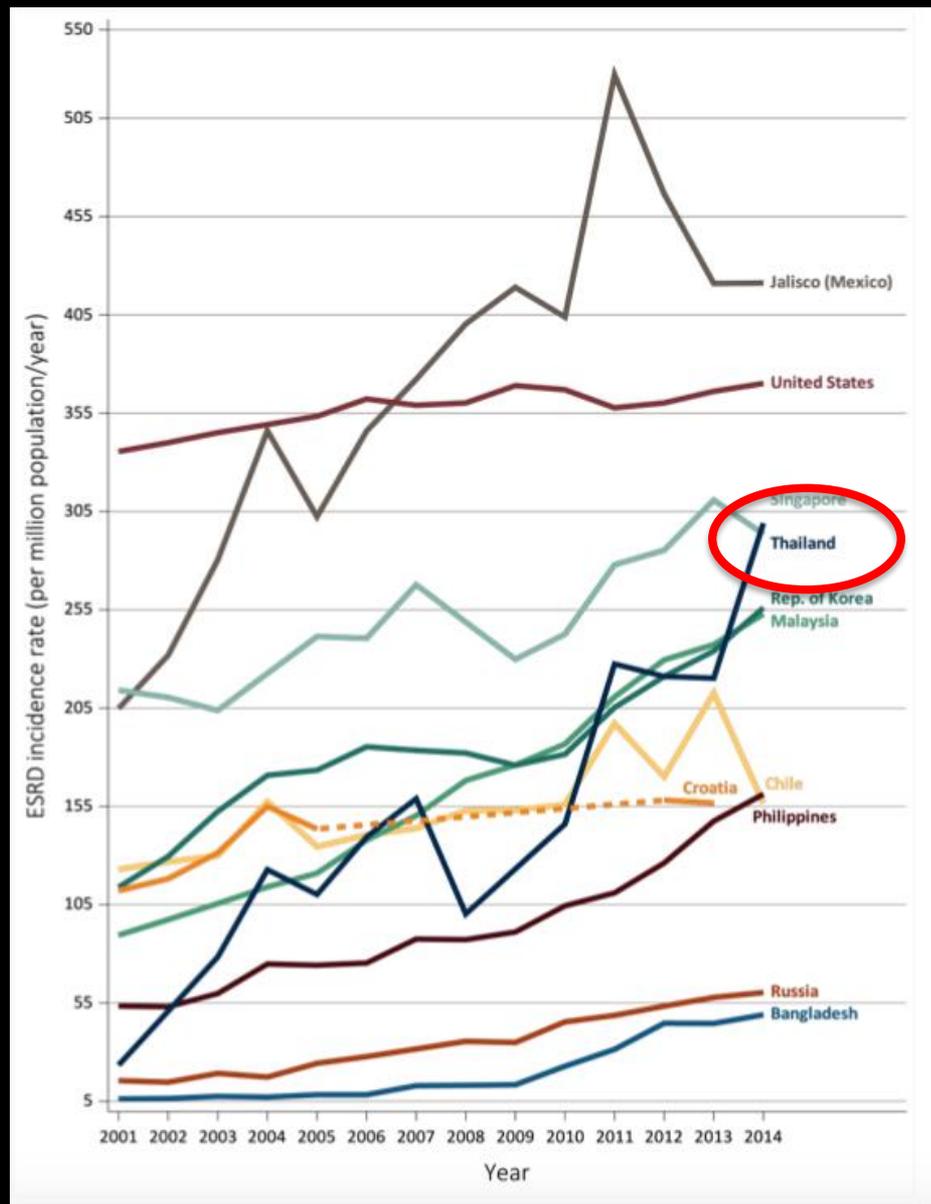
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The greatest increases in diabetes-related ESRD incidence rates from 2001-2014 have occurred in Thailand, Philippines, Malaysia, Korea and Mexico, roughly about 40% .

USRDS Annual Data Report 2016

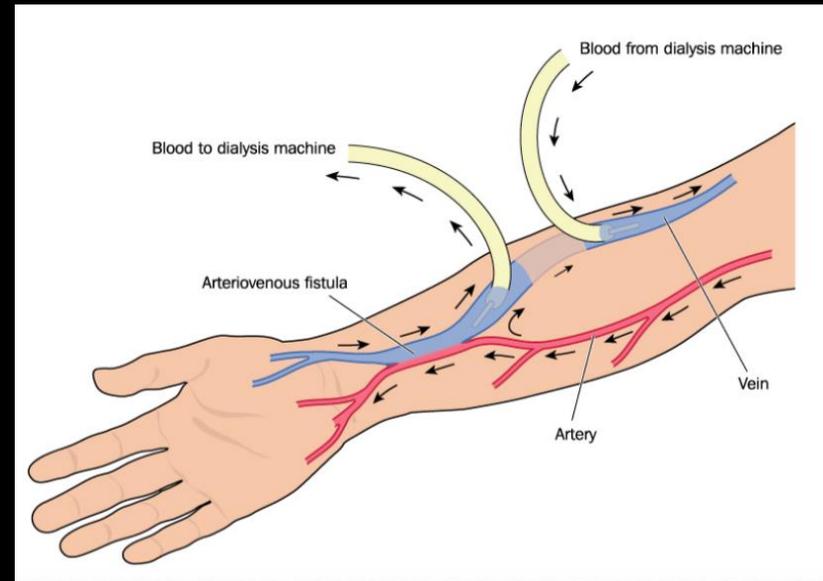


Blood Flow

: An adequate AV flow is a necessary part of the successful HD delivery dose, 300-600 ml/min.

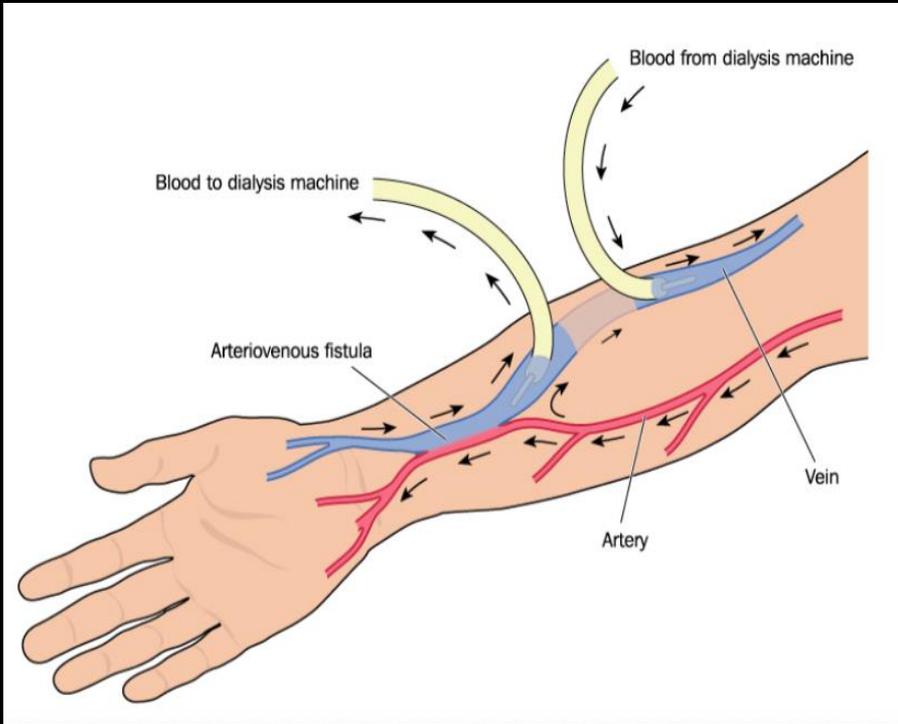
Artery + Vein (superficial)

