

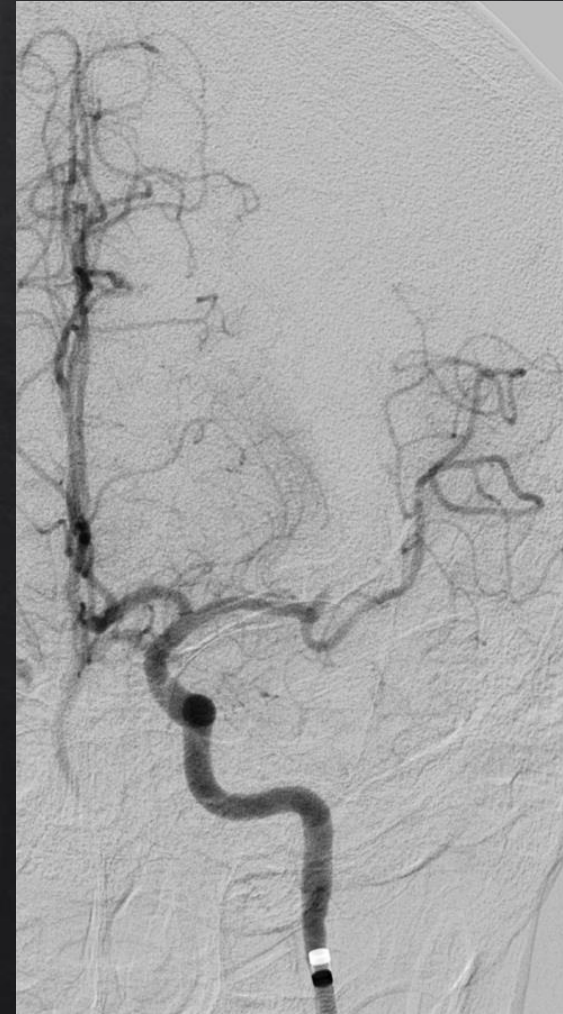
2018/12/15  
急性腦中風取栓工作坊 (III)

# Distal Emboli After Mechanical Thrombectomy

台北國泰綜合醫院 神經外科

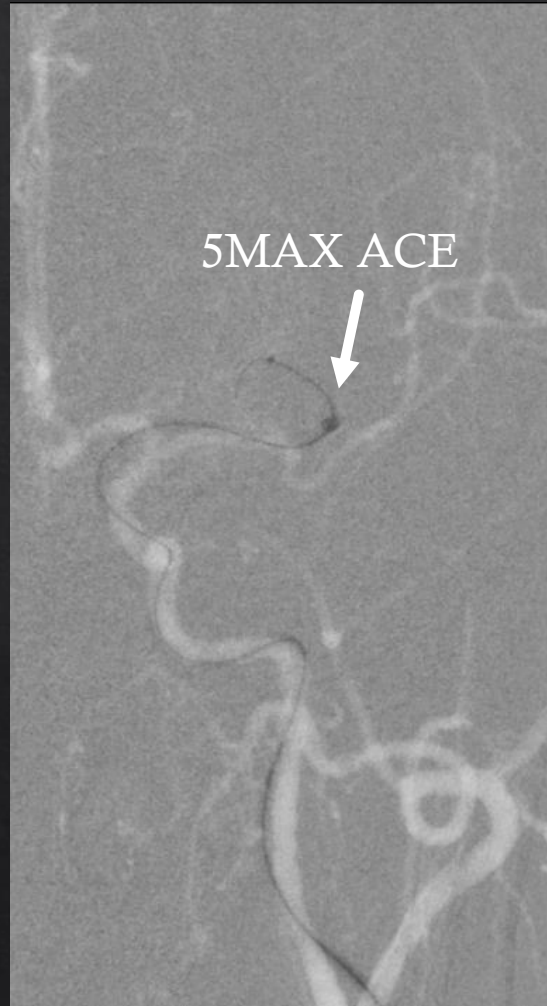
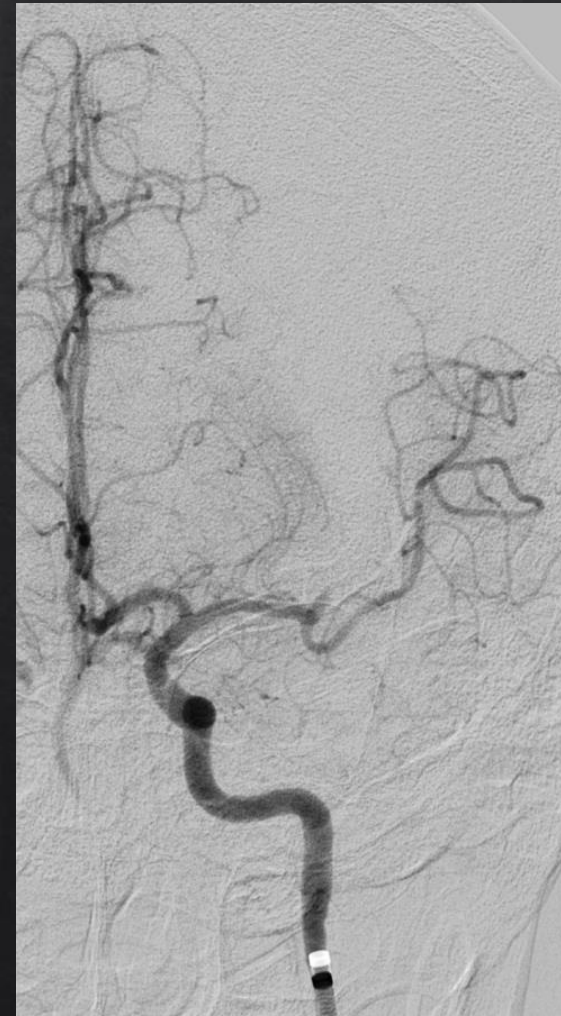
蘇亦昌醫師

# Case illustration-1



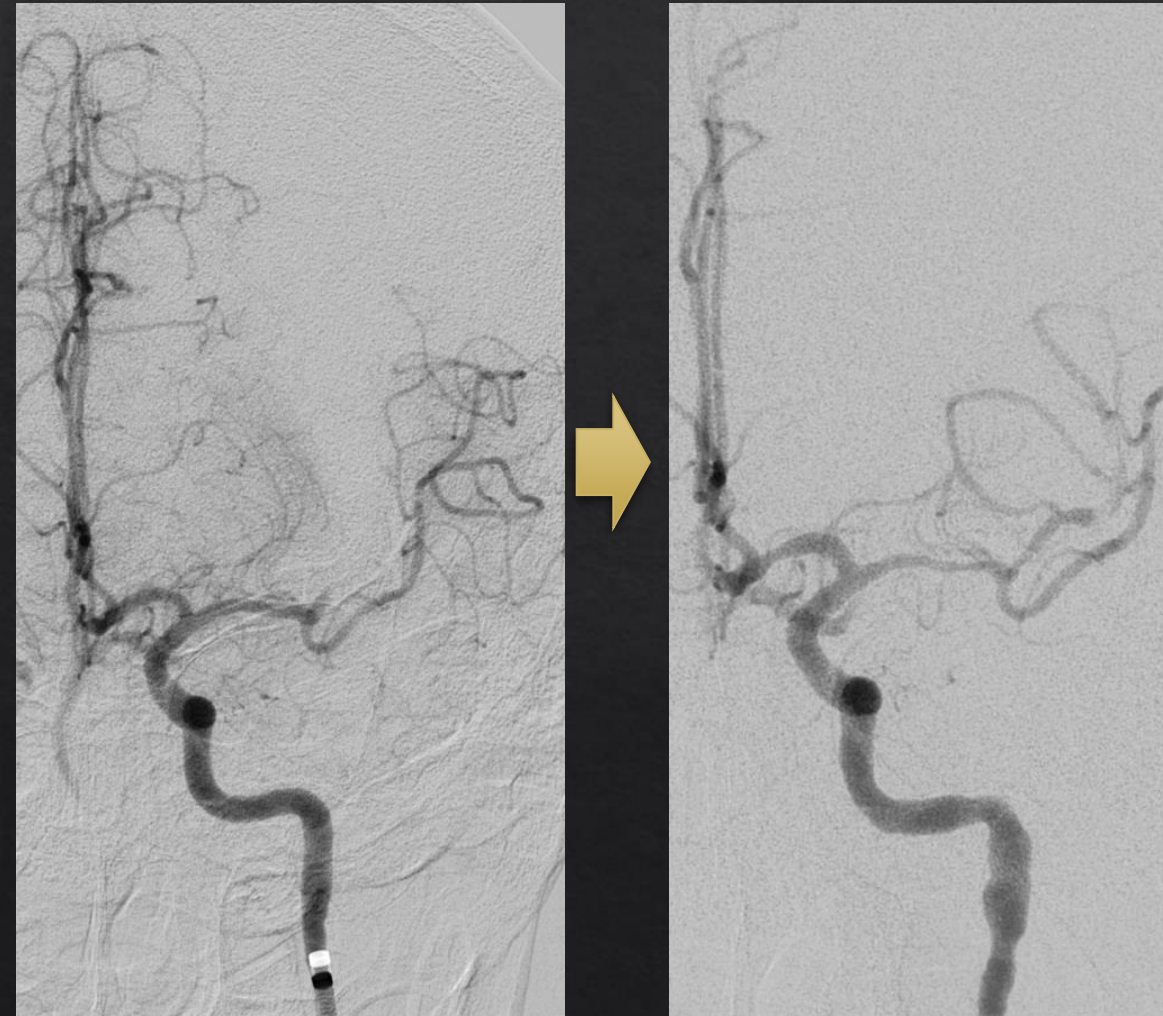
# Case illustration-1

5MAX ACE  
Aspiration catheter



# Case illustration-1

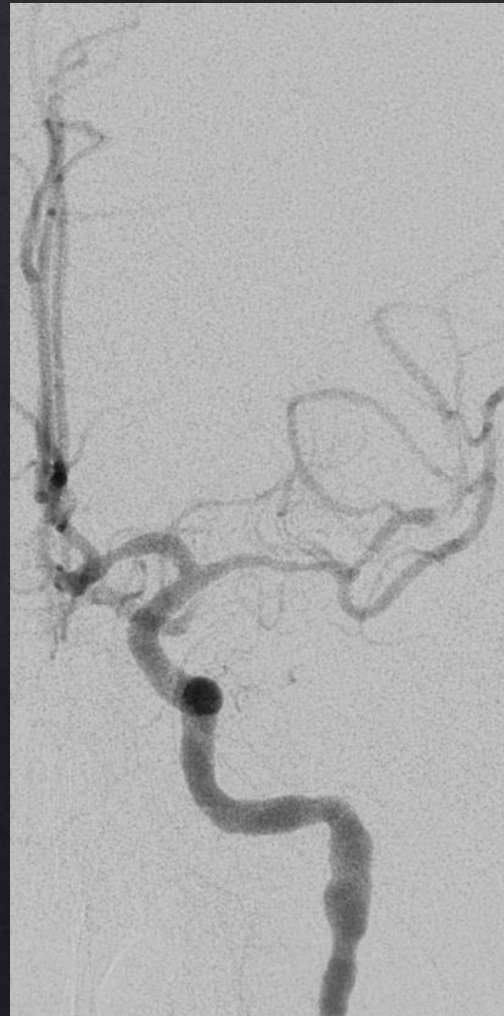
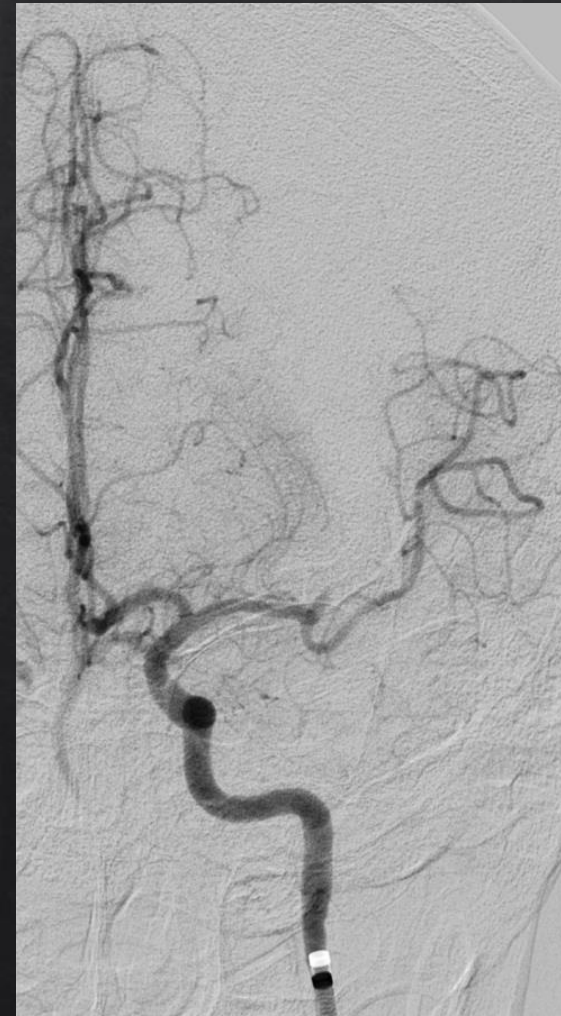
5MAX ACE  
Aspiration catheter



# Case illustration-1

5MAX ACE  
Aspiration catheter

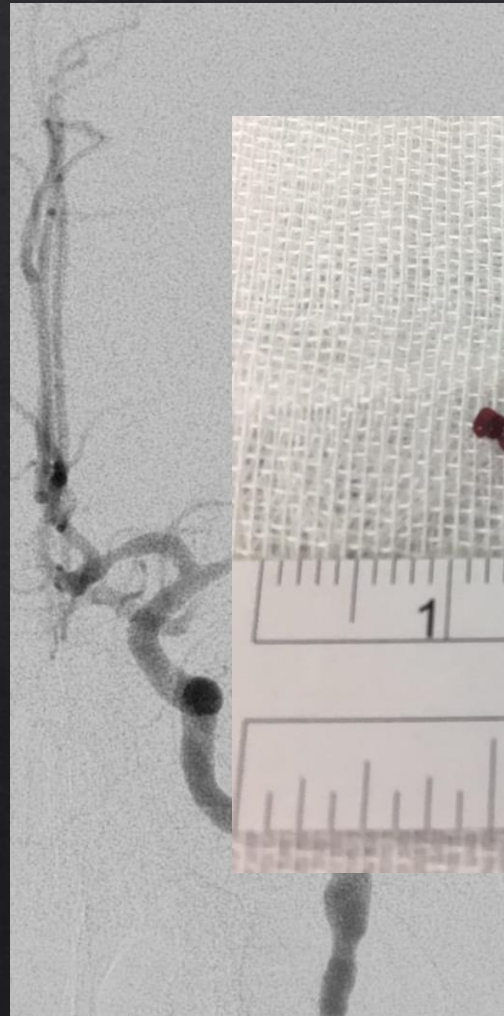
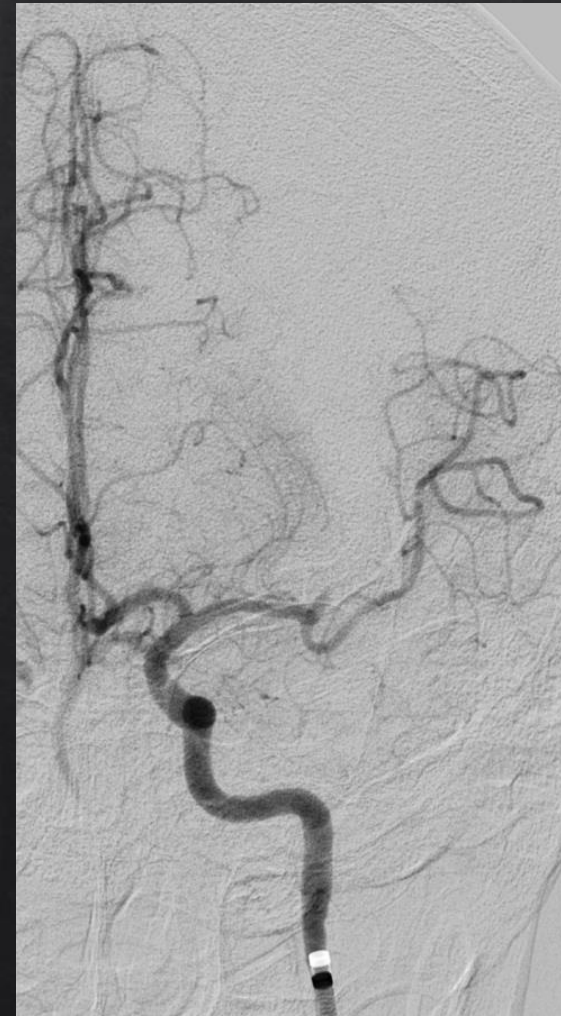
3MAX  
Aspiration catheter



