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Neuro-Salvage for Acute Procedural Cerebral Embolism

Procedural complications of CAS

- Systemic
  - Infection
  - Renal
  - Cardiac
- Wound
  - Hematoma
  - Vascular
- Cerebral hemorrhagic
  - Hyper-perfusion
  - ICH/SAH
- Cerebral ischemic
  - Hypo-perfusion
  - Embolism

Benchmark for CAS complication

- Symptomatic lesion death/stroke <6%
- Asymptomatic lesion death/stroke <3%

- But, silent embolism may be largely under-estimated, and the consequences are unknown

Pitfall of embolic protection device

- No "full procedure" protection
- Initial crossing
- Device apposition
- Dead-space
- Capture efficiency
- Patient tolerance
- Thrombus formation on the device surface

How to minimize embolism

- Dual antiplatelet for at least 1 week
- Procedural heparin to achieve adequate ACT
- Well hydrate the patient
- Delicate catheter/wire manipulation
- Always use EPD when possible

NTUH CAS experience

- 938 CAS in 796 patients since 1998/4
- Overall complication rates 3.6%
  - Symptomatic 4.7%
  - Asymptomatic 2.3%
- Structured and stepwise approach for procedural embolism applied since 2003/3

Neuro-salvage : general

- Only when patient becomes symptomatic
- Compare with baseline IC shots carefully
- Identify culprit based on angiogram and clinical deficit
- 5F ST01 thru 8F GC into distal ICA as platform
- Target endopoint: TIMI 2 flow, clear MI
- CT immediately after procedure

Step 1

- Pass 0.014" wire across the embolic site with gentle rotation
- Micro-catheter (MC) advanced over wire proximal to the emboli
- Withdraw wire and give NTG (100µg) and heparin (2000U) through MC