Vascular anastomosis



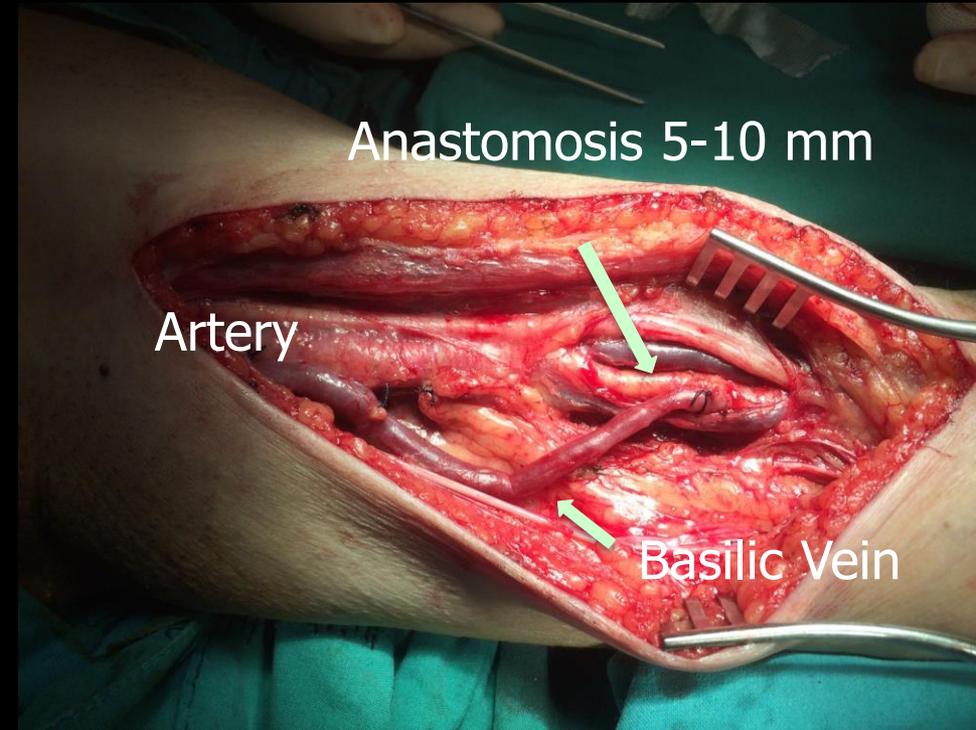
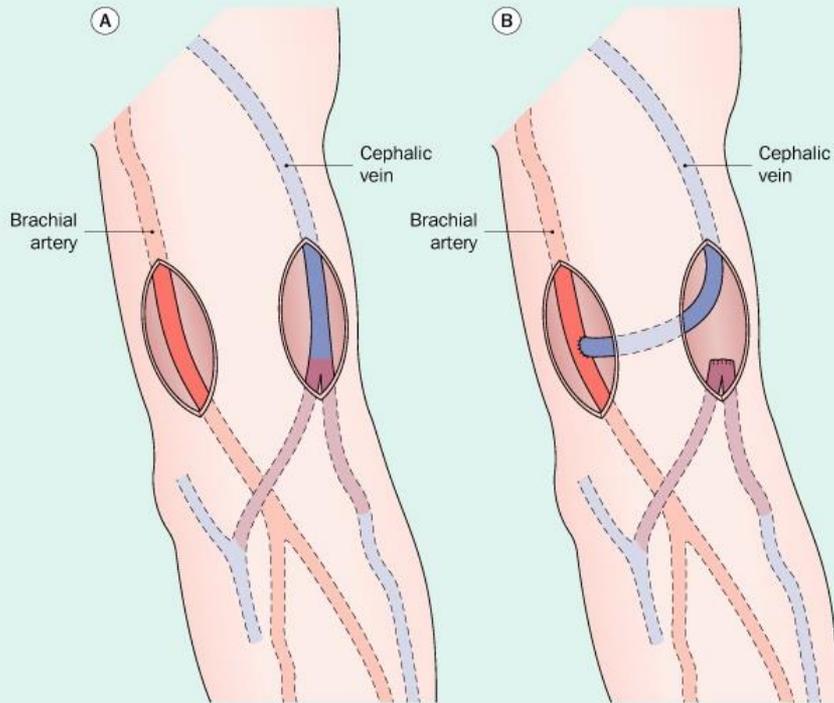
Vascular Access 2008

Operative Technique : Radial artery – Cephalic vein (forearm)



Radial artery to cephalic vein arteriovenous fistula is one of the most common vascular procedure. One of the key success for this operation is an anastomosis which have to be more than 15 mm in length. The smaller/shorter length of anastomosis in this type of operation usually associated with the failure or non-functioning AVF.

Operative Technique : Brachial artery – Basilic vein (upper arm)



Upper arm arteriovenous fistula is the second surgical treatment option. I prefer to use this kind of operation in the patient who have small forearm vein less than 4 mm or the patients who had failed forearm AVF. DM patient usually have associated atherosclerotic obstruction of radial artery also good candidate for upper arm AVF as a first treatment option.

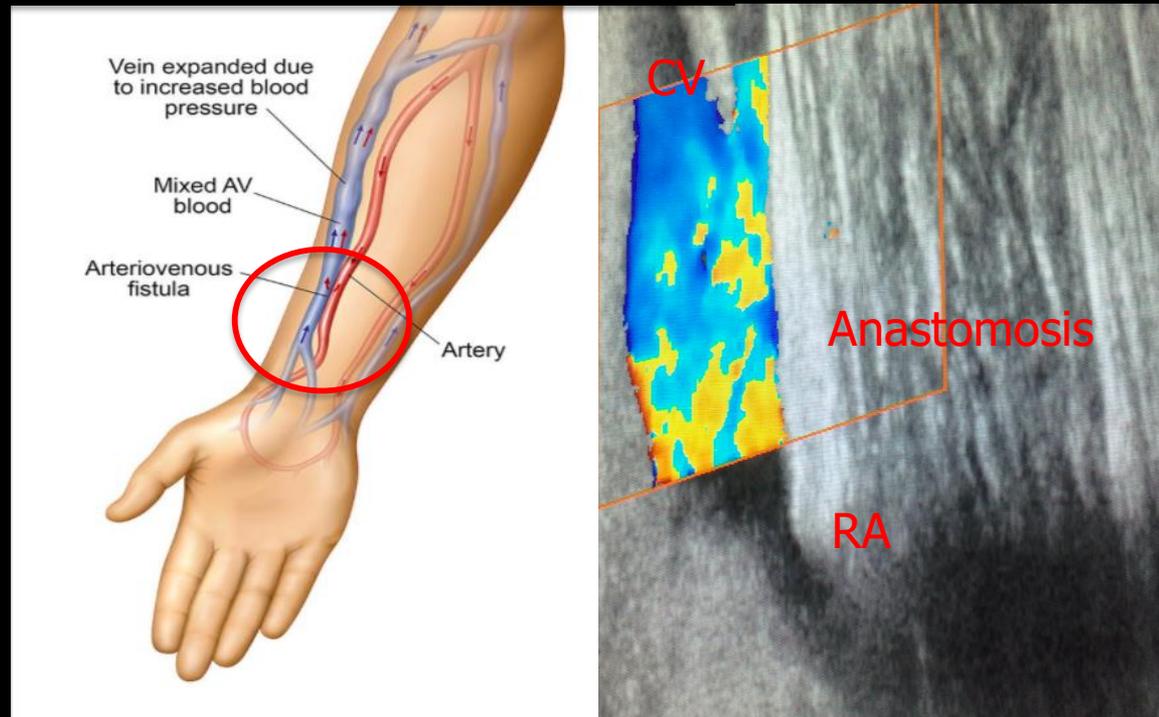
Arterial Physiology

: Vascular adaptation to high flow (AV access surgery)

Blood flow rate in RA before and immediate after AVF surgery was increased from 20 ml/min to 200 ml/min.

In well-developed fistula, blood flow rate reach values of 600-1200 ml/min.