# Case illustration-1

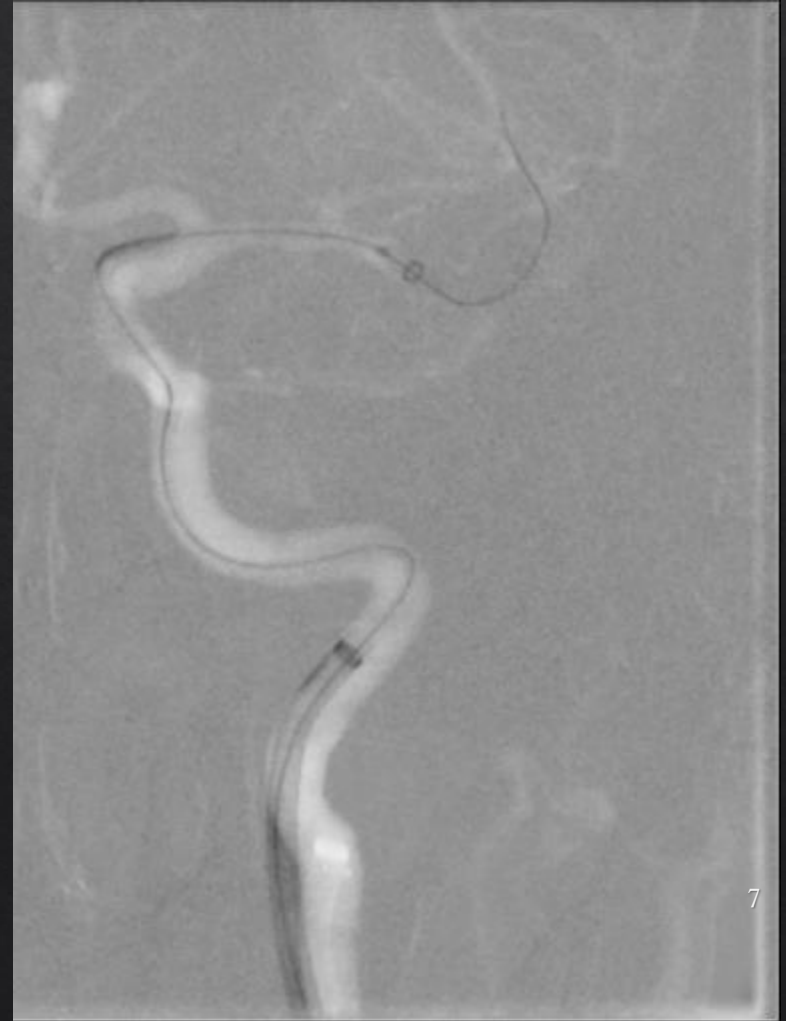
5MAX ACE  
Aspiration catheter

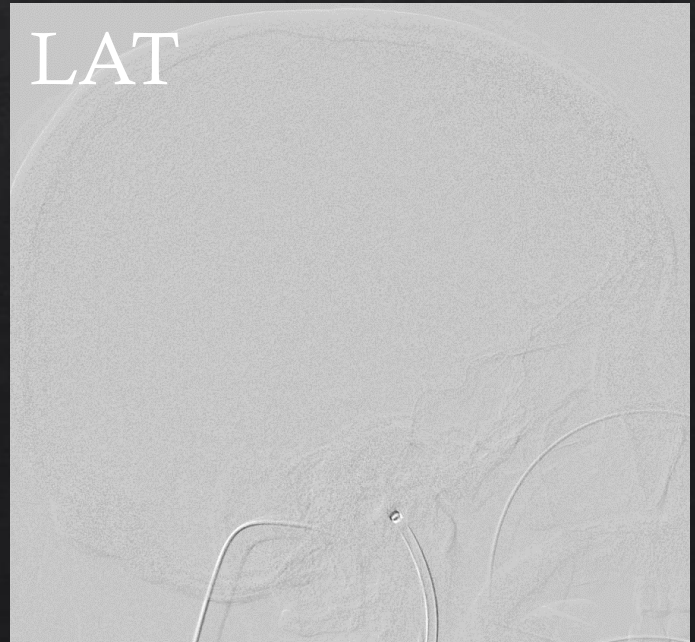
3MAX  
Aspiration catheter



# Case illustration-2

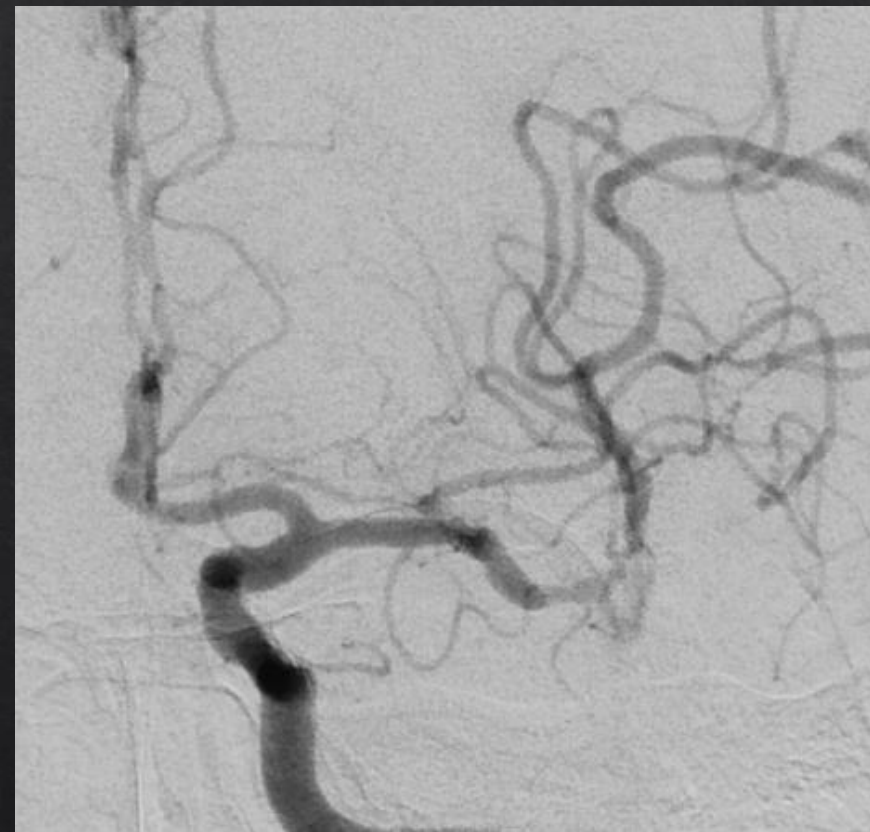
5MAX ACE  
Aspiration catheter







# Case illustration-2

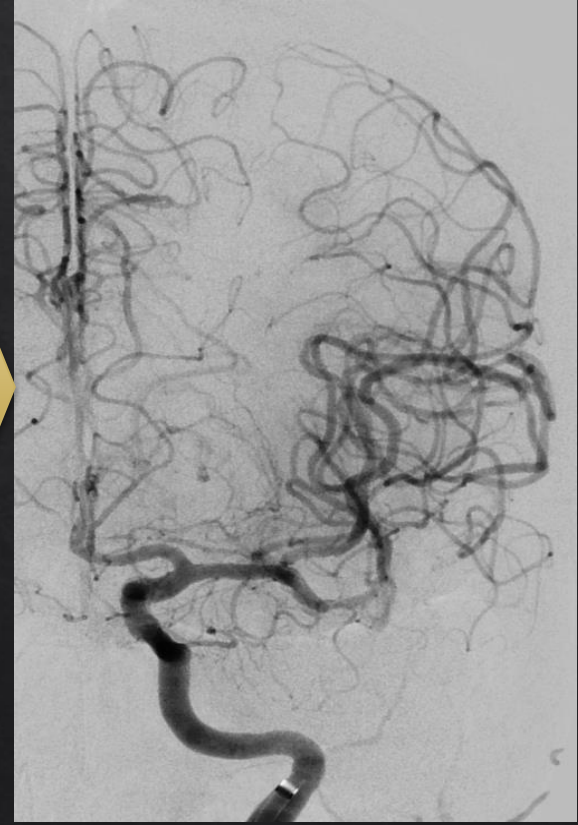
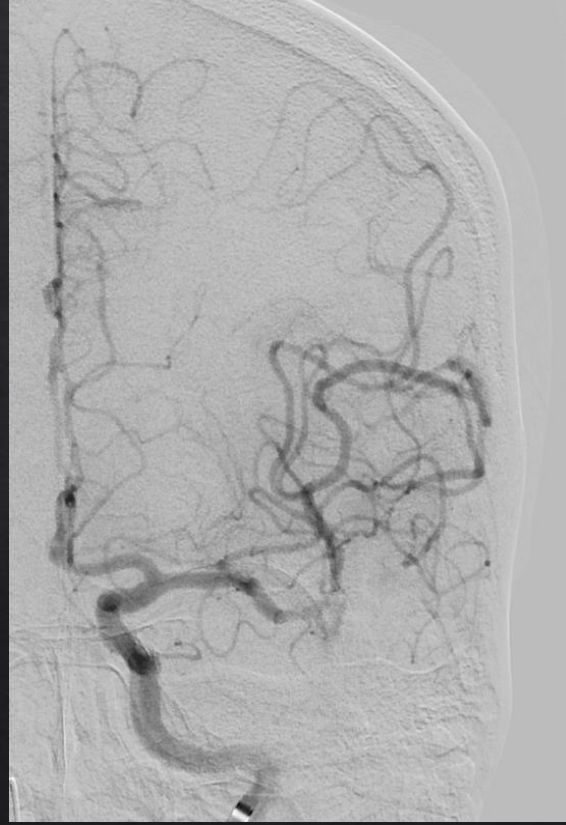


# Case illustration-2

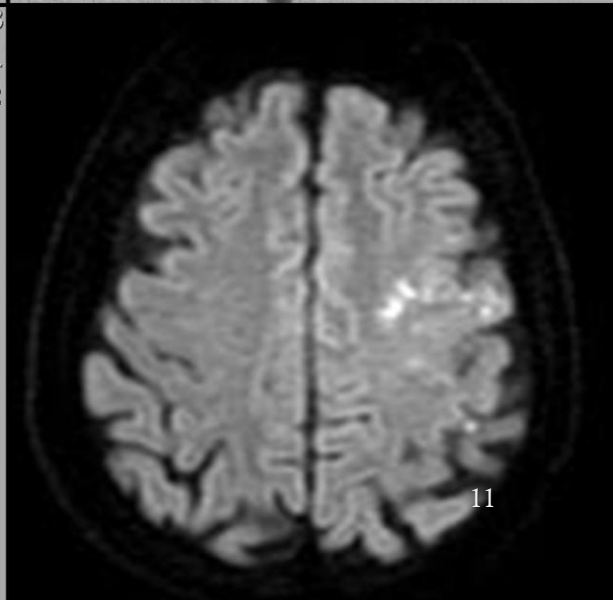
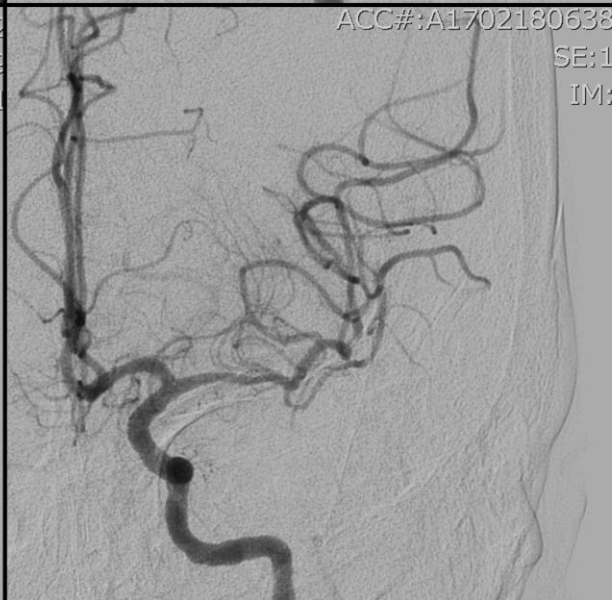
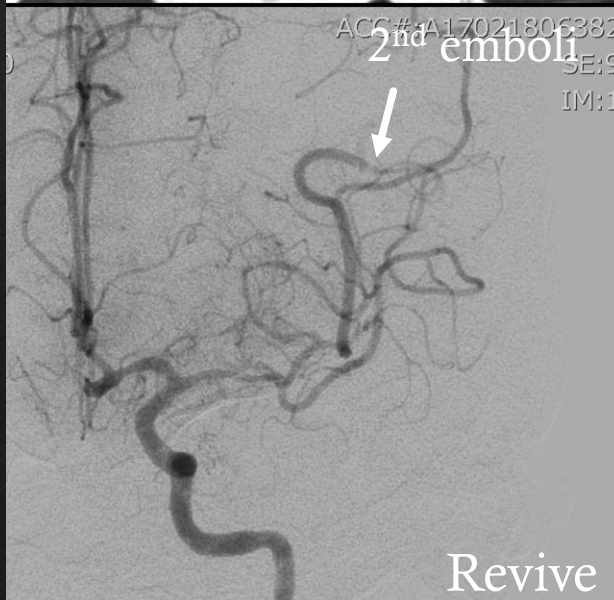
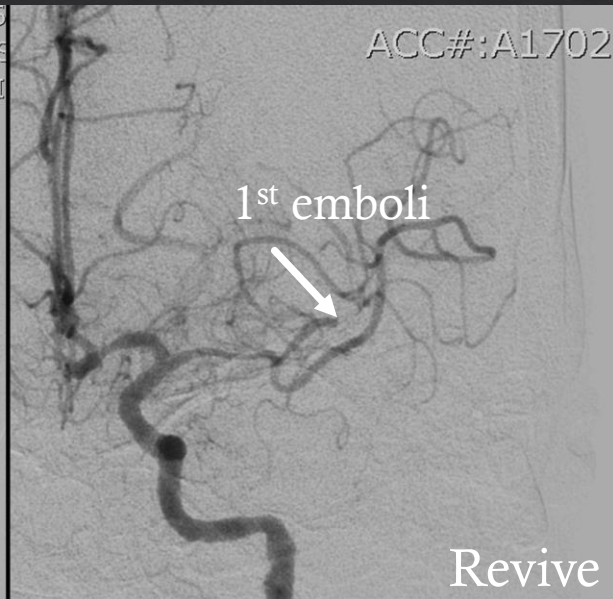
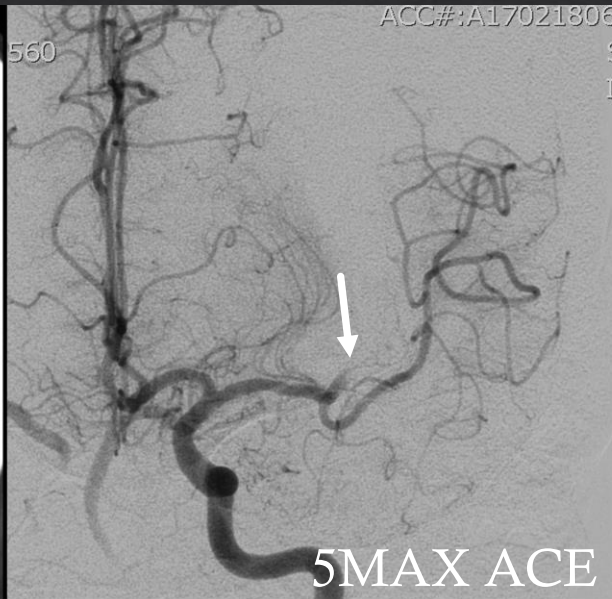
Baseline