J Am Soc Nephrol 2003



Vascular Calcification

is the result of chronic injurious stimuli associated with multiple metabolic toxicities and their associated reactive oxygen species.

metabolic syndrome

type 2 diabetes mellitus

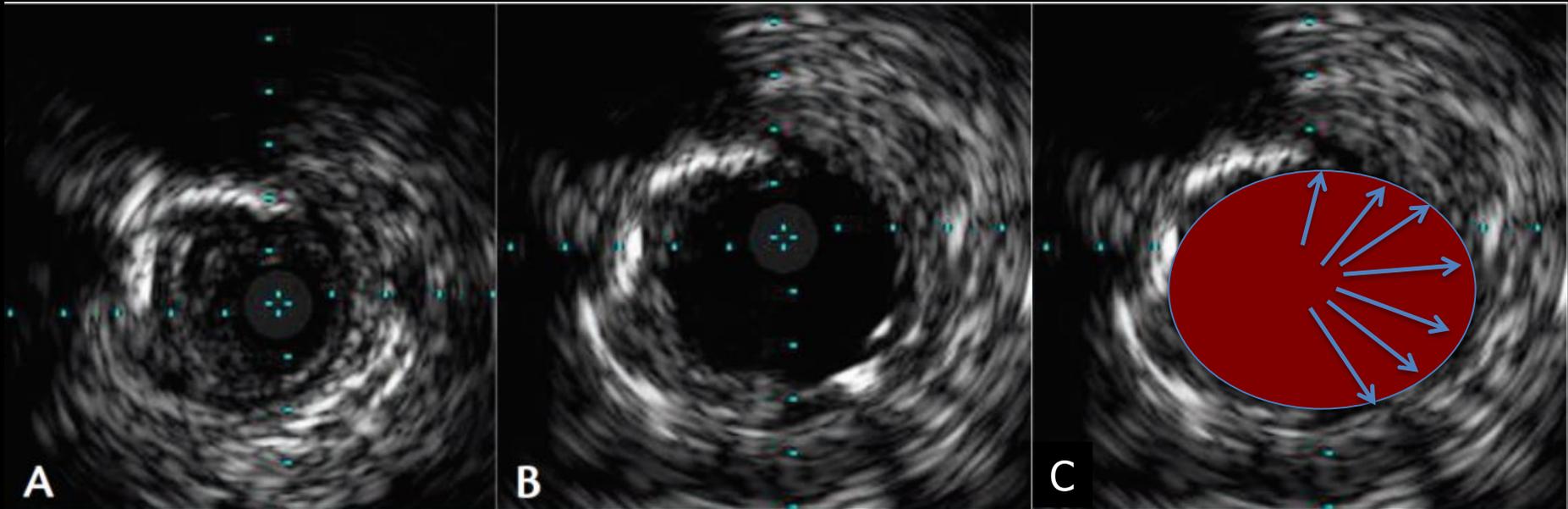
Pathology reveal the cell proliferation and expression of osteopontin in VSMCs

→ **Medial calcification**

Curr Diab Rep. 2003



Arterial Calcification



A Calcified artery with intra-luminal thrombus

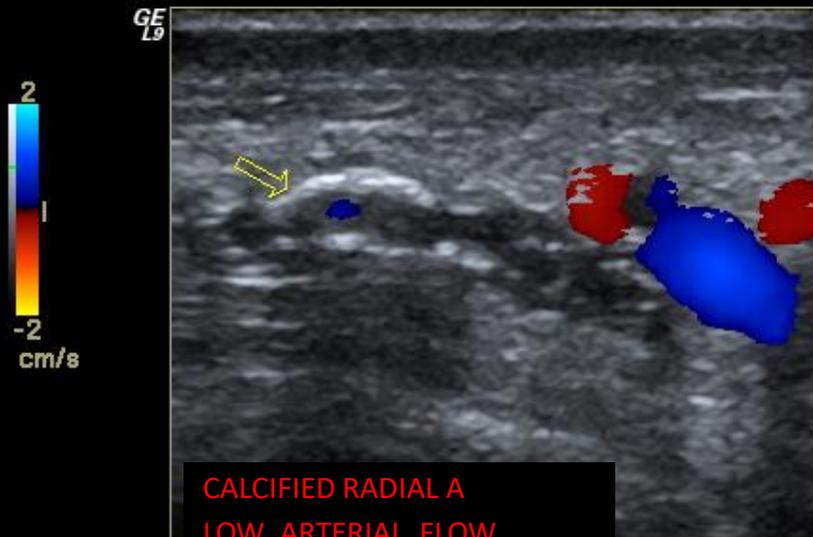
B Debulking of heavily calcified area by atherectomy

C Drug coated Balloon dilatation (DCB) dilatation only affecting area without calcification

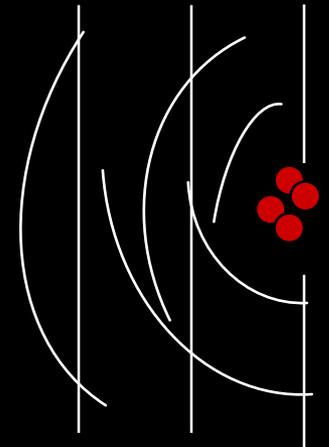
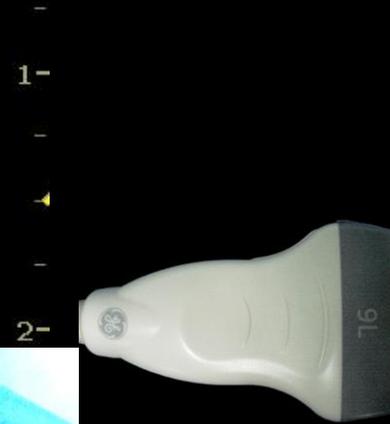
18th Congress of ASVS 2017

From the study model of balloon dilatation at the calcified peripheral artery, we observe that arterial calcification does prohibit arterial wall enlargement . As you know, this adaptation is very important for AV access surgery.

USE Ultrasound



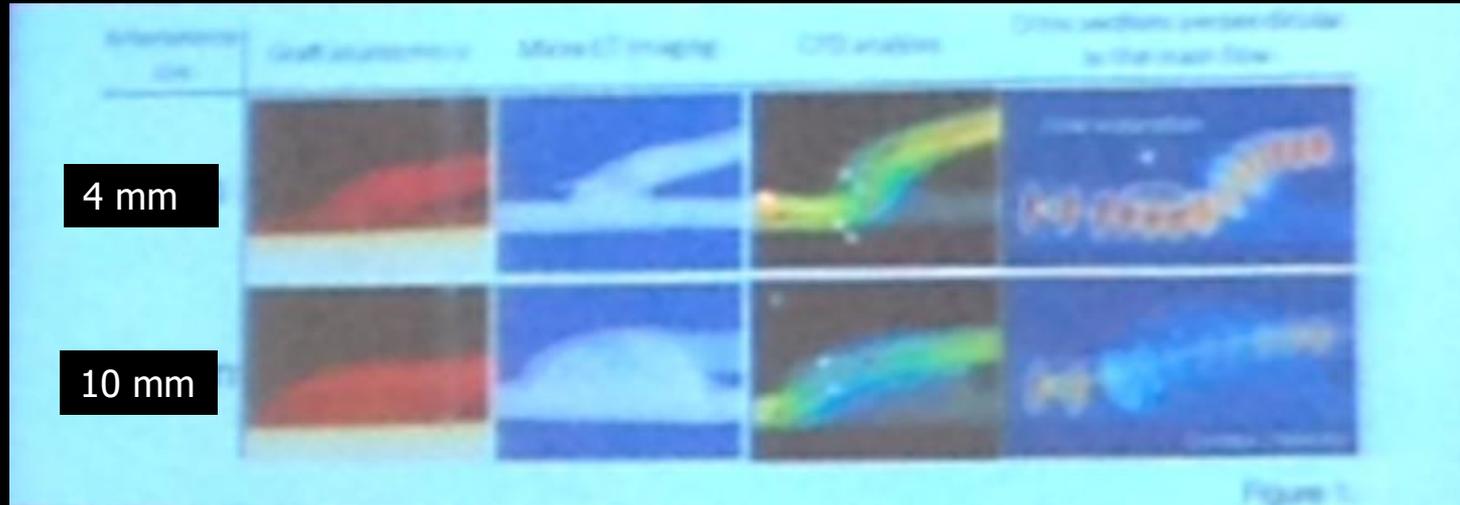
Pre + intraoperative mapping
Easy to use & low cost
Improve operative outcome



As you can see from this slide, there is a circumferential calcification of radial artery which is difficult situation for the surgeon to do an anastomosis. Normally, this situation can be prevented. For now, vascular surgeon will do a preoperative ultrasound or even an intraoperative ultrasound to confirm the size and the absence of vascular calcification before doing a surgical incision.