Distal emboli

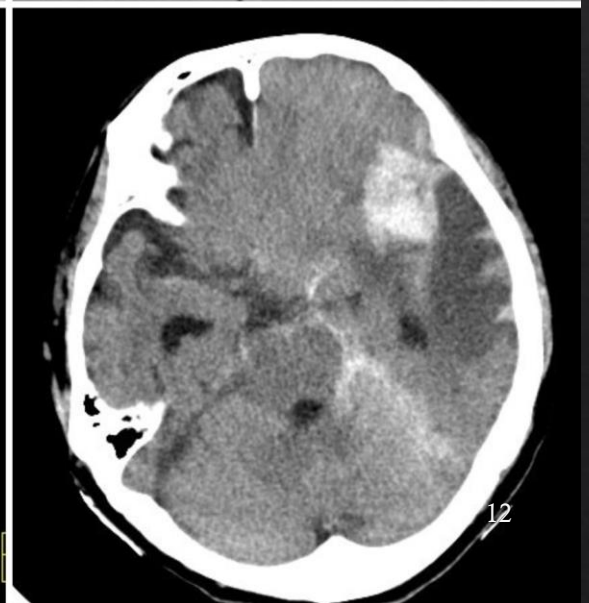
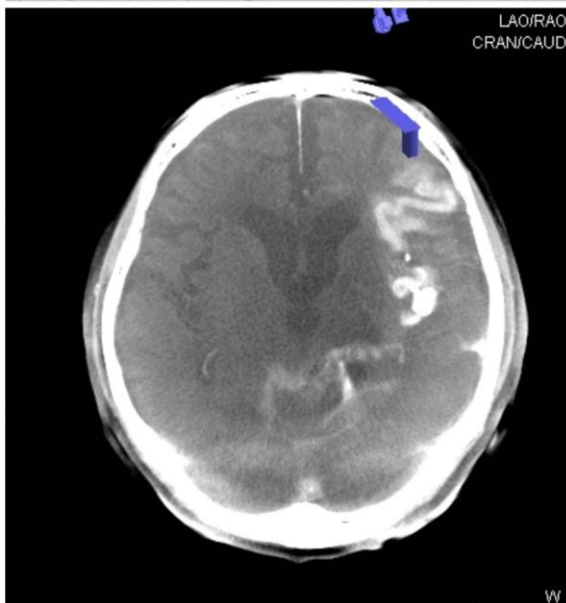
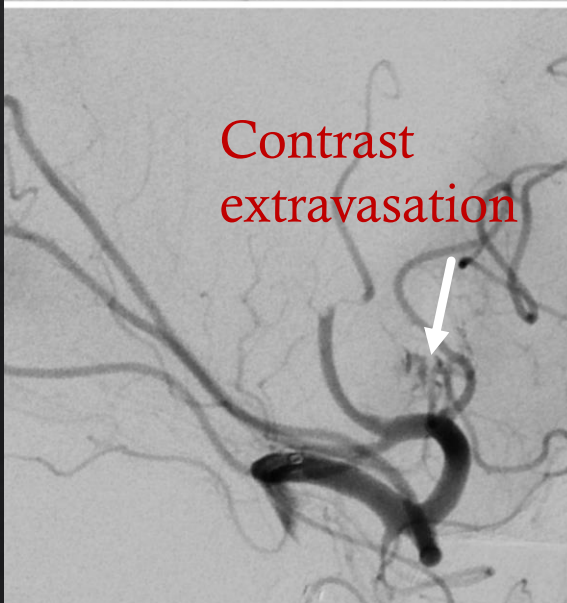
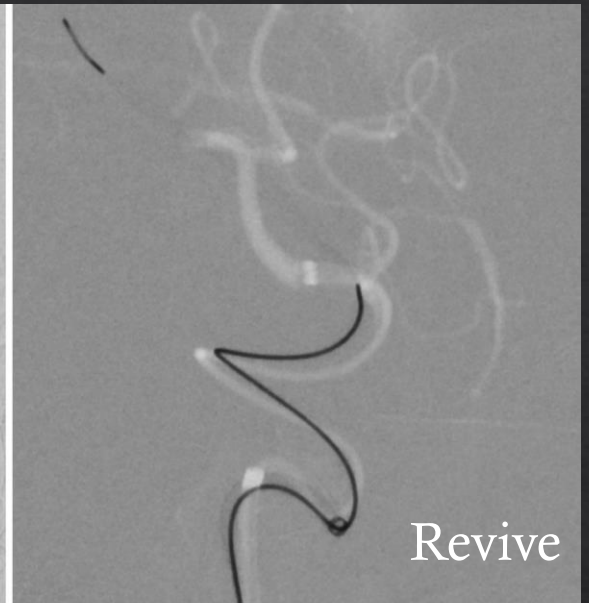
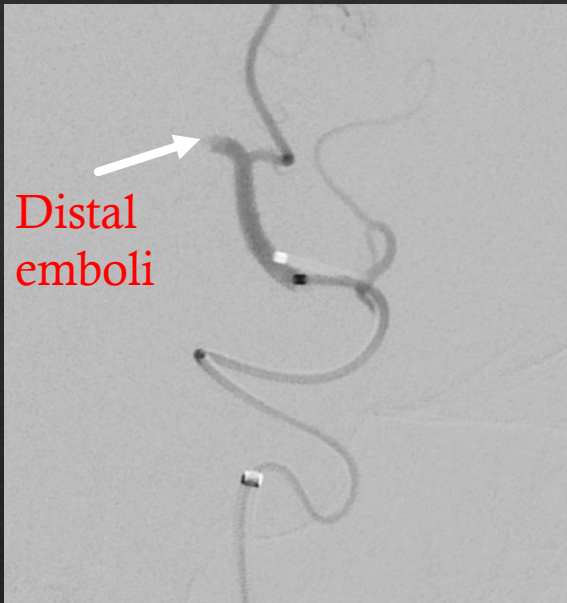
Final



# Case illustration-3



# Case illustration-4

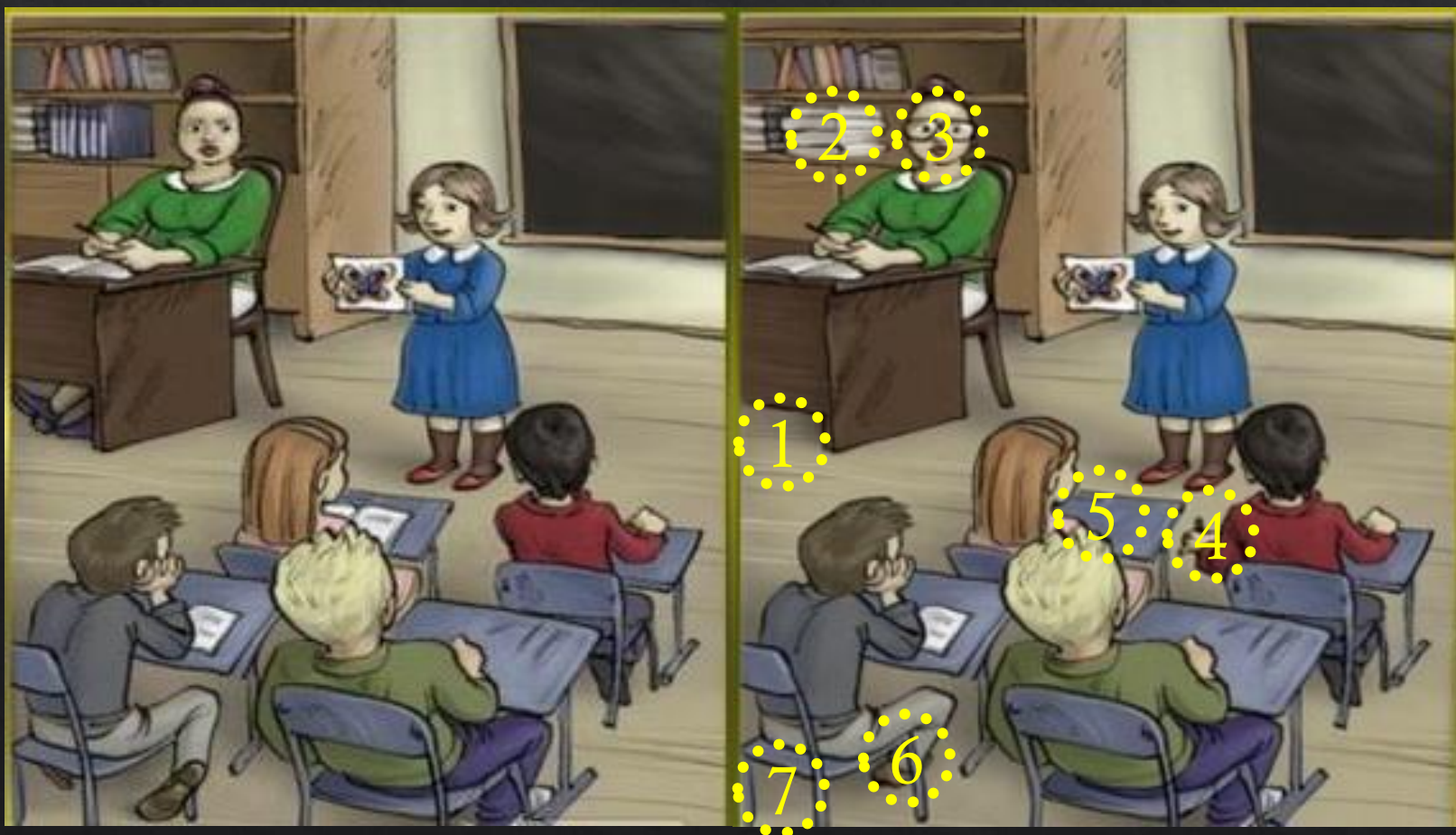


# 學習大綱

- ◆ Find out the distal emboli
- ◆ Some facts about emboli
- ◆ Techniques to reduce emboli
- ◆ Techniques to rescue emboli

# 學習大綱

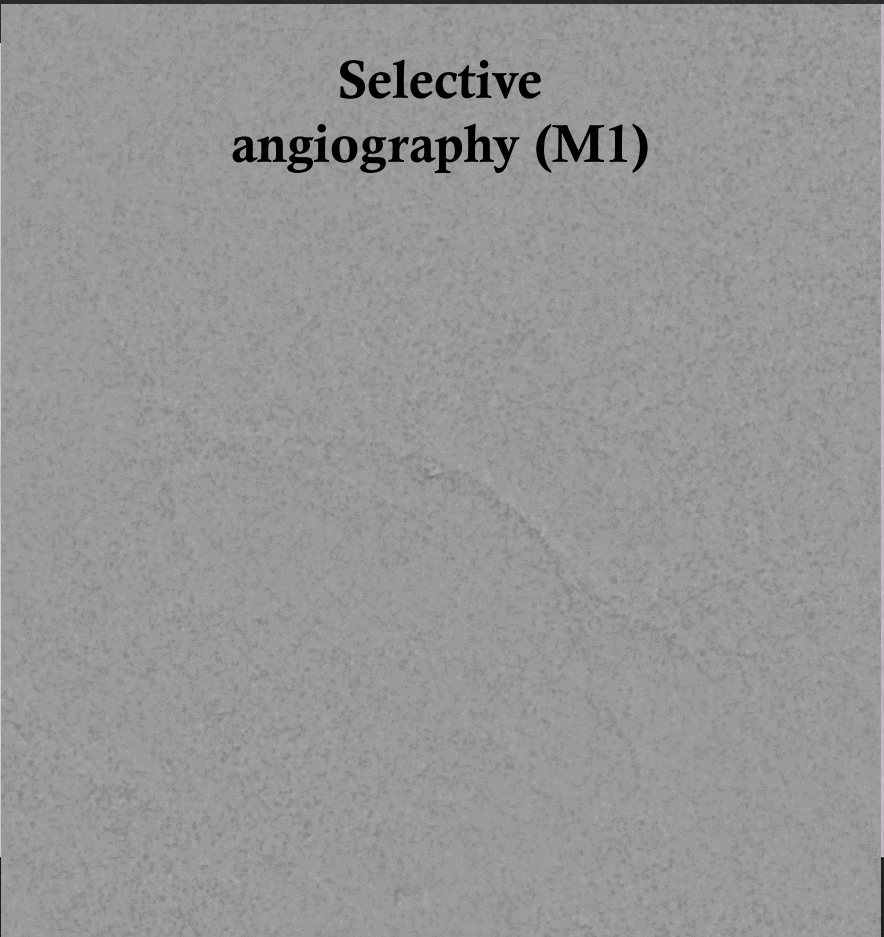
◆ Find out the distal emboli: 訓練眼力



# 訓練眼力：大家來找碴

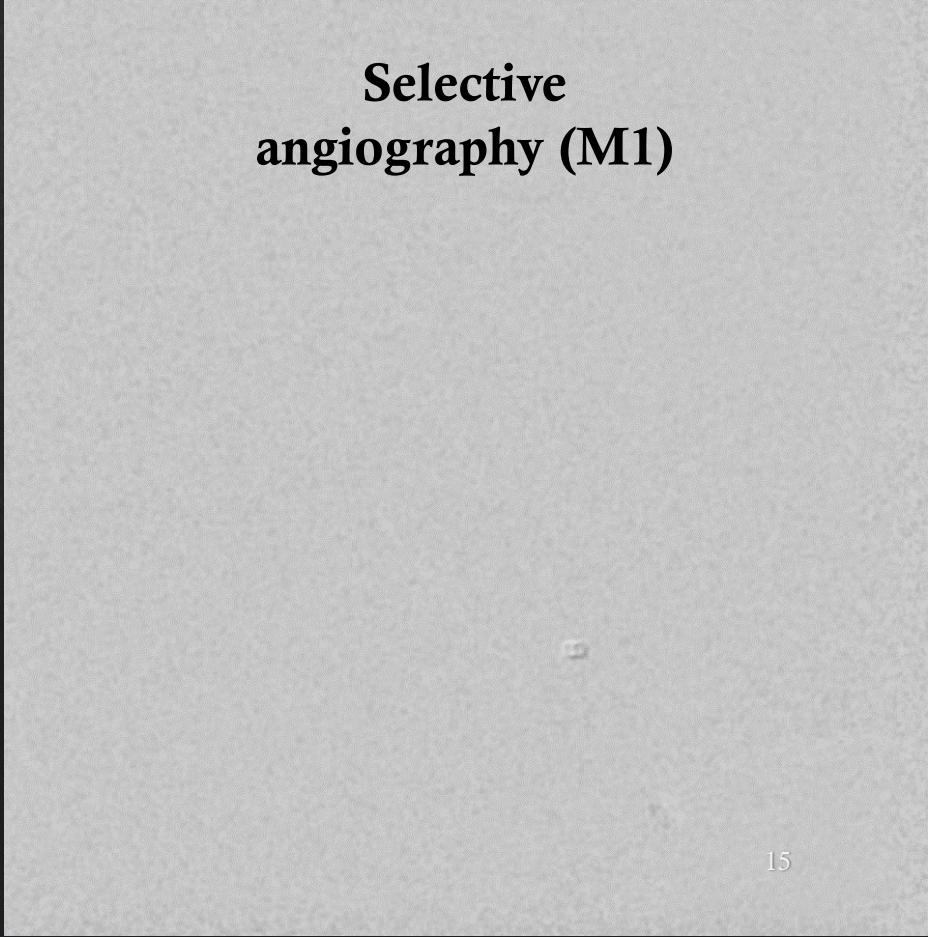
AP view

**Selective  
angiography (M1)**

This is an AP view selective angiography (M1) image. It shows a faint, curved vessel structure, likely the M1 segment of the middle cerebral artery, against a dark background. The vessel is not clearly defined, making it difficult to identify.

Lateral view

**Selective  
angiography (M1)**

This is a lateral view selective angiography (M1) image. It shows a small, bright spot, likely the M1 segment of the middle cerebral artery, against a dark background. The spot is very small and faint, making it difficult to identify.