Longer coronary anastomosis provides better hemodynamic in CABG

Hiroyuki Tsukui Tokyo women's medical university, Tokyo, Japan



Anastomosis is more uniform in 10 mm model.

4 mm model : Sudden change of the blood flow direction at the junction and a flow separation causing congestion and risk of thrombosis

10 mm model : Provides a more streamlined blood flow and faster to recovery to normal in distal coronary artery.

Anastomosis is more uniform in 10 mm model

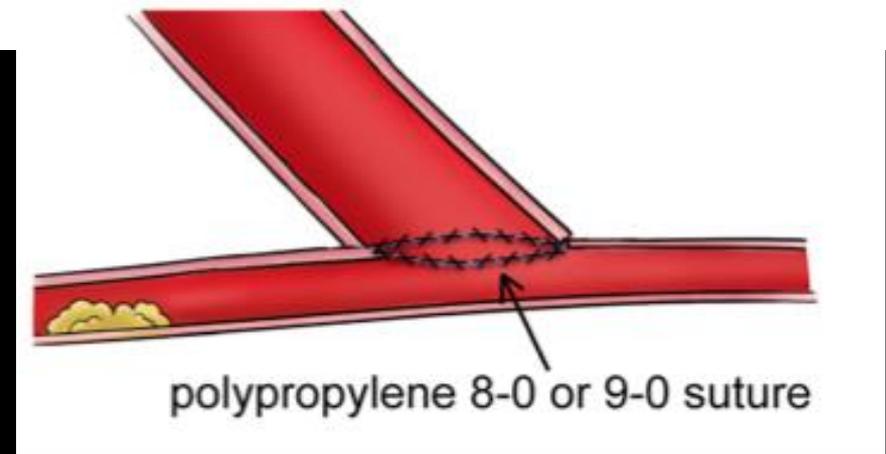
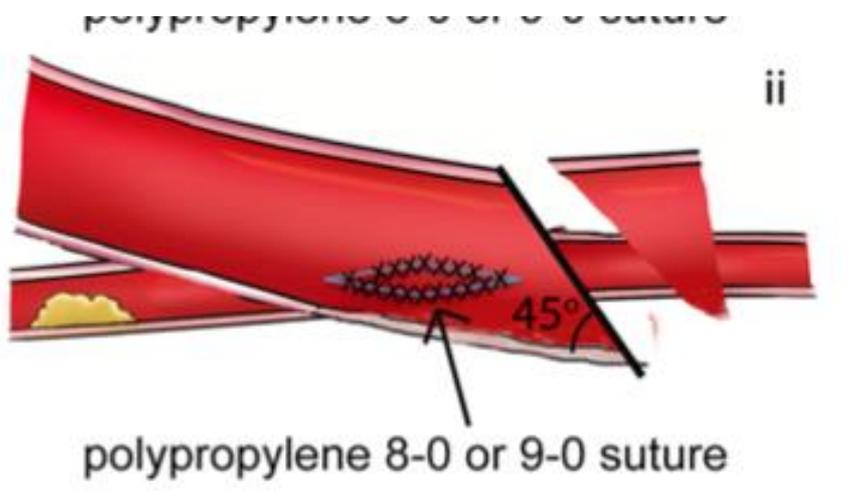
29th EACTS Annual Meeting 2015.

RESEARCH ARTICLE

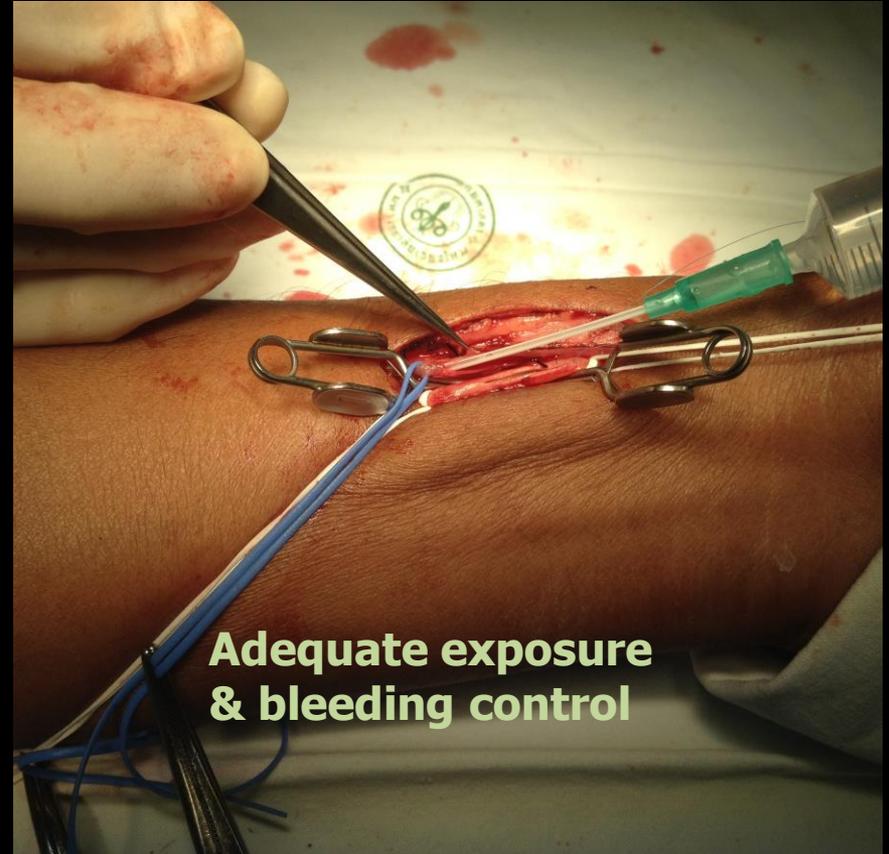
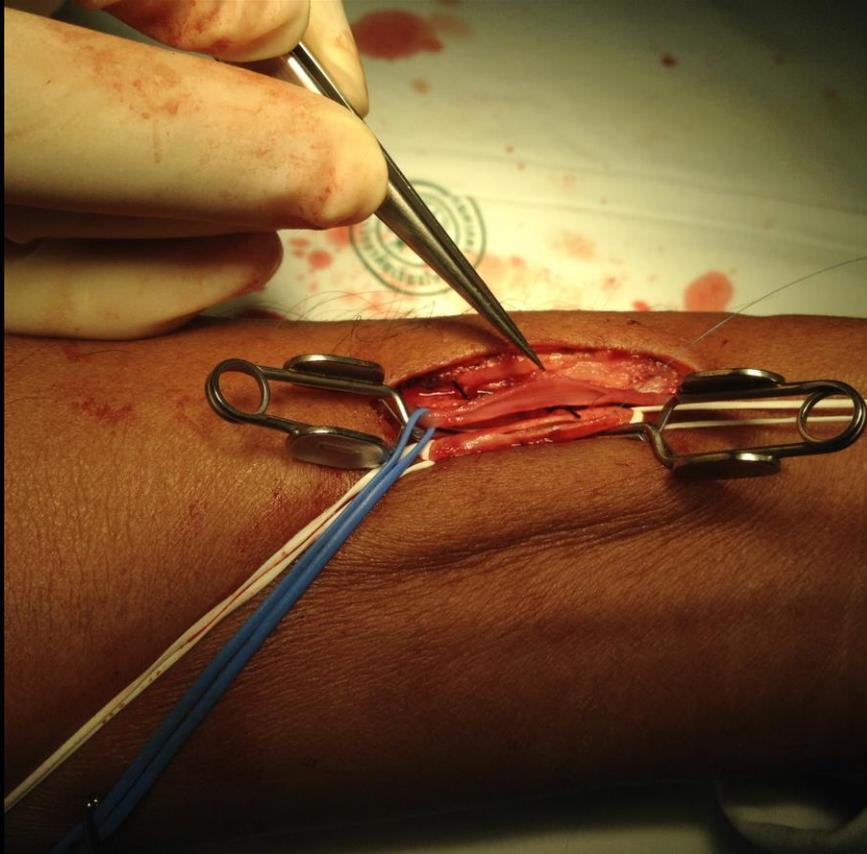
Open Access