# 訓練眼力：怎麼找碴？

1. Map out the decreased perfusion region first

2. Look for the exact emboli location by

- ◆ Zoom-in

- ◆ Different X-ray projection

- ◆ Selective angiography



# 訓練眼力：大家來找碴

AP view



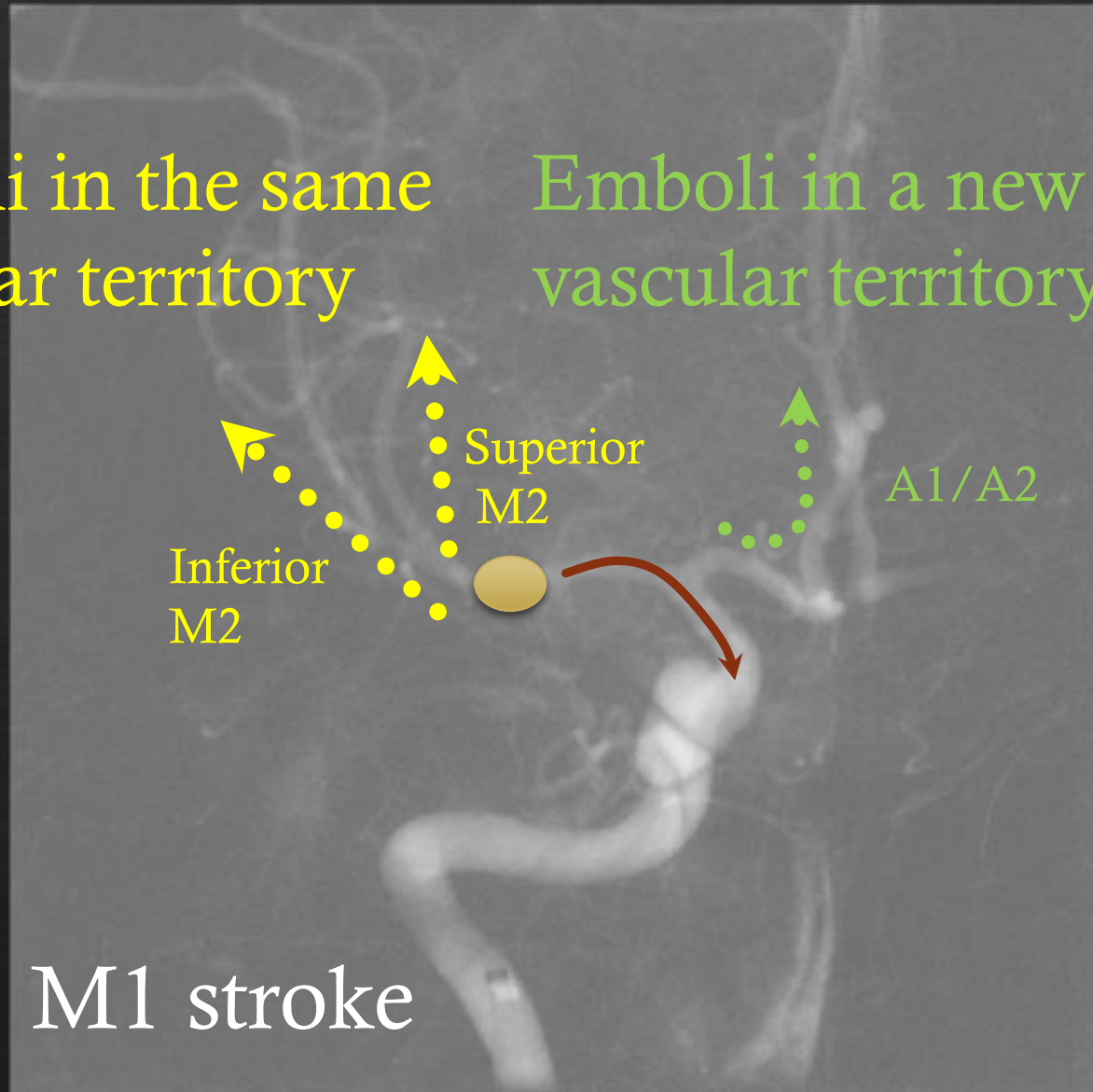
Lateral view



# Emboli in the **Same** and **New** vascular territory

Emboli in the same  
vascular territory

Emboli in a new  
vascular territory



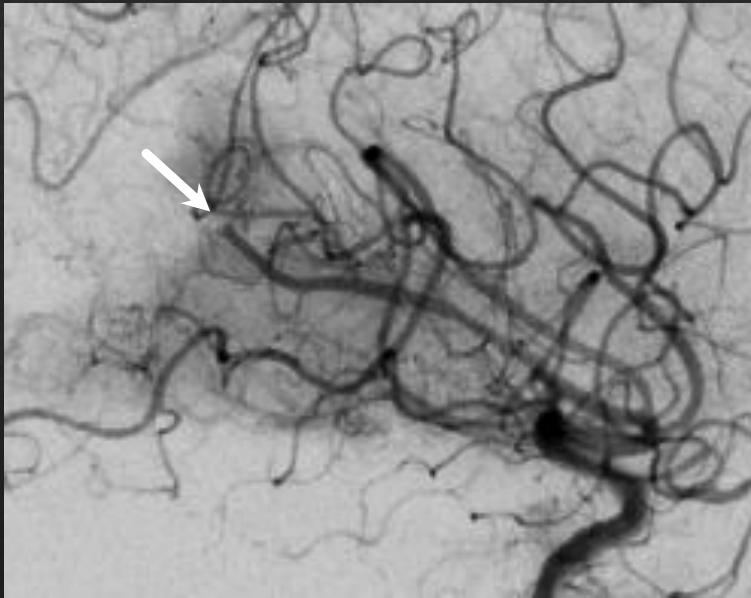
# 學習大綱

- ◆ Find out the distal emboli
- ◆ Some facts about emboli
- ◆ Techniques to reduce emboli
- ◆ Techniques to rescue emboli

# Some facts about emboli

## 1. Angiographically visible distal emboli: 8-15%

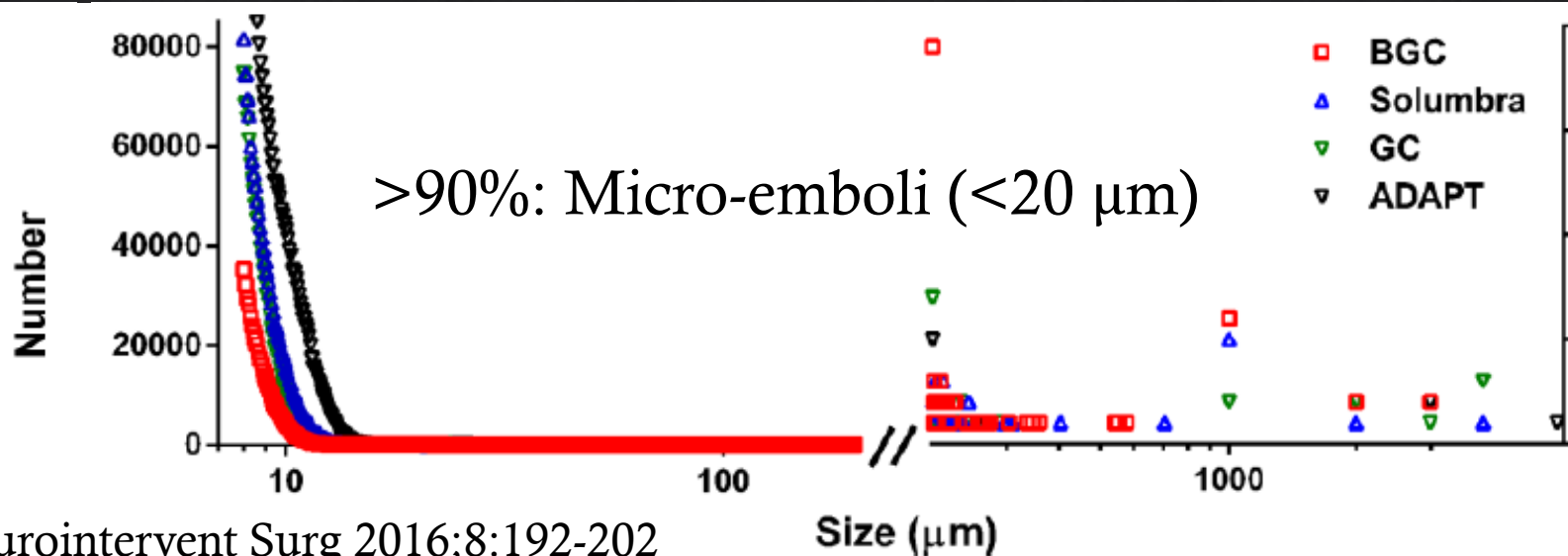
Neurosurgery 78:242–250, 2016



Angiographically “invisible” distal emboli?

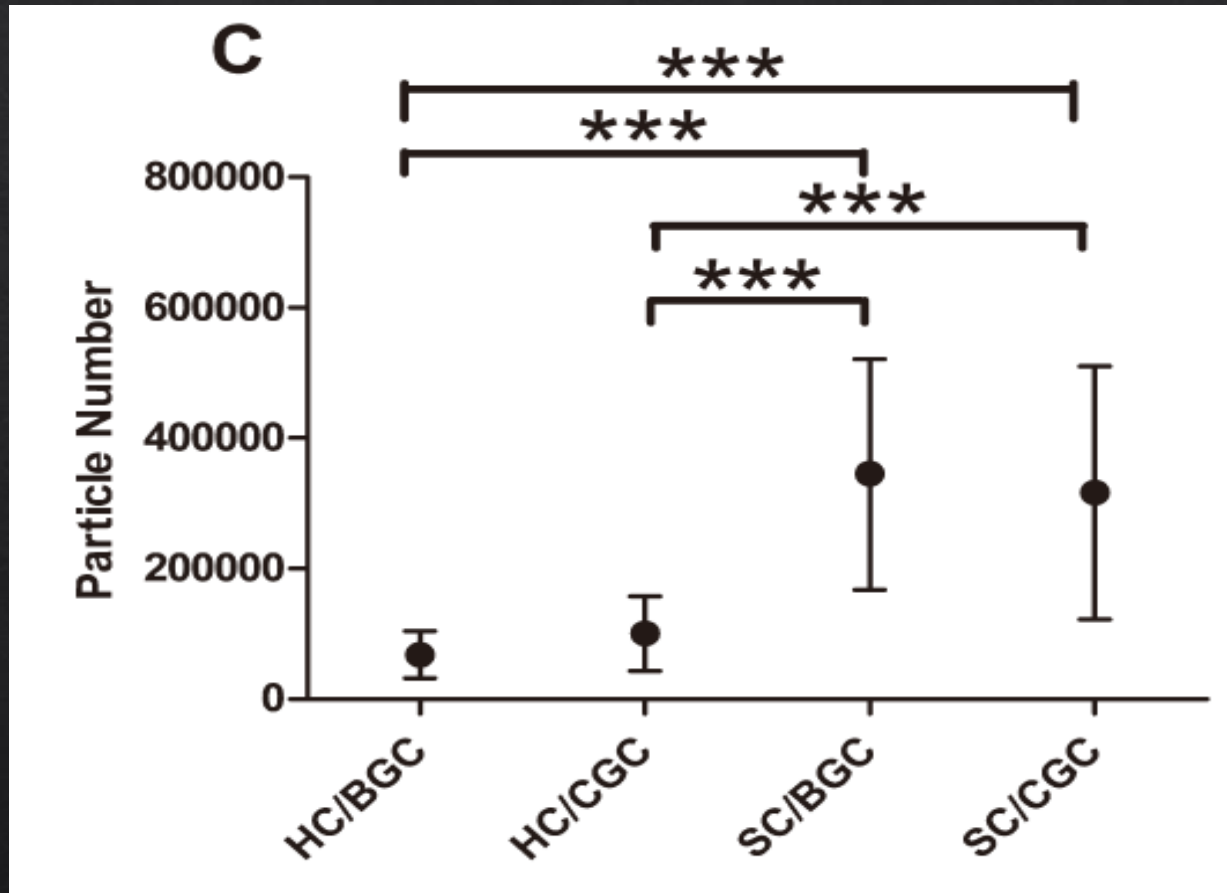
## 2. “Size” of distal emboli:

	<20 $\mu\text{m}$ (Micro-emboli)	20-200 $\mu\text{m}$ (Small size)	200-1,000 $\mu\text{m}$ (Medium size)	>1,000 $\mu\text{m}$ (Large size)
Angiographic visibility	← Invisible			Visible →
Occlusion level	Collateral routes Microcirculation		Cortical arteries Perforator arteries	Circle-of-Willis M1/2/3 A1/2/3



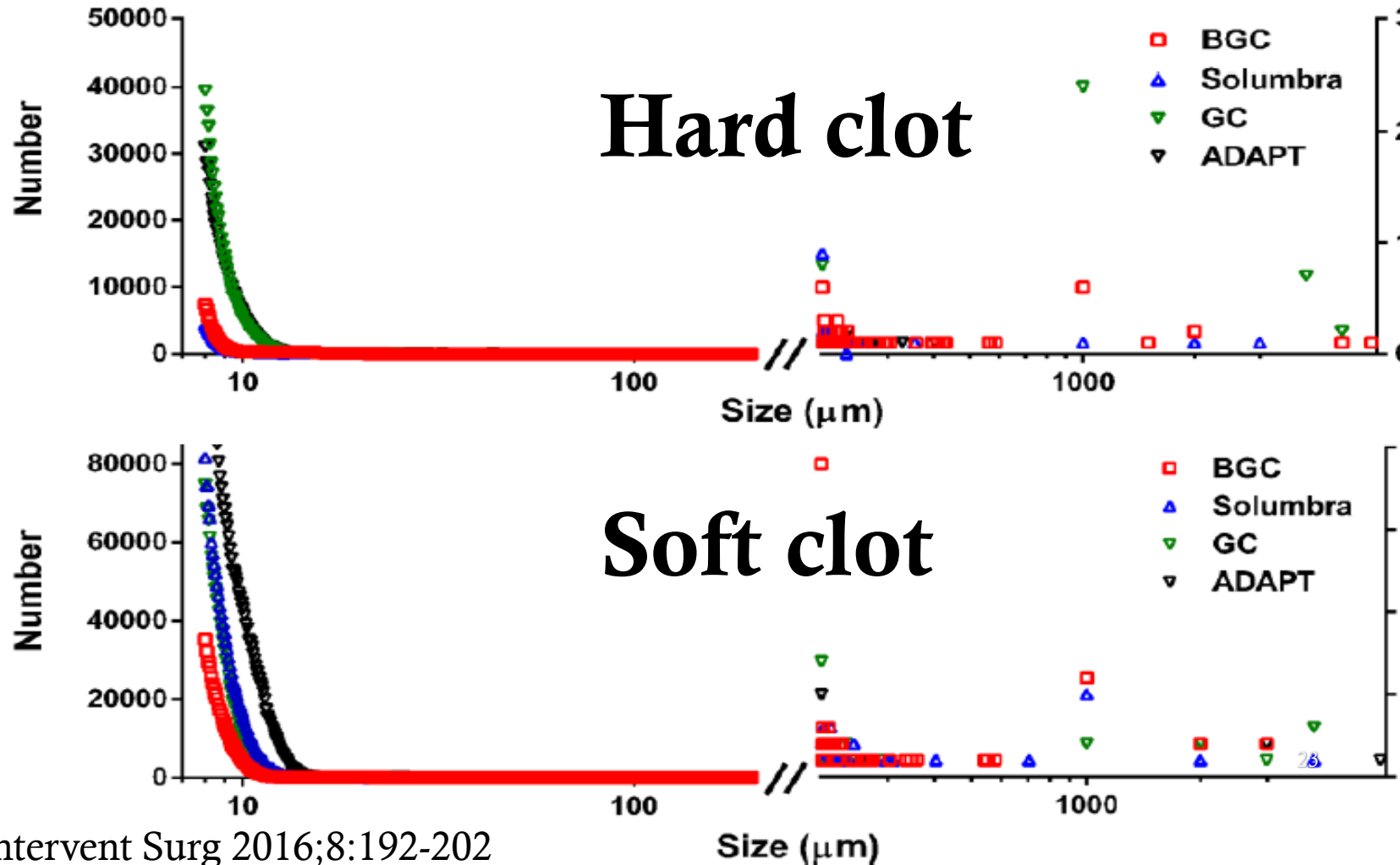
### 3. “Risk” of distal emboli: Soft clot >> Hard clot

Hard clot  
(White clot) *V.S.* Soft clot  
(Red clot)



### 3. “Risk” of distal emboli: Soft clot >> Hard clot

>90%: micro-emboli (<20 μm)

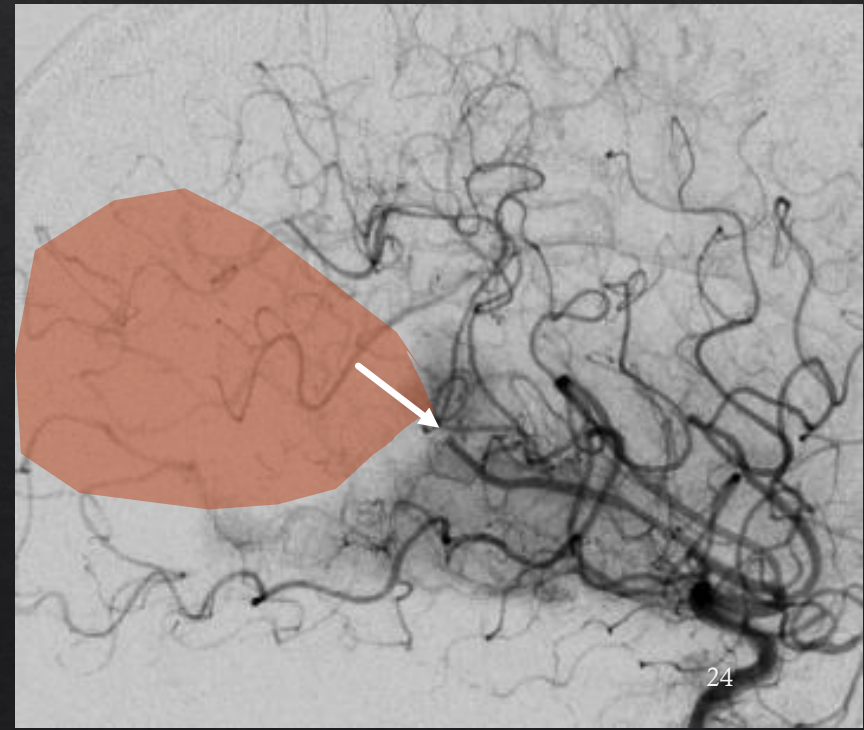
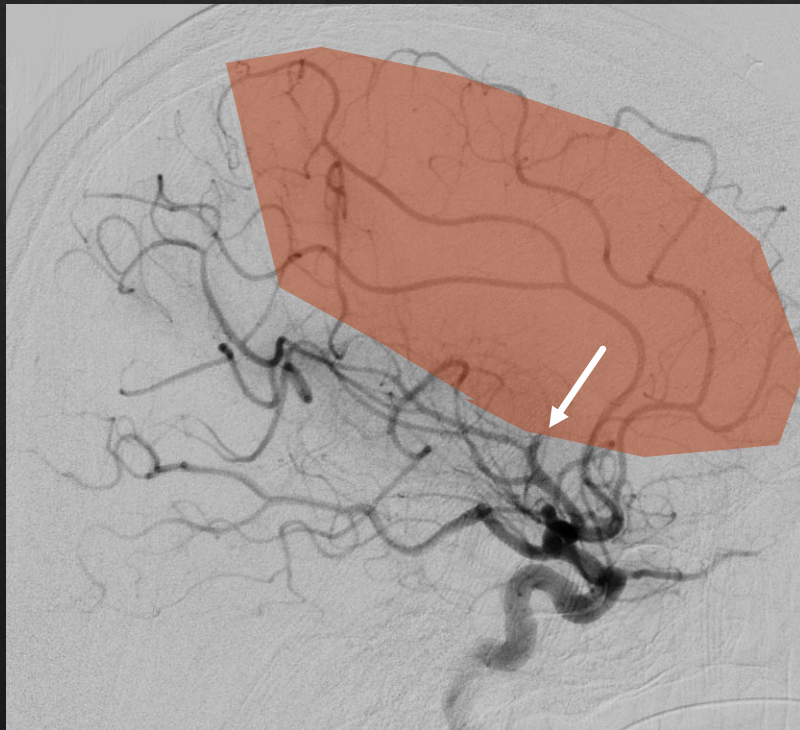


# 4. Distal emboli is “*not*” equally important

More eloquent

V.S.

Less eloquent



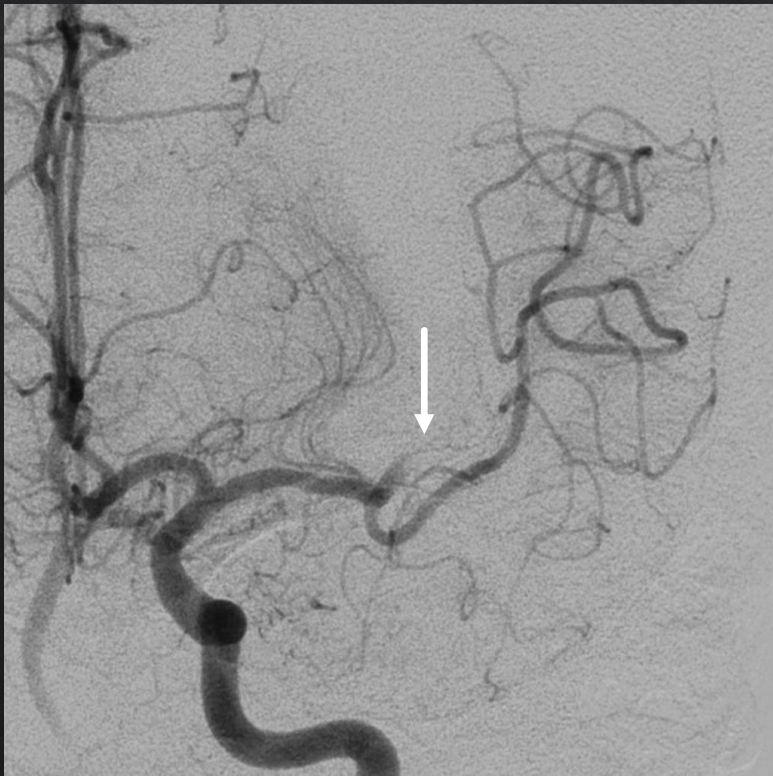


# 4. Distal emboli is “*not*” equally important

Less distal  
(Less tortuous)

V.S.

More distal  
(More tortuous)



## 4. Distal emboli is “*not*” equally important

Less distal  
(Less tortuous)

V.S.

More distal  
(More tortuous)

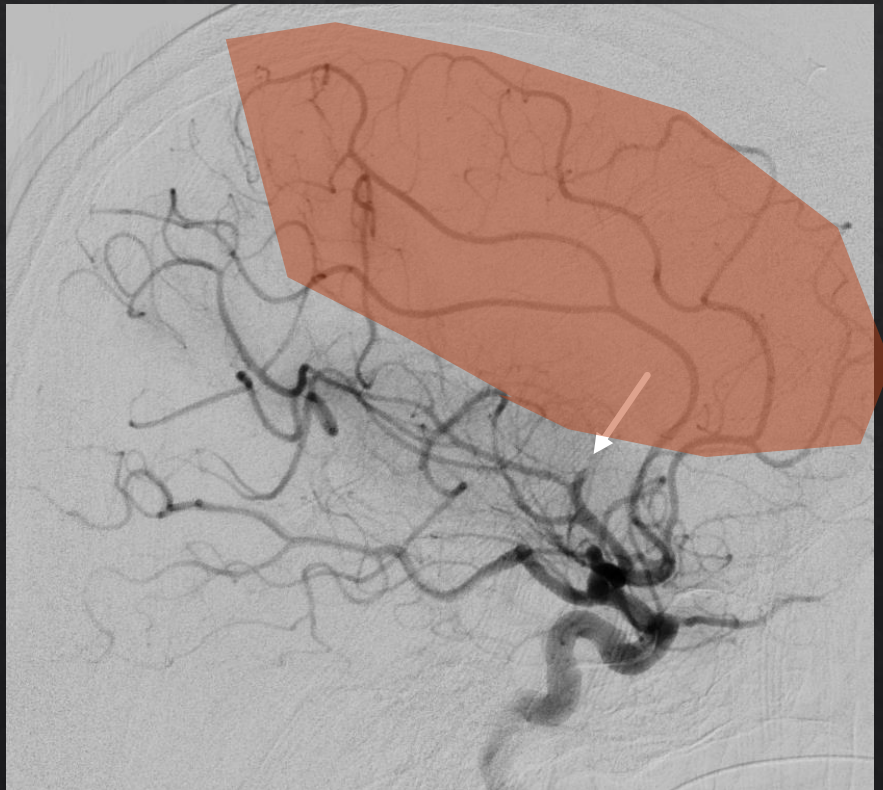


# 4. Distal emboli is “*not*” equally important

Dominant hemisphere

V.S.

Non-dominant hemisphere



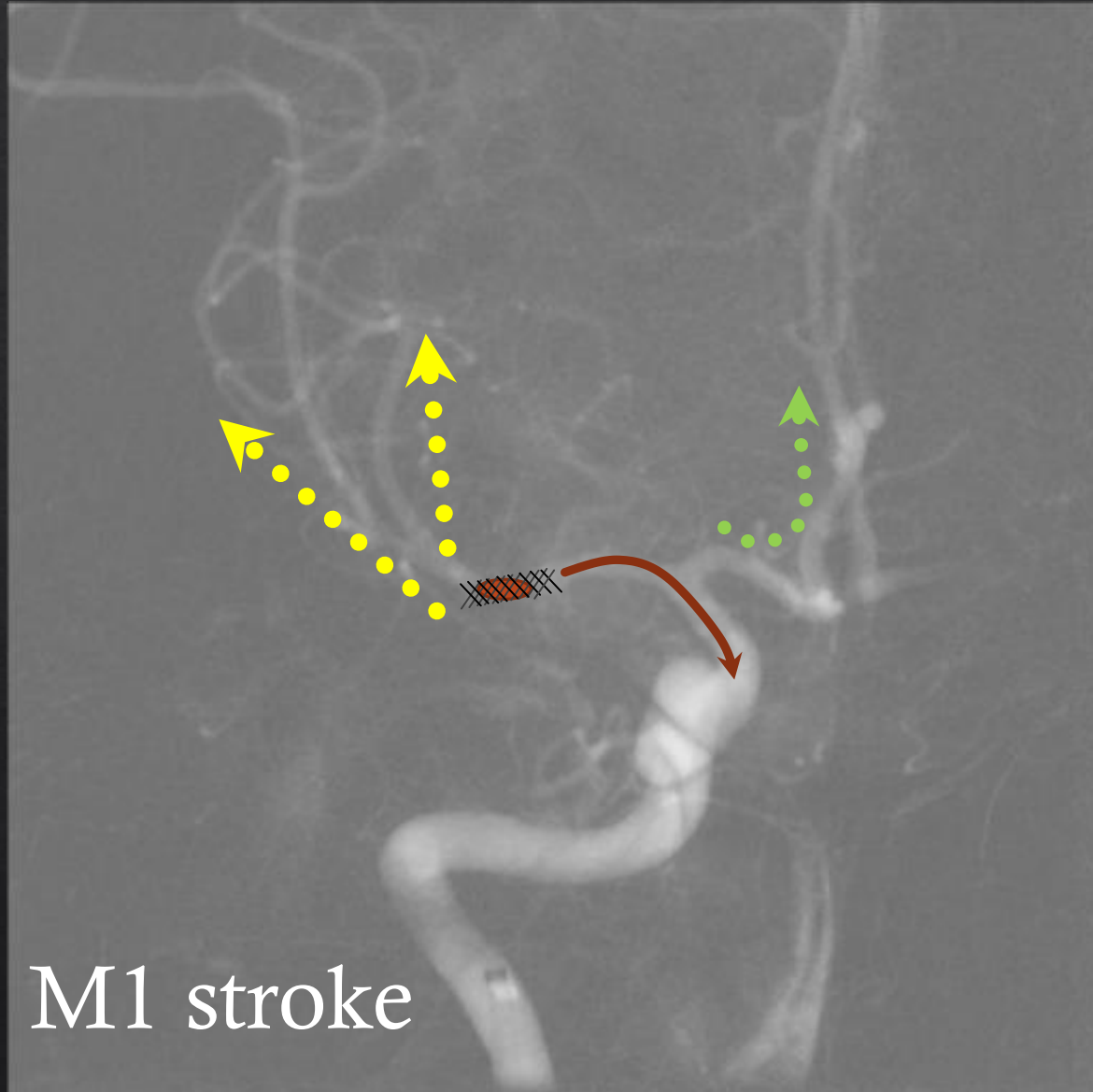
# 學習大綱

- ◆ Find out the distal emboli
- ◆ Some facts about emboli
  - ◆ Angiographically visible & invisible emboli
  - ◆ Numbers and sizes of emboli
  - ◆ Different clinical relevance of distal emboli

# 學習大綱

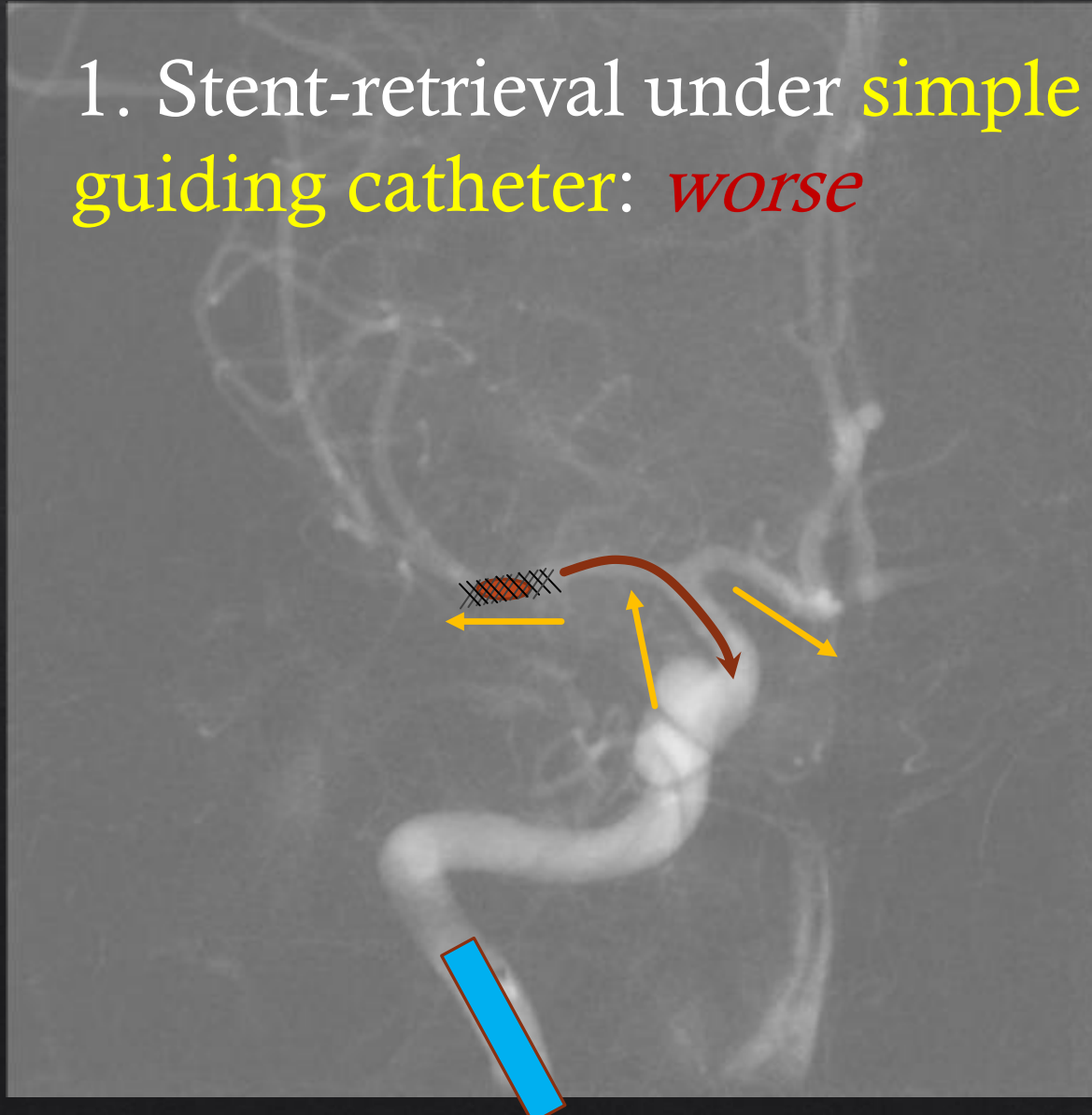
- ◆ Find out the distal emboli
- ◆ Some facts about emboli
- ◆ Techniques to reduce emboli
- ◆ Techniques to rescue emboli