Distal end side-to-side anastomoses of sequential vein graft to small target coronary arteries improve intraoperative graft flow

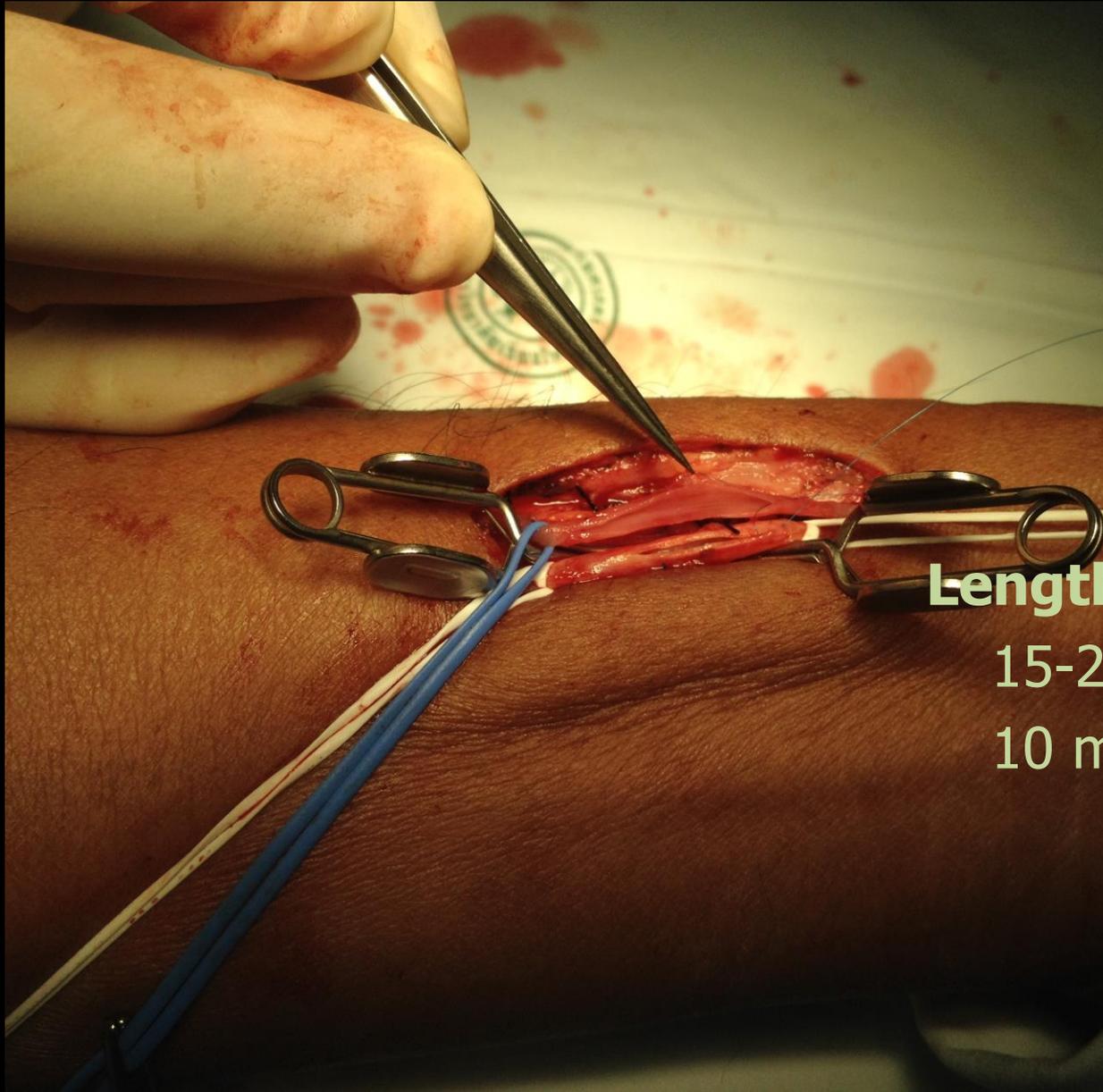
Haitao Li^{1†}, Baodong Xie^{2†}, Chengxiong Gu¹, Mingxin Gao¹, Fan Zhang¹, Jiayang Wang¹, Longsheng Dai¹ and Yang Yu^{1*}



Radial artery – Cephalic vein



It looks like the concept of every kind of vascular operation. The keys success are the combination of adequate vascular exposure and bleeding control during the time of vascular anastomosis creation. If we do it properly, we get easier identification of the point we can do suture stitches and reduce operative complication such as bleeding or vascular obstruction.



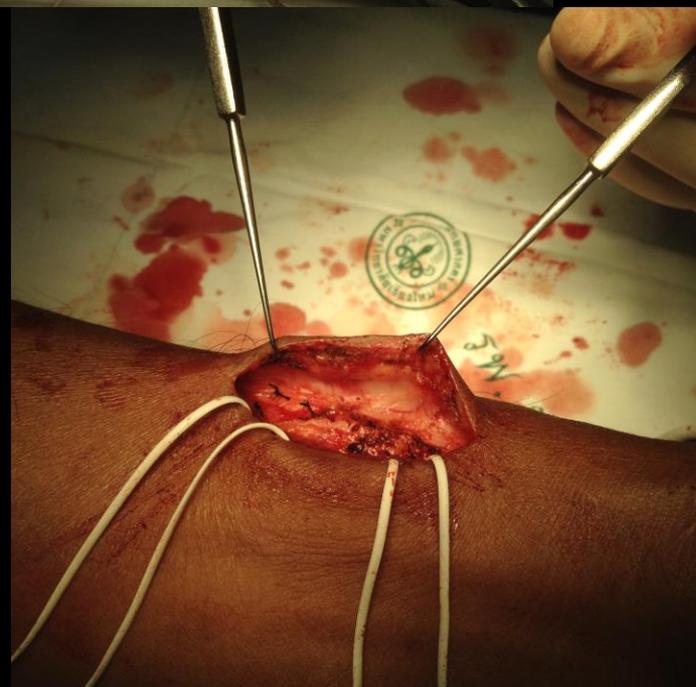
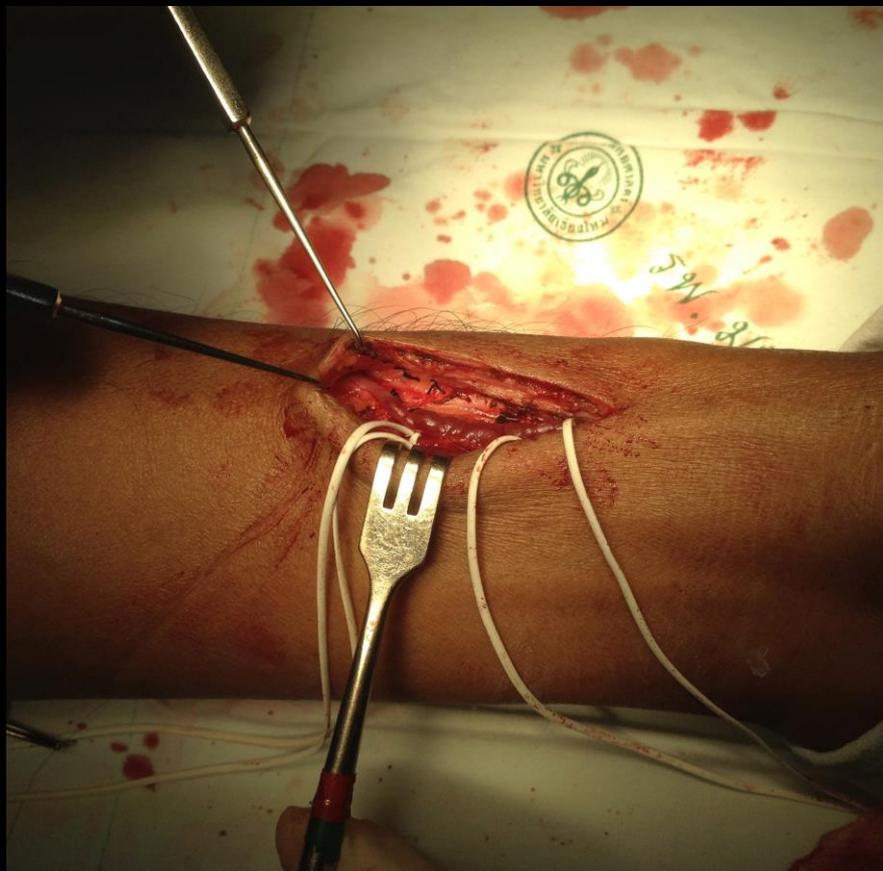
Length of Anastomosis