# Techniques to reduce emboli



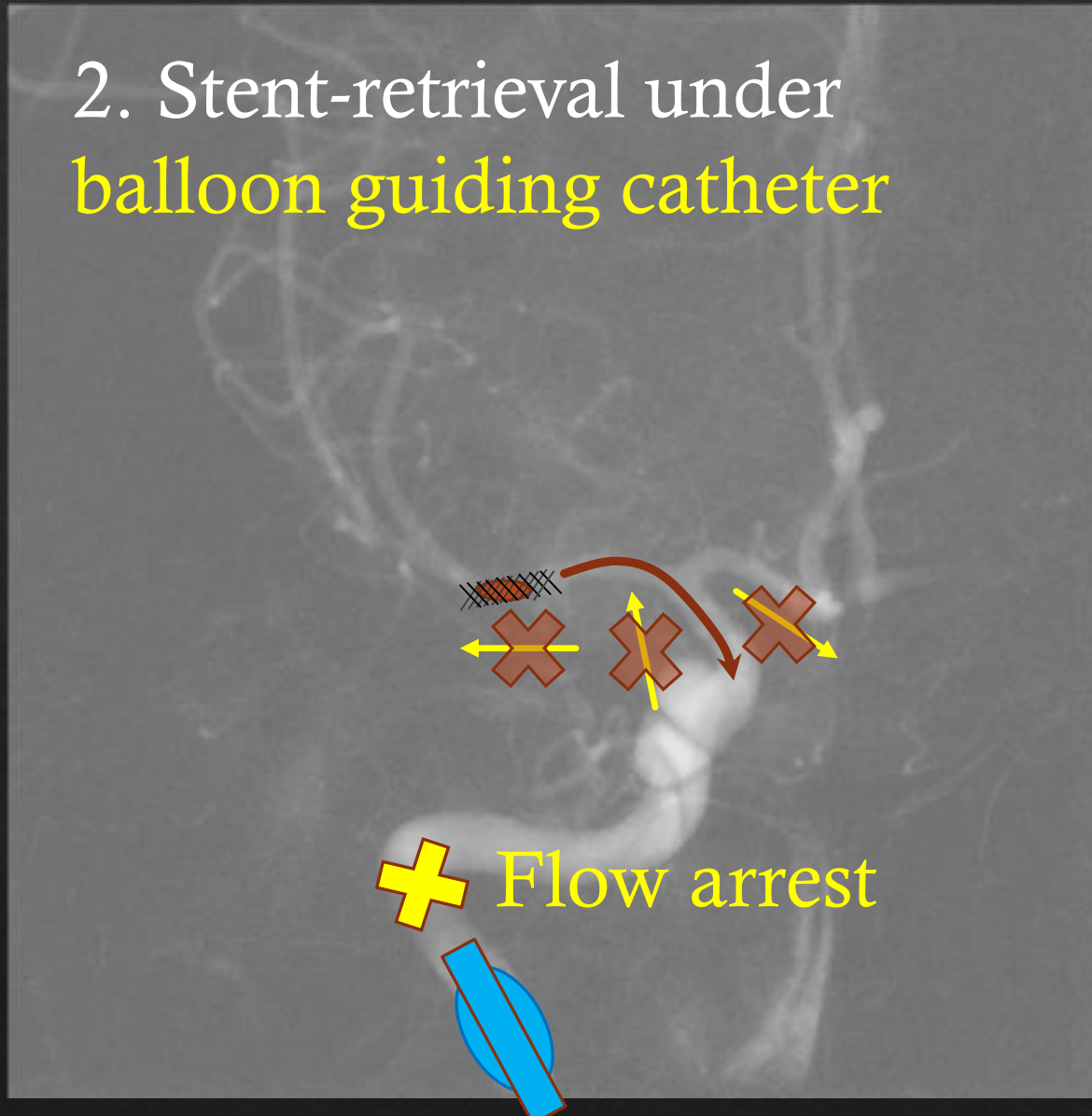
# Techniques to reduce emboli

1. Stent-retrieval under **simple**  
guiding catheter: *worse*



# Techniques to reduce emboli

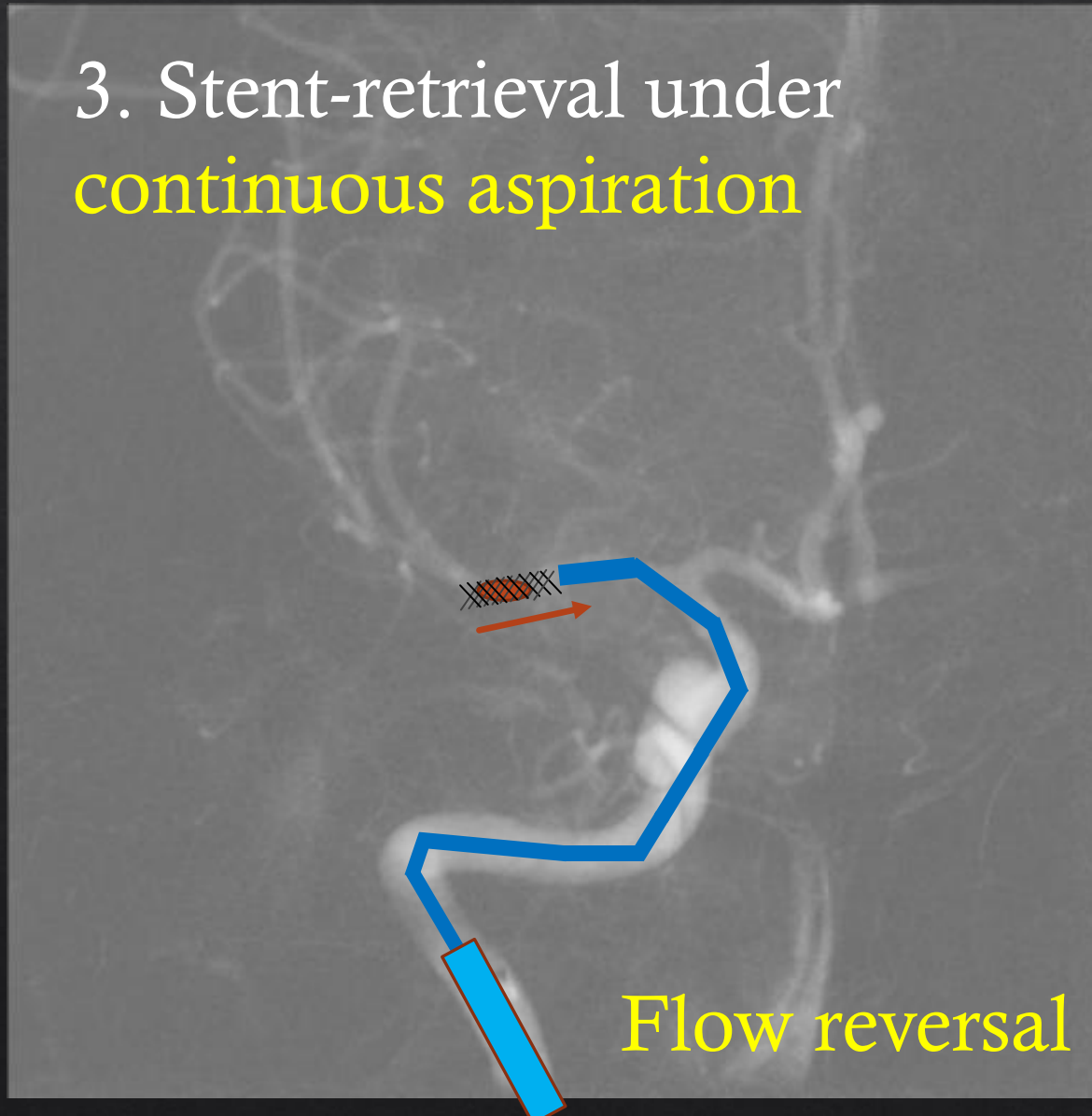
## 2. Stent-retrieval under balloon guiding catheter





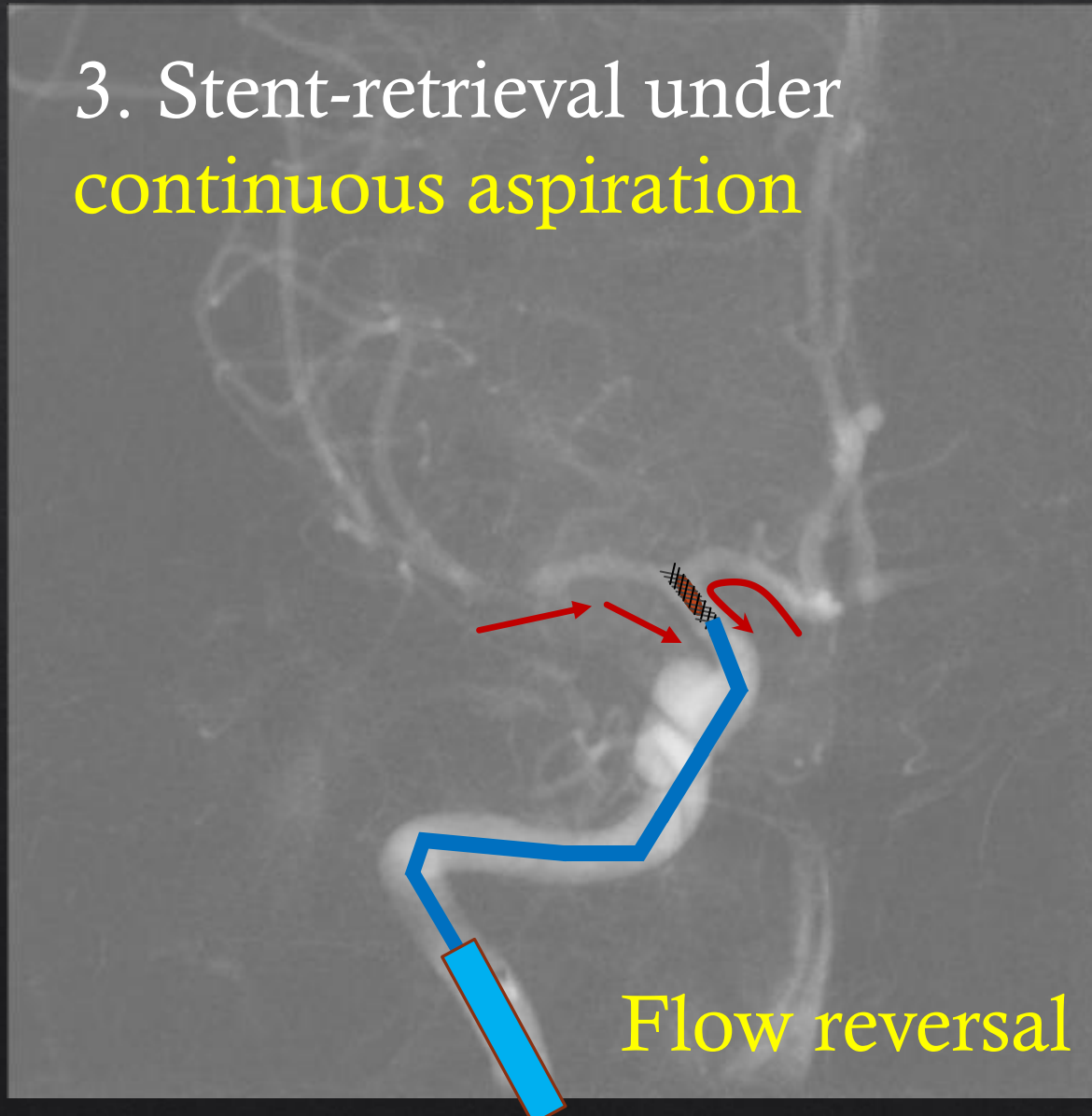
# Techniques to reduce emboli

## 3. Stent-retrieval under continuous aspiration



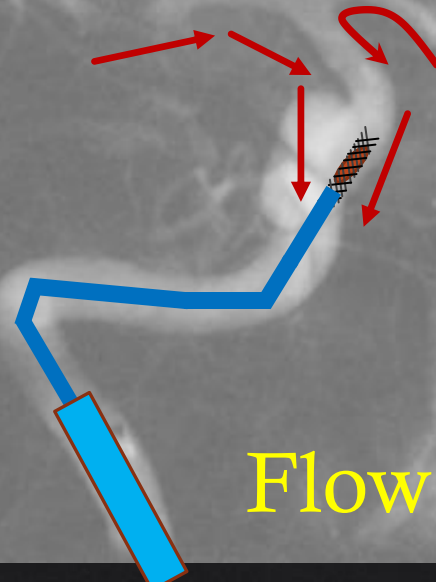
# Techniques to reduce emboli

## 3. Stent-retrieval under continuous aspiration



# Techniques to reduce emboli

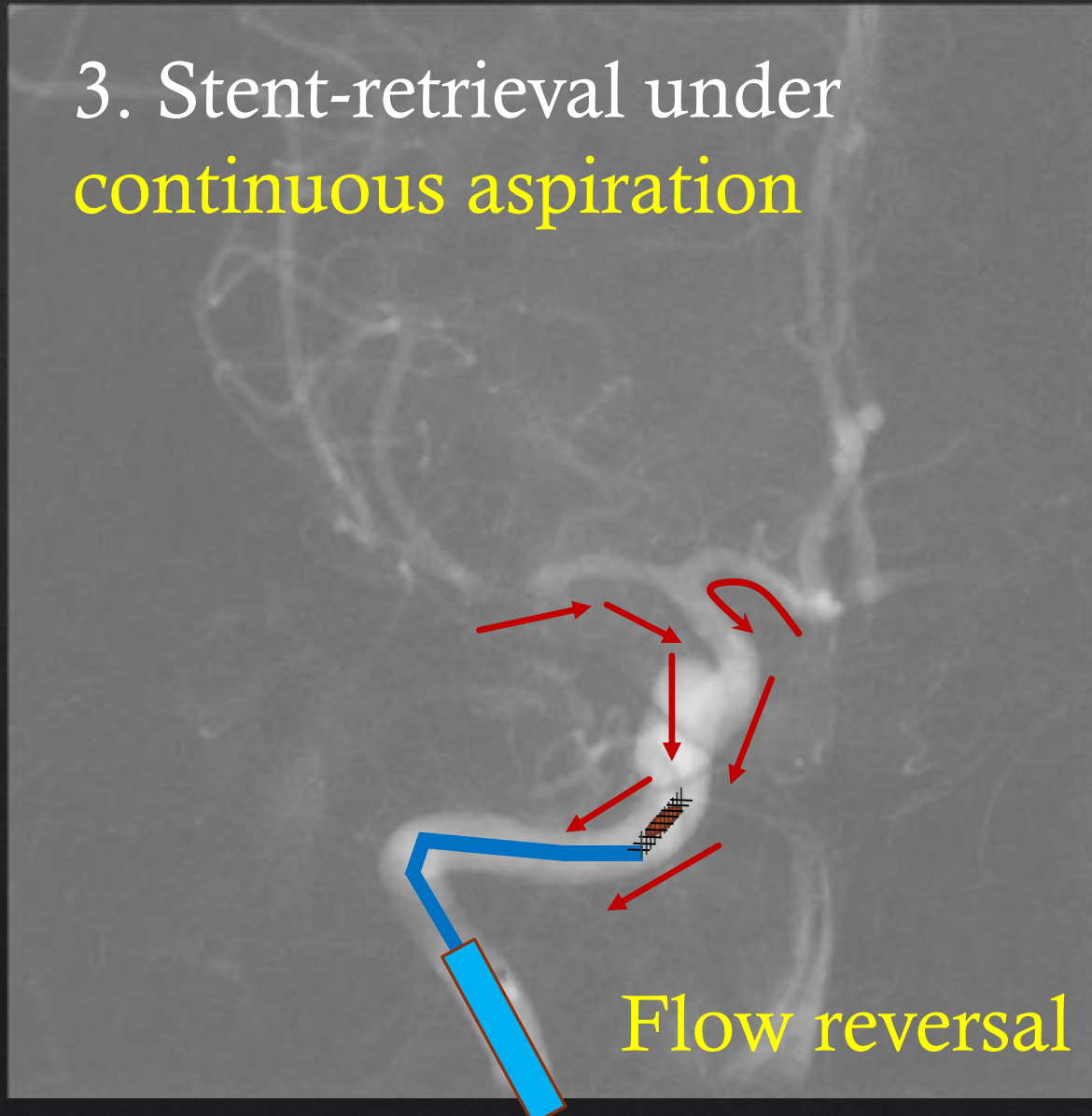
## 3. Stent-retrieval under continuous aspiration