15-20 mm (wrist)

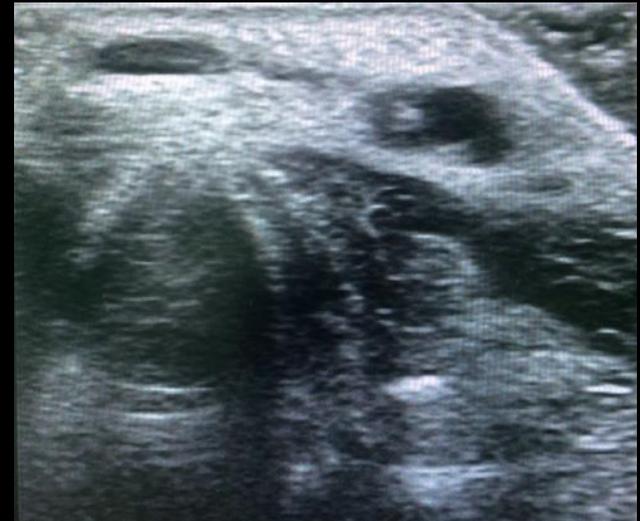
10 mm (upper arm)

The other key points is the design of the vascular anastomosis. Good anastomosis must be absent of any tension and The length have to be about 15-20 mm in wrist AVF. These are very important for the adequate flow and also the prevention of long term stenosis.

Radial artery – Cephalic vein



And before closure the wound, carefully inspecting for unsuspected bleeding point is mandatory.



52 year old male presenting with non-functioning wrist AVF,

BFR 100-150 ml/min

PE: Dilated forearm cephalic v. with poor AVF thrill

Example, this gentleman presented with non-functioning AVF. Blood flow was slow as about 100-150 mL/min.



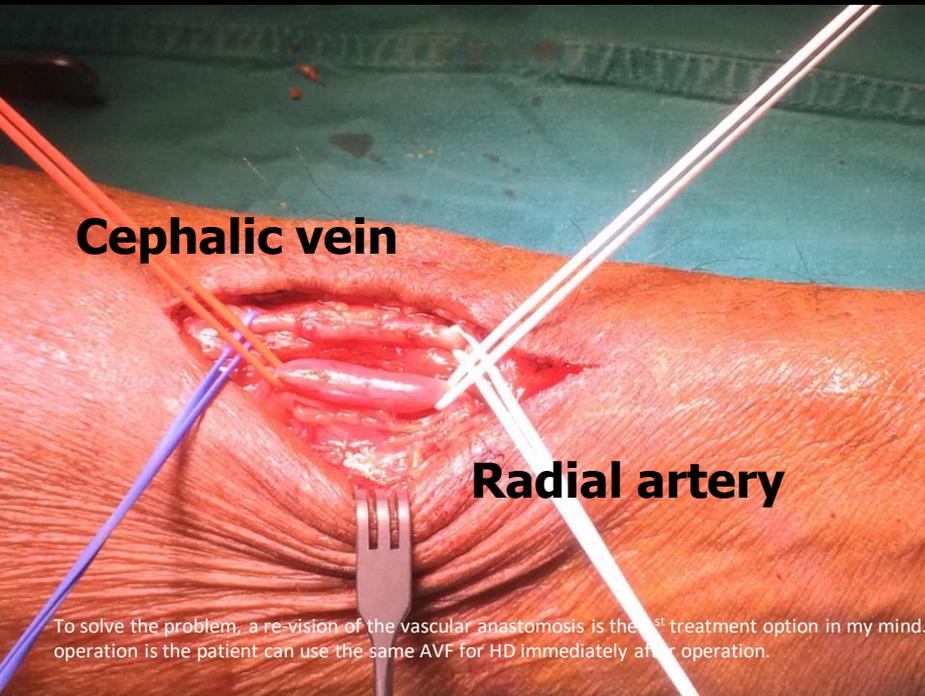
52 year old male presenting with non-functioning wrist AVF, BFR 100-150 ml/min

PE: Dilated forearm cephalic v. with poor AVF thrill

Same patient, the ultrasound examination reveal a very small anastomosis which is only 3 mm in length. With this small vascular anastomosis, as you can see, a calcium plaque which is very common in CKD patient. The plaque can obstruct the lumen cause a dysfunction of the fistula. As I mentioned this problem can be prevent if we routinely do a longer & bigger anastomosis.