Flow reversal

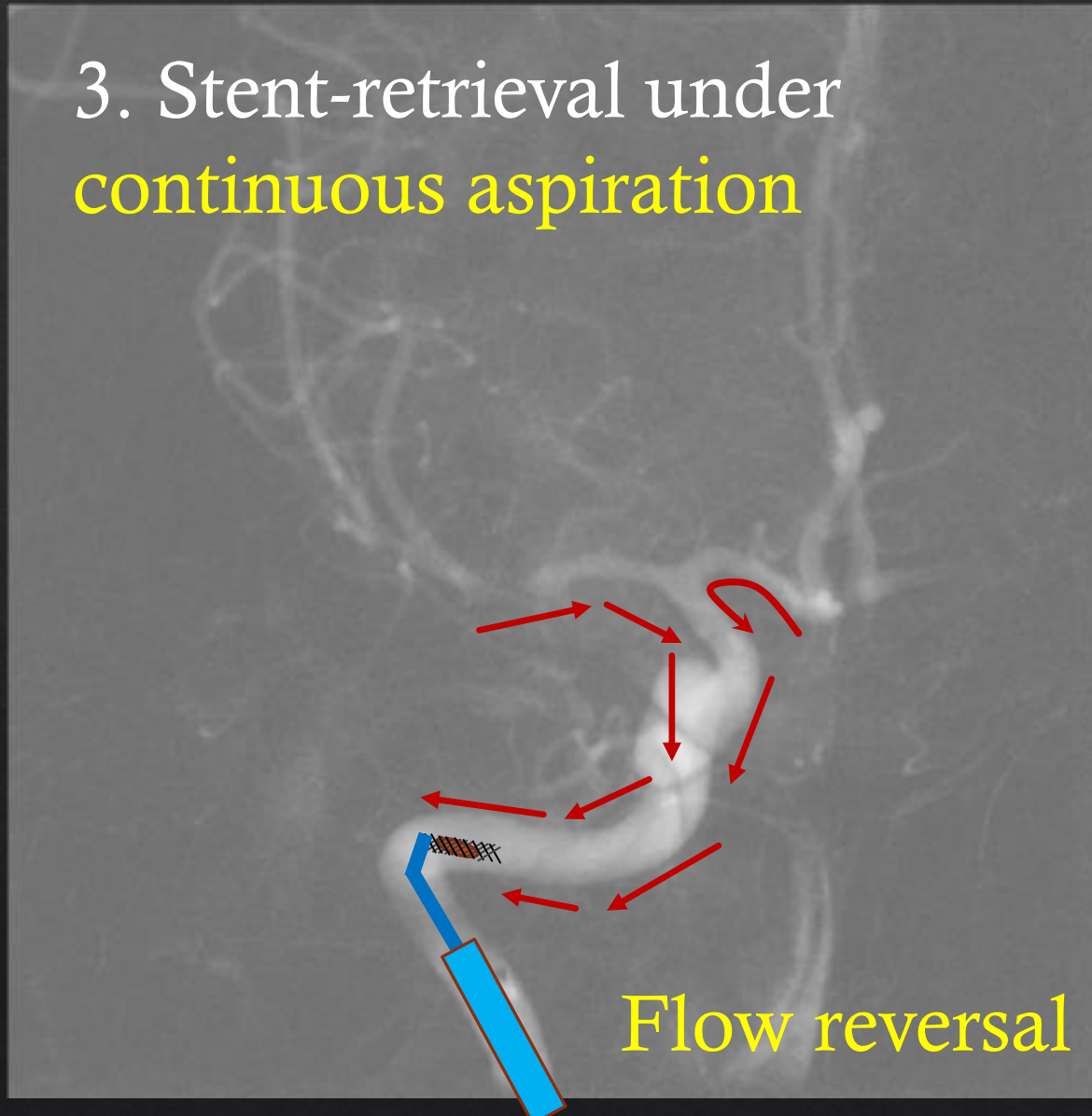
# Techniques to reduce emboli

## 3. Stent-retrieval under continuous aspiration



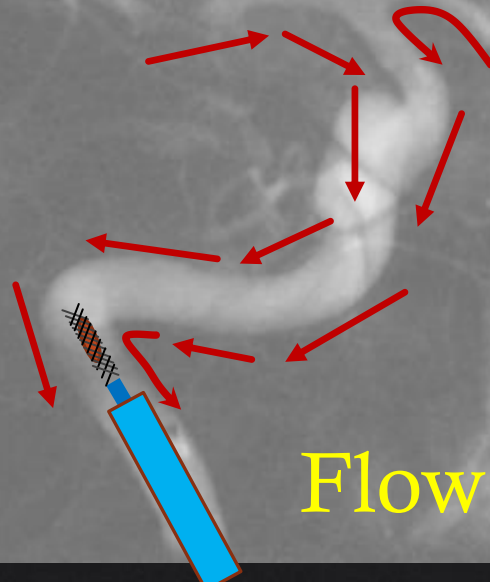
# Techniques to reduce emboli

## 3. Stent-retrieval under continuous aspiration



# Techniques to reduce emboli

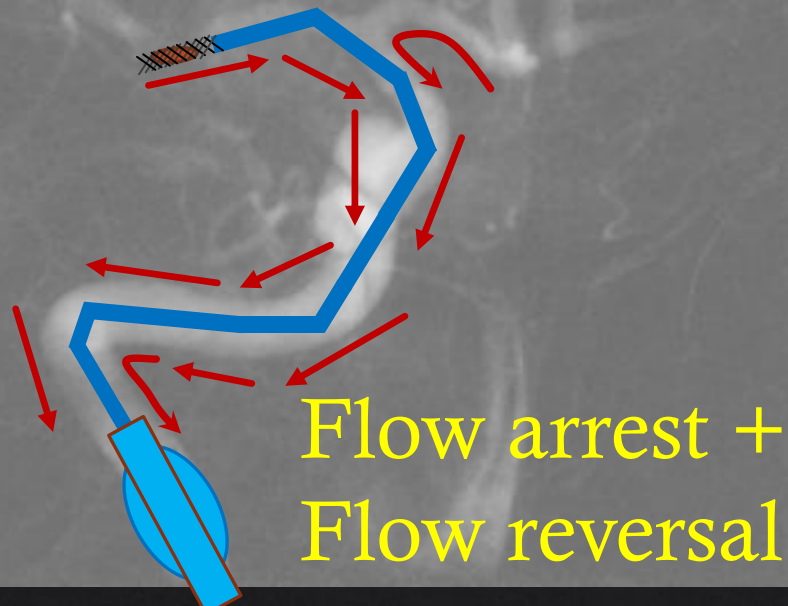
## 3. Stent-retrieval under continuous aspiration



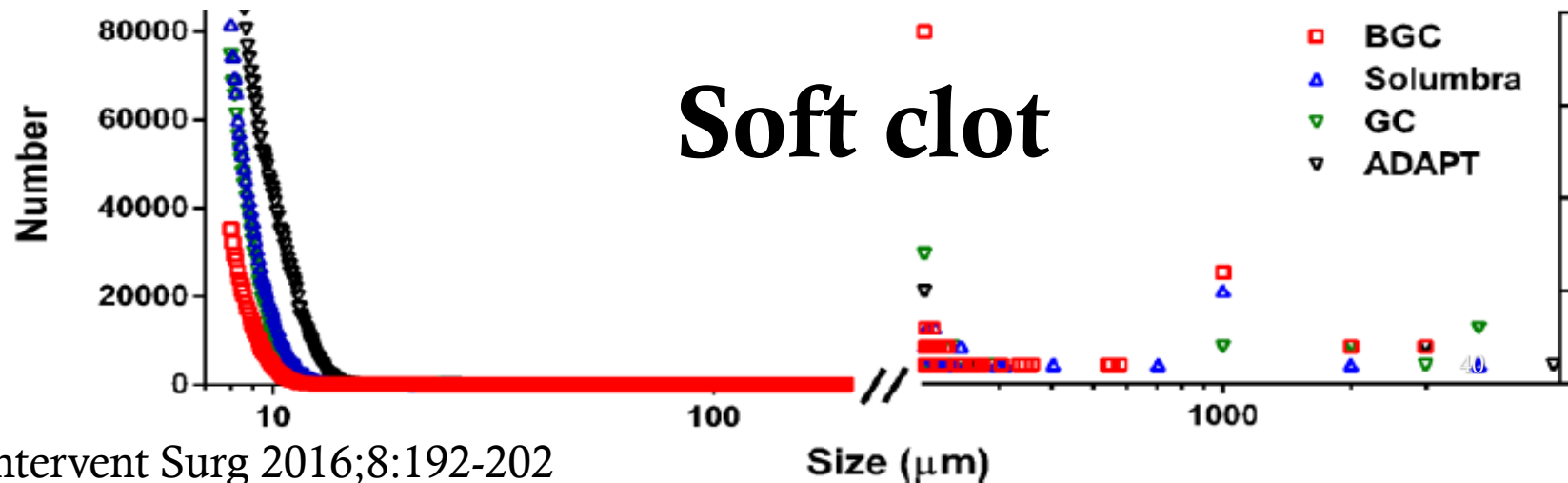
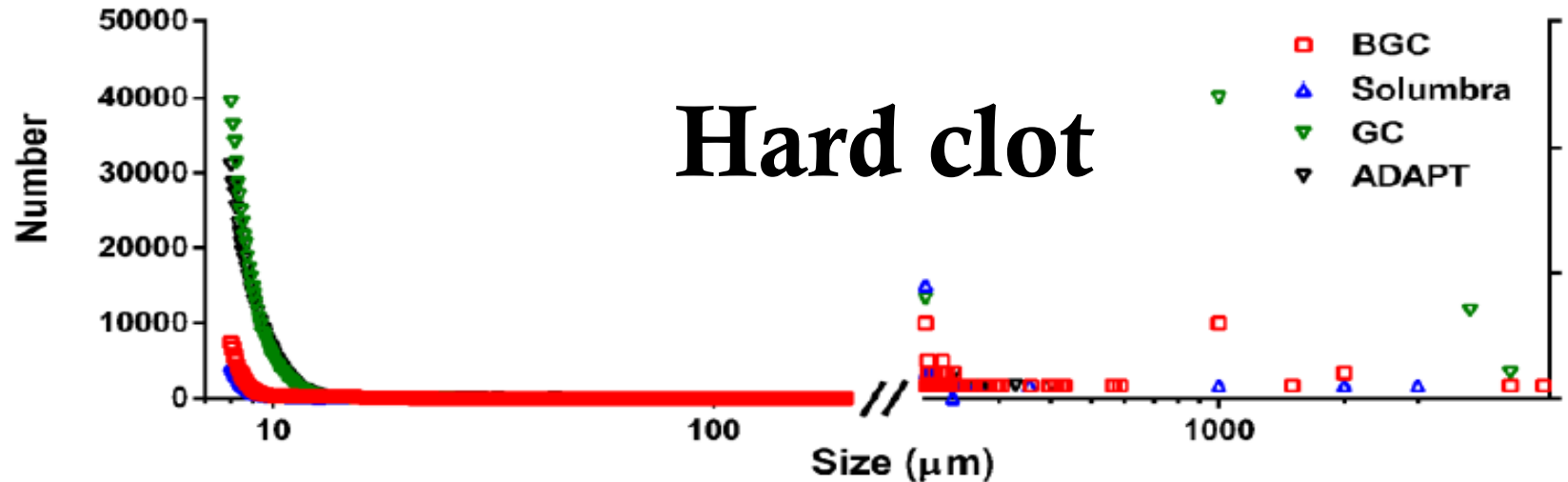
Flow reversal

# Techniques to reduce emboli

4. Stent retrieval under  
balloon guiding catheter +  
continuous aspiration

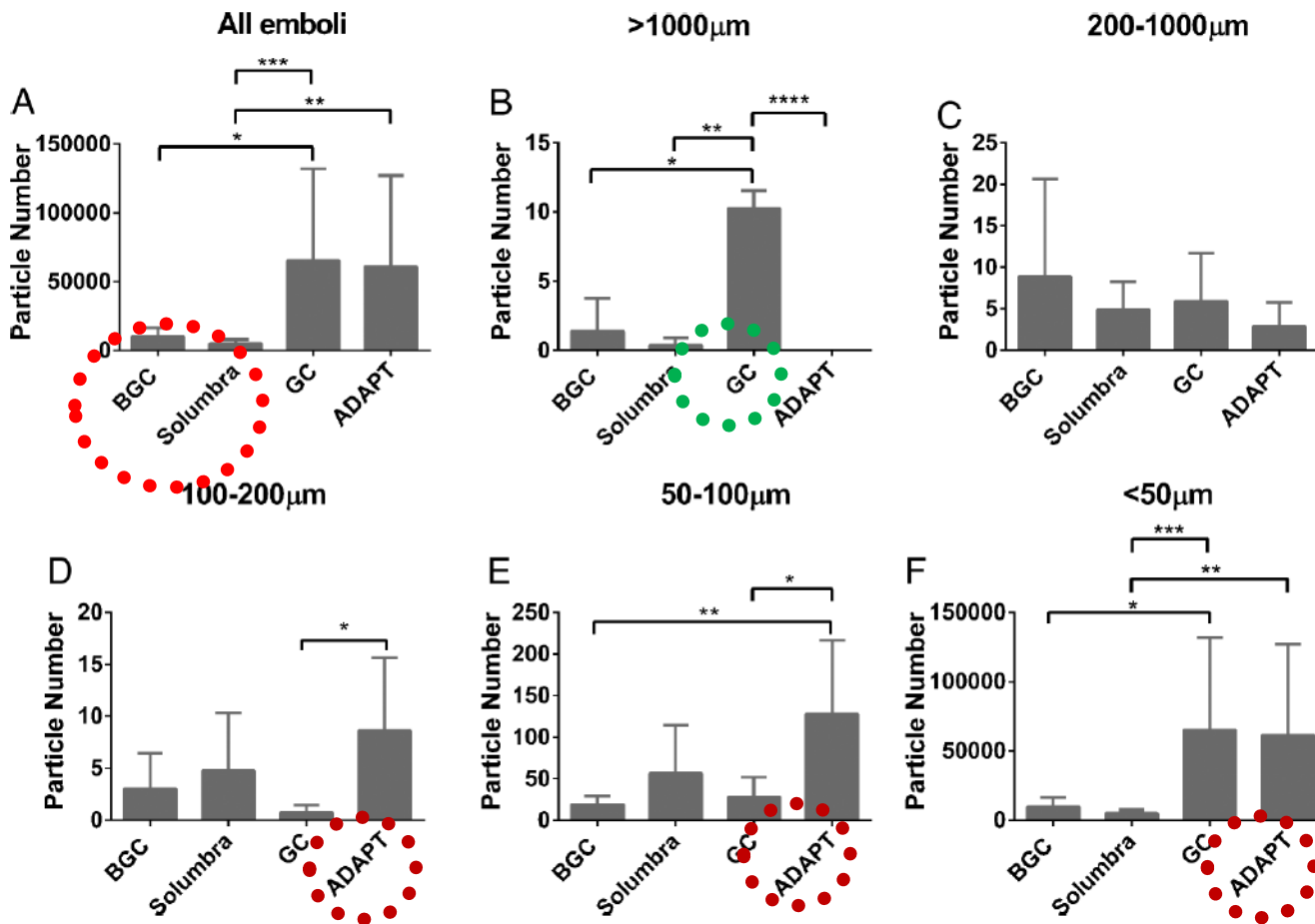


- |            |                          |        |                |
|------------|--------------------------|--------|----------------|
| □ BGC      | Balloon guiding catheter | —————> | Flow arrest    |
| △ Solumbra | Solitaire + penumbra     | —————> | Flow reversal  |
| ▽ GC       | Guiding catheter         | —————> | Antegrade flow |
| ▽ ADAPT    | Aspiration thrombectomy  |        |                |