AV access options after failed Brescia-Cimino fistula / calcified radial artery

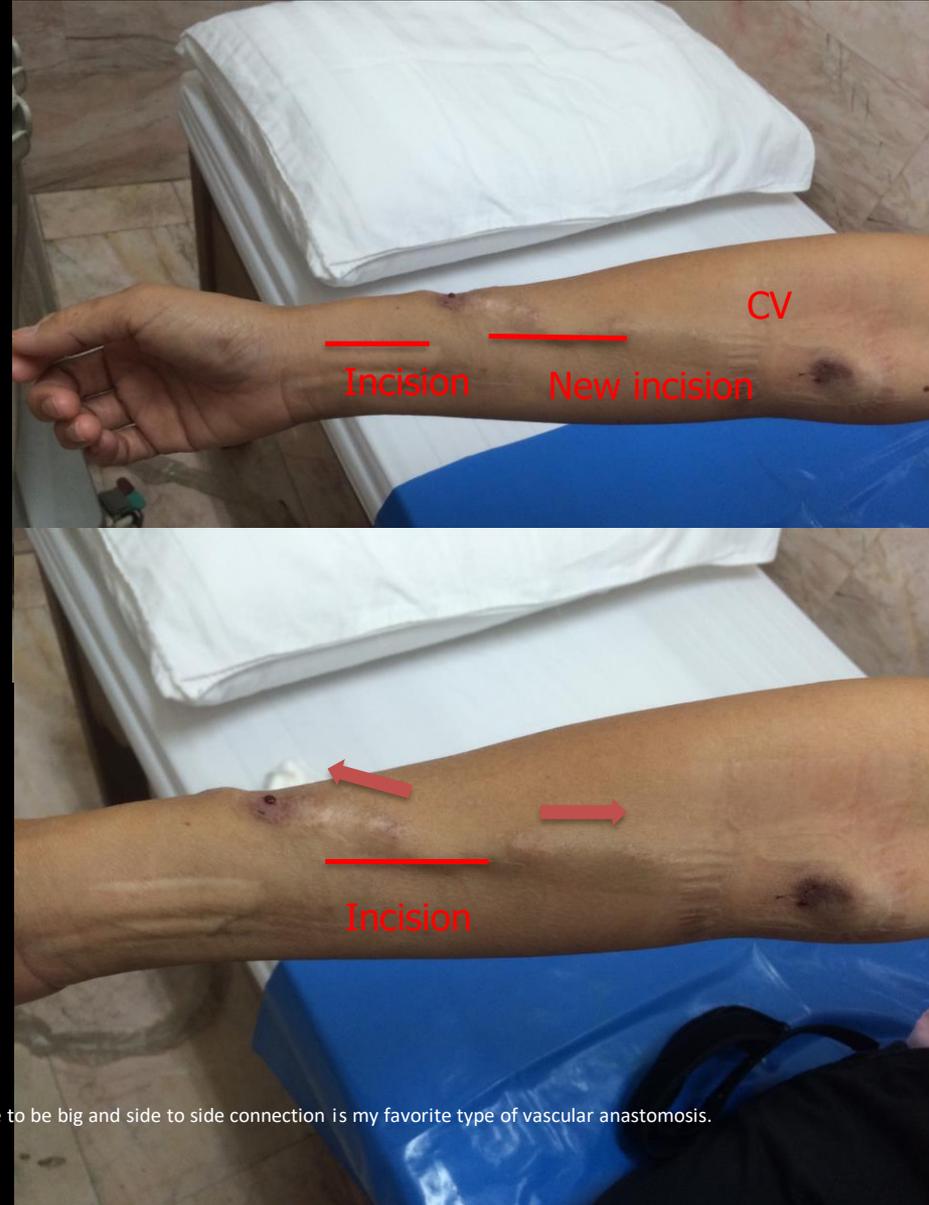
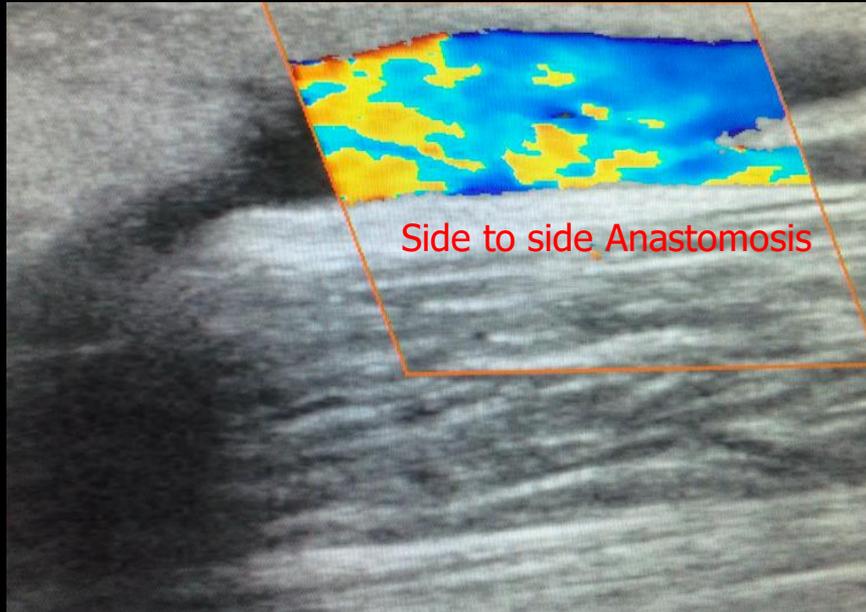
Radio-Cephalic forearm AVF



To solve the problem, a re-vision of the vascular anastomosis is the 1st treatment option in my mind. The new vascular anastomosis is a just above the previous surgical incision. The benefit for this type of operation is the patient can use the same AVF for HD immediately after operation.

AV access options after failed Brescia-Cimino fistula / calcified radial artery

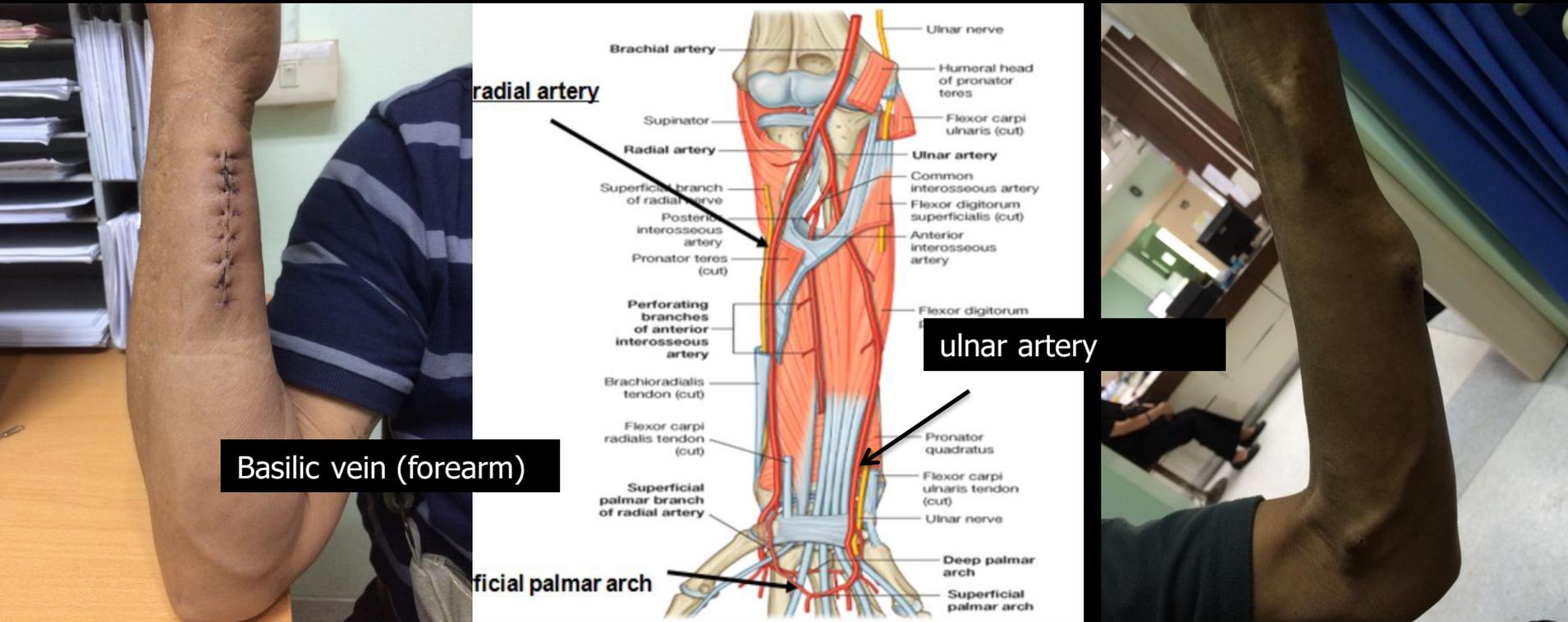
Radio-Cephalic forearm AVF



And as I mention... to make sure a patency of the new vascular anastomosis, the size of anastomosis have to be big and side to side connection is my favorite type of vascular anastomosis.