# Hard clot

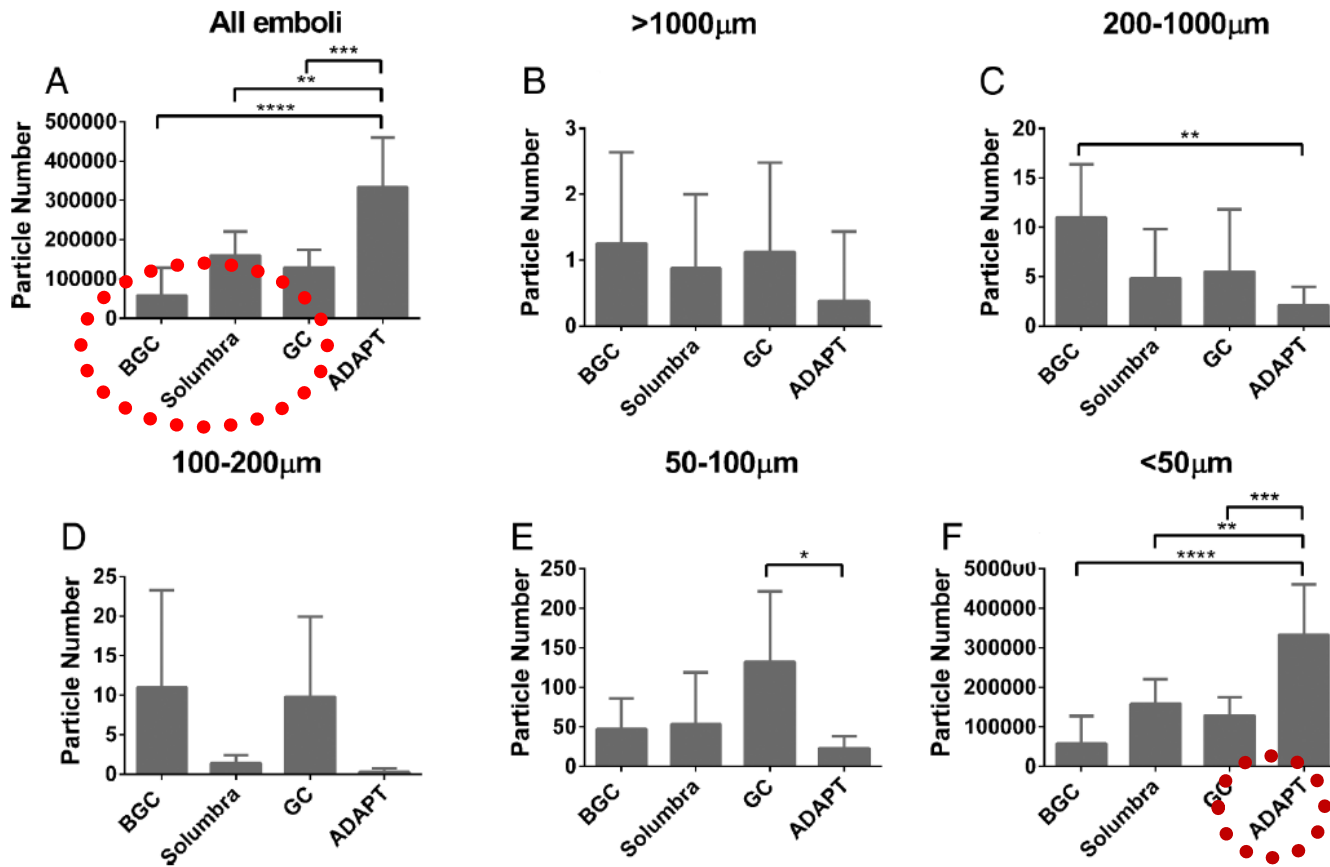


Simple guiding catheter produce larger-size emboli

ADAPT produce smaller-size emboli

- |   |                 |                          |   |                |
|---|-----------------|--------------------------|---|----------------|
| □ | <b>BGC</b>      | Balloon guiding catheter | → | Flow arrest    |
| ▲ | <b>Solumbra</b> | Solitaire + penumbra     | → | Flow reversal  |
| ▼ | <b>GC</b>       | Guiding catheter         | → | Antegrade flow |
| ▼ | <b>ADAPT</b>    | Aspiration thrombectomy  |   |                |

# Soft clot



ADAPT produce smaller-size emboli

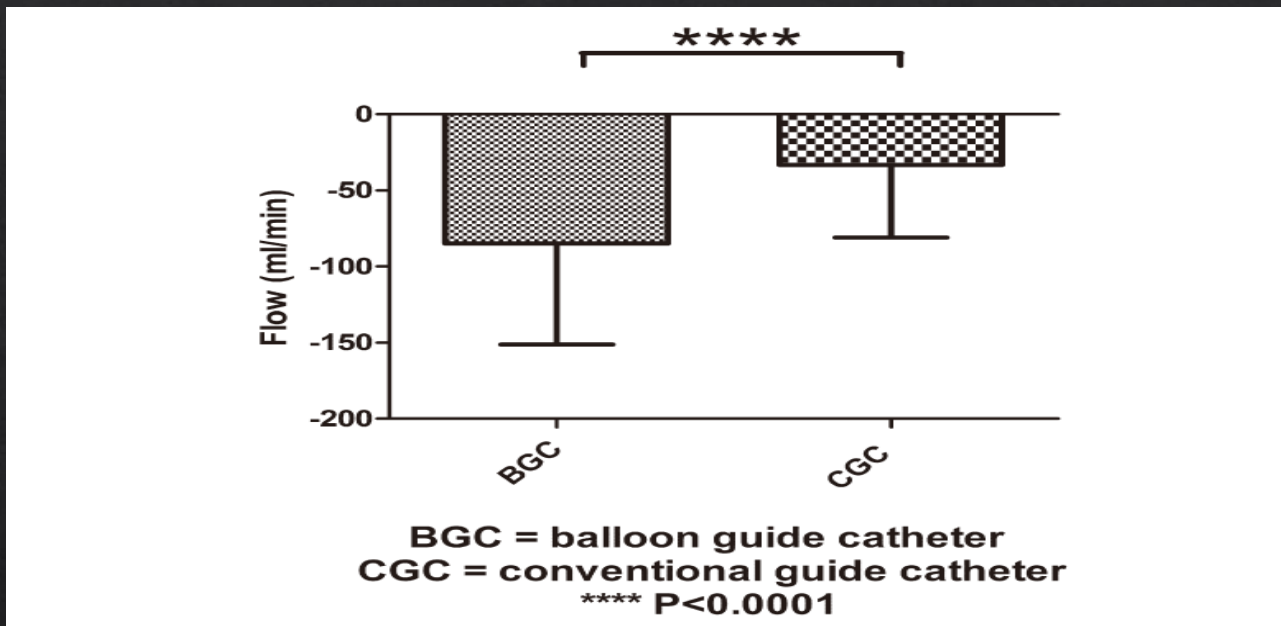
- |   |                 |                          |   |                |
|---|-----------------|--------------------------|---|----------------|
| □ | <b>BGC</b>      | Balloon guiding catheter | → | Flow arrest    |
| △ | <b>Solumbra</b> | Solitaire + penumbra     | → | Flow reversal  |
| ▽ | <b>GC</b>       | Guiding catheter         | → | Antegrade flow |
| ▽ | <b>ADAPT</b>    | Aspiration thrombectomy  |   |                |

- Flow arrest / Flow reversal matters

Aspiration at  
balloon guiding catheter  
(Flow arrest + Flow reversal)

V.S.

Aspiration at  
standard guiding catheter  
(Flow reversal)



- The degree of flow reversal under aspiration is significantly larger under flow arrest

# North American Solitaire Acute Stroke Registry

However, in clinical studies, risk of distal emboli is similar in BGC and non-BGC groups

**Table 2. Imaging, Procedural, and Clinical Results in the BGC Group vs Non-BGC Group**

	BGC (n=149), n (%)	No BGC (n=189), n (%)	P Value
Imaging results			
Distal emboli	26 (18.2)	29 (16)	0.7
Emboli in new territory	8 (5)	10 (5.2)	0.9
Recanalization TICI 3	80 (53.7)	61 (32.5)	<0.0001
Recanalization TICI 2b–3	113 (76)	133 (71)	0.3
Recanalization TIMI 2/3	128 (86)	158 (84)	0.6
Recanalization TICI 2a–3	131 (87.9)	166 (87.8)	1

Angiographically  
“invisible”  
distal emboli?

# 學習大綱

- ◆ Find out the distal emboli
- ◆ Some facts about emboli
- ◆ Techniques to reduce emboli
  - ➔ Flow arrest + Flow reversal

# 學習大綱

- ◆ Find out the distal emboli
- ◆ Some facts about emboli
- ◆ Techniques to reduce emboli
- ◆ Techniques to rescue emboli

# Techniques to rescue emboli

- ◆ Use devices with smaller profiles for rescue (Aspiration catheter)



## SIZED FOR THE VESSEL



3MAX catheter for thromboaspiration of downstream and new territory emboli after mechanical thrombectomy of large vessel occlusions: initial experience

Fabio Settecase<sup>1,2,3</sup> 

Successful rate: 75%  
No procedural complications

# Techniques to rescue emboli

- ◆ Use devices with smaller profiles for rescue (Stent-retriever)



## Solitaire

	Stent diameter (mm)	Working length (mm)
4 x 20	4	20
4 x 40	4	40
6 x 20	6	20
6 x 24	6	24
6 x 40	6	40

## Revive

Vessel diameter (mm)	Working length (mm)
4.5	22
4.0	23
3.5	24
3.0	25
2.5	26
2.0	27
1.5	28

## Trevo

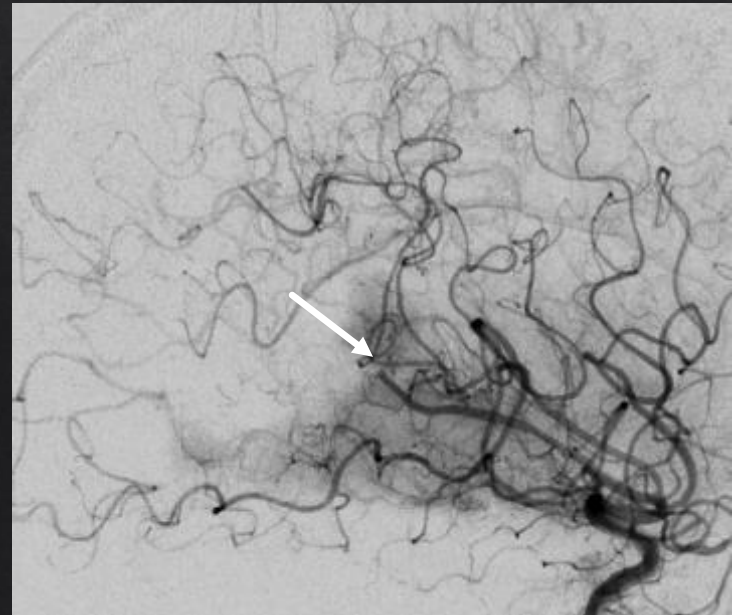
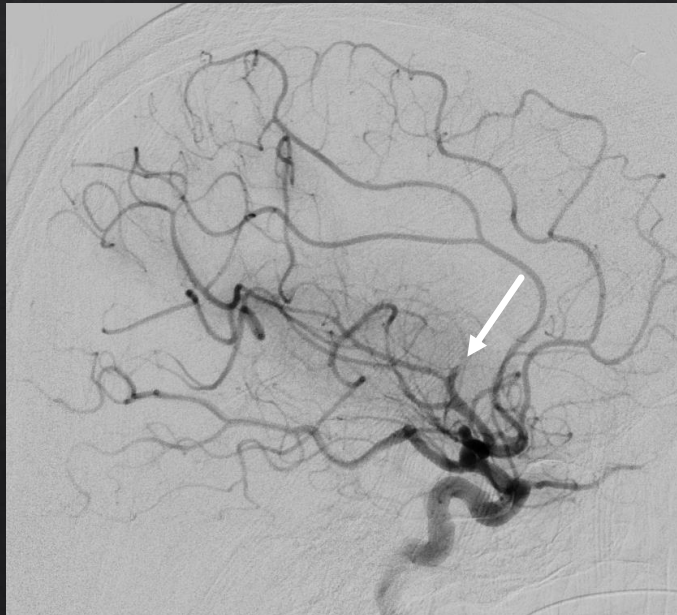
	Stent diameter (mm)	Working length (mm)
3 x 20	3	20
4 x 20	4	20
4 x 30	4	30
6 x 25	6	25



# Techniques to rescue emboli

## ◆ Before rescue, keep two things in mind

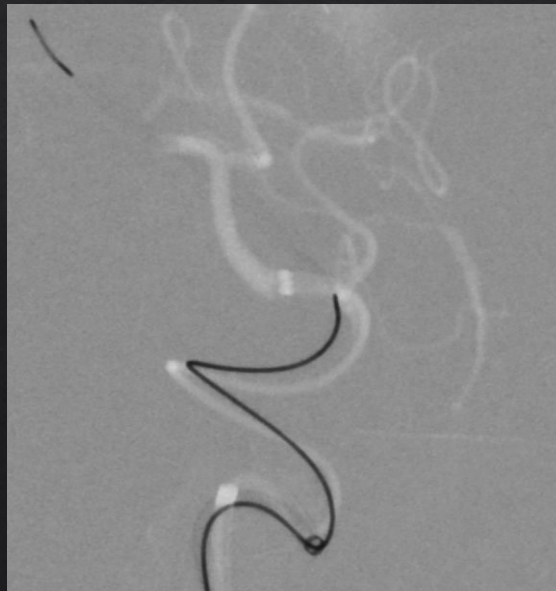
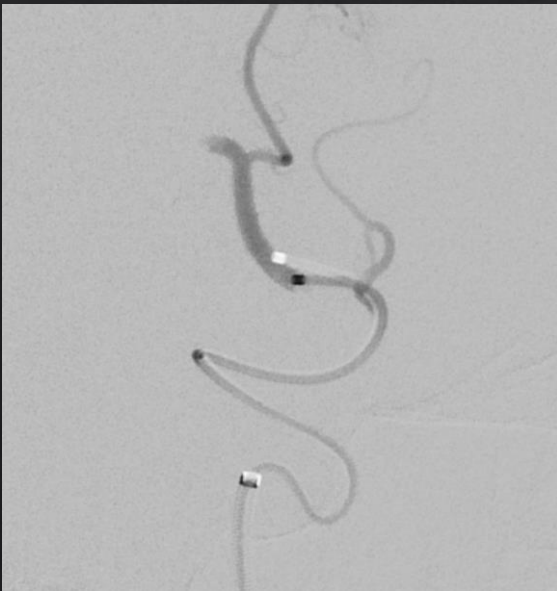
1. Attack the branches that were considered to vascularize eloquent brain or that were judged to have poor collaterals



# Techniques to rescue emboli

## ◇ Before rescue, keep two things in mind

2. The more vessel tortuosity, the higher risk of vascular injury  
→ vasospasm (62.5%), hemorrhage (25%), or dissection



# Techniques to rescue emboli

## ◇ Before rescue, keep two things in mind

2. The more vessel tortuosity, the higher risk of vascular injury  
→ vasospasm (62.5%), hemorrhage (25%), or dissection



**Half-Trevo technique:**  
decrease tension on  
tortuous vessel

# Take home messages

- ◆ Accurate detection of distal emboli requires practice
- ◆ Try your best to prevent distal emboli
  - ◆ Flow arrest: balloon guiding catheter
  - ◆ Flow reversal: continuous aspiration during stent-retrieval
- ◆ Chase or not to chase?: that is always the question
  - ◆ If you plan to chase the emboli, choose devices with smaller profile

# Thanks for your attention



[ichangsu@gmail.com](mailto:ichangsu@gmail.com)