AV access options after failed Brescia-Cimino fistula / calcified radial artery

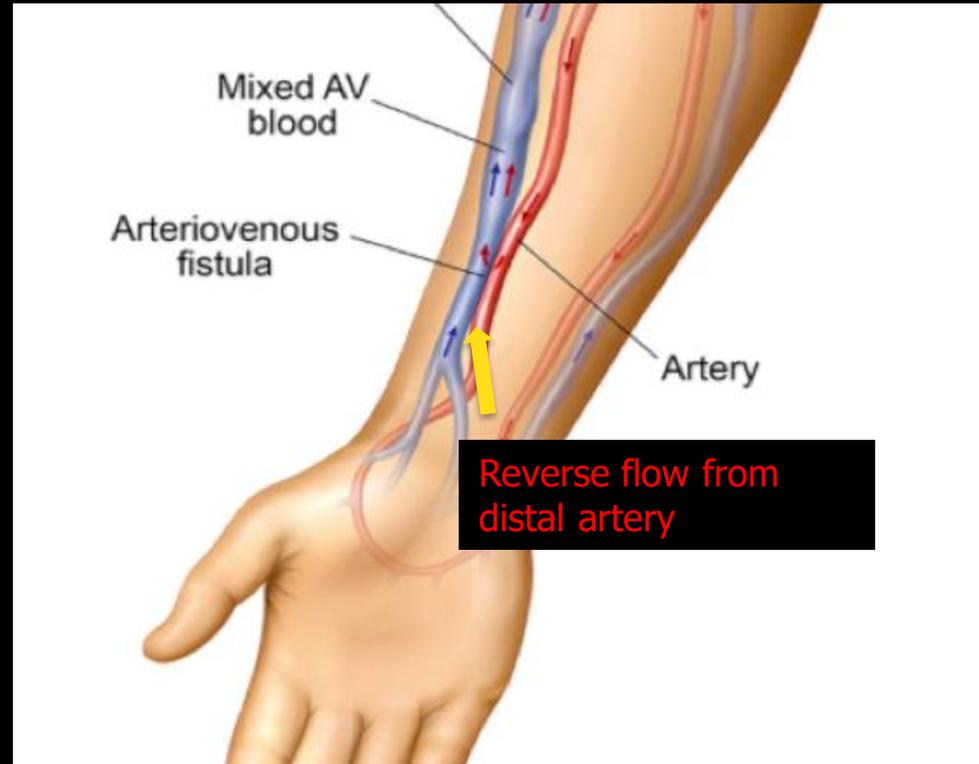
Ulnar-Basilic (forearm) AVF



The forearm Ulnar to Basilic AVF is my 2nd treatment option after failed a Brescia-Cimino fistula. This kind of creation, as you can see, the dilate vein segment is on the medial side which is a little bit difficult for cannulation. However, I prefer this approach before go to the upper arm fistula.

Steal syndrome is defined as a reversal blood flow in the distal arteries, causes tissue hypoxia, and possible permanent tissue necrosis.

Increase risk in patients with Peripheral artery disease (DM, HT, smoking etc.)



Steal syndrome is a reversal flow in the distal artery cause a tissue hypoxia or even tissue necrosis in severe cases, and it is frequent occur in the DM patients.

Diagnosis – Digital Brachial index (DBI)

Ischemic symptoms + DBI <0.6

Steal syndrome is usually due to one or more of the following factors;

Inflow stenosis – defined as stenosis within the arterial system, anastomosis, and juxta-anastomotic region (the first 2 cm downstream from the arterial anastomosis)

Distal arteriopathy – result of generalized vascular calcification due to diabetes .

- Kidney International. 2005; 67: 1986-92.
- Clinical Journal of The American Society of Nephrology: CJASN. 2007; 2: 175-83.

Steal syndrome – Treatments

Mild : Observation

Moderate - Severe

: Intervention

Inadequate arterial inflow →

1 Enhancement of arterial inflow (angioplasty)

Distal arteriopathy →

2 Access flow reduction

3 Distal revascularization

4 Access ligation

Endovascular Today FEB 2009

Nephrology Dialysis Transplantation 2007

An ESRD patient has had left hand pain and cyanosis during HD, (steal grade 2).

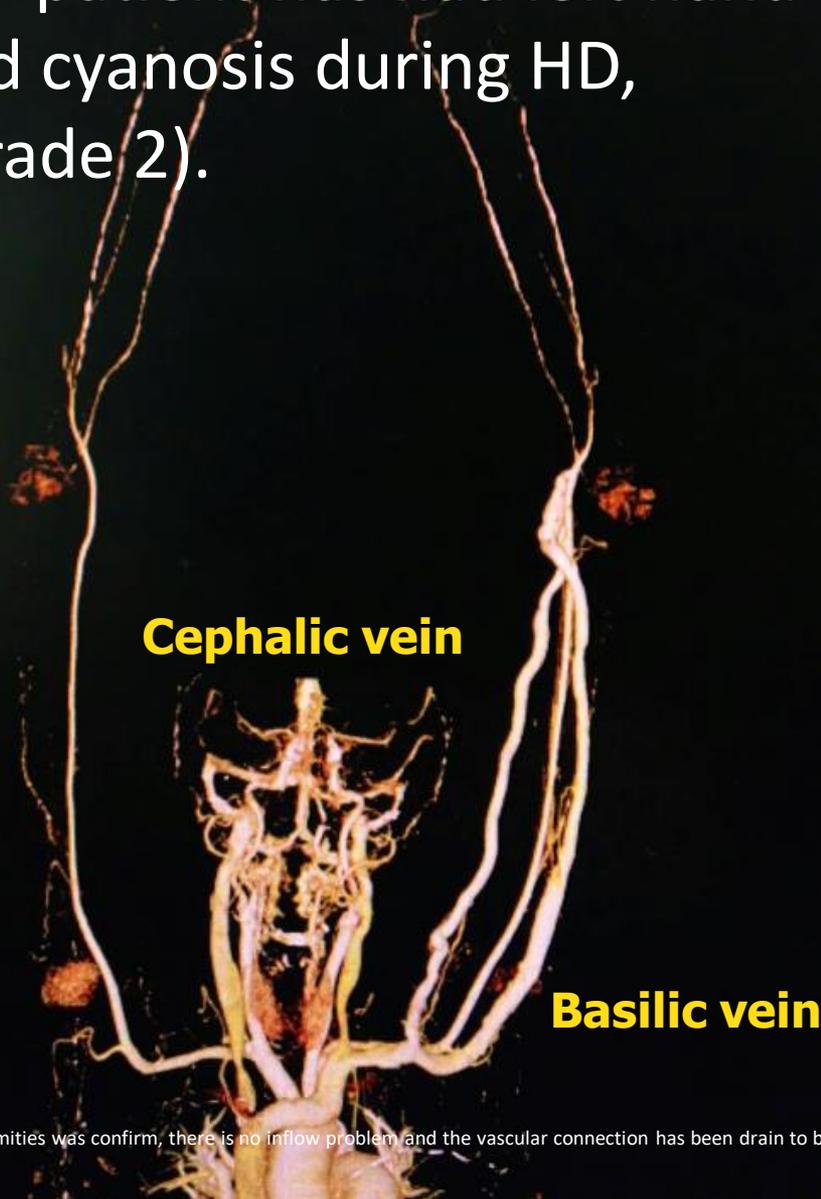
Her AVF was connected between median cubital (basilic+cephalic vein) vein and brachial artery.

Radial pulse is +1

AVF flow 1400 ml/min



An ESRD patient has had left hand pain and cyanosis during HD, (steal grade 2).



CT scan of the upper extremities was confirm, there is no inflow problem and the vascular connection has been drain to both cephalic and basilic veins.

An ESRD patient has had left hand pain and cyanosis during HD, (steal grade 2).



Treatment : Ligation basilic vein (access flow reduction)
→ increase arterial flow to distal vascular bed (hand)

So in this patient, we decide to ligation the basilic vein to reduce and access flow which subsequently increase a distal perfusion.

The color of the hand during hemodialysis after ligation of the basilic vein



An operation was done successfully and then patient can continue HD via a n upper arm cephalic vein without any ischemic symptom .

Key Points

- **ESRD and the maintenance of hemodialysis access** is a significant public health problems
- To obtain a successful AV access operation are depend on several factors –
 - Patient selections**
 - Access surveillances**
 - Surgical techniques**

Operative Technique

- Variation of AVF

Balance patient's risk & benefit

- Regional anesth. (brachial n. block)

Vein dilated (easier to perform anastomosis)

- Use ultrasound

Pre-operative / Intra-operative + mapping

- Length of anastomosis

- Complications / steal syndrome : expect them

Thank you for your attention 😊