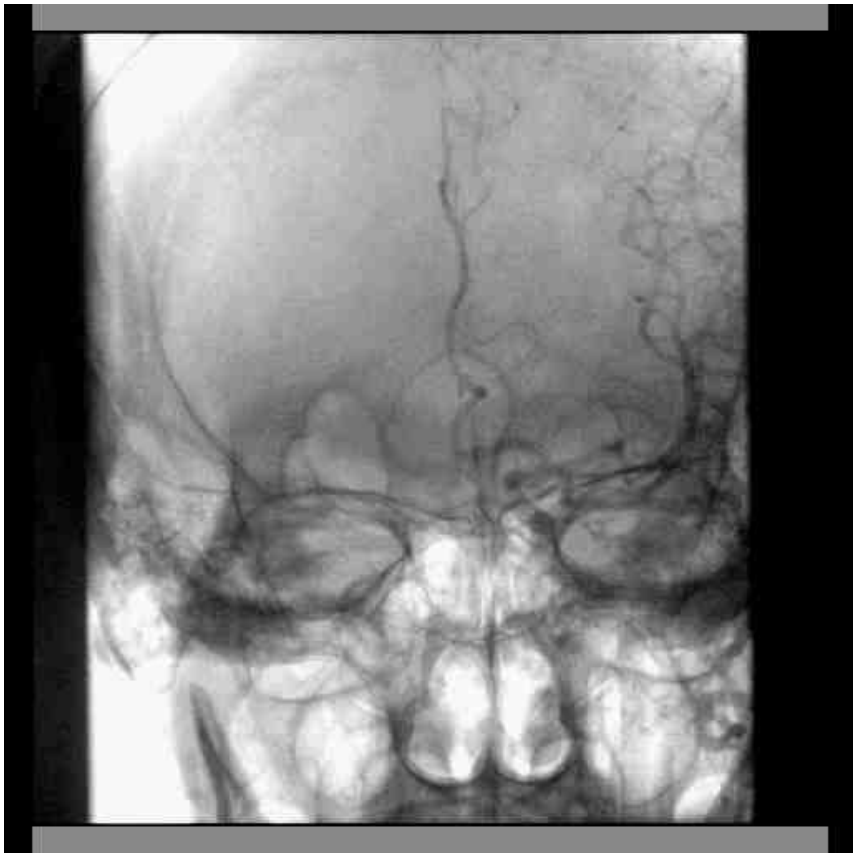
Step 2

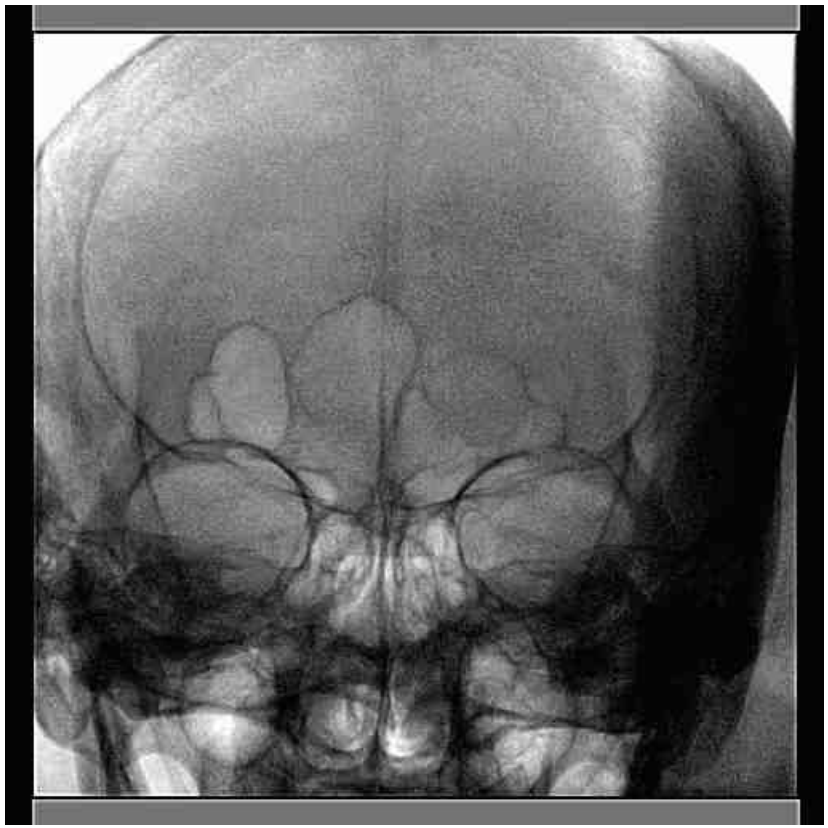
- When step 1 failed
- rt-PA, if not contra-indicated, in 3mg aliquots through MC every 5 minutes until 0.3mg/Kg

Step 3

- When step 2 contraindicated or failed
- Advance wire in MC across emboli again
- Remove MC
- Angioplasty at low pressure (2-4atm) using flexible low-profile 1.25mm coronary balloon
- May be followed by larger balloon or stent if refractory recoil or flow-limiting dissection is present

Aphasia and right arm weakness





Salvage numbers

- 407 CAS in 342 consecutive patients (283 men, 72.1 ± 8.9 y/o) from 2003/3 to 2007/12
- 10 neuro-salvage (2.5%) was done and analysed

Patients characteristics

Pt	Age	Sex	NASCET status	Target ICA	Procedure causing embolism	Emboli site
1	72	M	Sym (stroke)	Right	Diagnostic angiography	M1, left
2	67	M	Sym (stroke)	Left	GC engagement	M1/M2, left
3	68	M	Asym	Left	Post-dilatation	A1, left
4	70	M	Asym	Left	Diagnostic angiography	M3, right
5	73	M	Asym	Right	Diagnostic angiography	M3, left
6	84	F	Asym	Left	Diagnostic angiography	VB junction
7	86	F	Sym (stroke)	Left	Diagnostic angiography	M2, left
8	77	F	Sym (TIA)	Left	Diagnostic angiography	M3, left
9	79	M	Asym	Left	Post-dilatation	M2, left
10	61	M	Asym	Left	Diagnostic angiography	M1, right

Salvage procedure

Pt	Pre-salvage TIMI flow	Step 1	TIMI flow after step 1	IA rt-PA dose (mg)	TIMI flow after rt-PA	Balloon fragmentation	TIMI flow after balloon	Intracranial stenting	Post-salvage TIMI flow
1	0	Yes	0	CI	-	Yes	1	No	1
2	1	Yes	1	CI	-	Yes	1	Yes	2
3	0	Yes	1	15	2	No	-	No	2
4	0	Yes	0	9	2	No	-	No	2
5	0	Yes	0	21	1	Yes	3	No	3
6	1	Yes	3	0	-	No	-	No	3
7	0	Yes	0	CI	-	Yes	2	No	2
8	0	Yes	1	CI	-	Yes	2	No	2
9	0	Yes	0	15	3	No	-	No	3
10	0	Yes	3	0	-	No	-	No	3

Clinical outcome

Pt	Hemorrhagic complication	New infarct in 1 week brain CT	NIHSS evaluation			1 month neurological deficit
			Pre-procdure	Post-procedure	1 month	
1	SAH	Yes	3	9	8	Right hemiparesis & dysarthria
2	No	Yes	2	5	3	Motor aphasia & dysarthria
3	No	Yes	0	10	8	Right hemiparesis & slurred speech
4	ICH + SAH	Yes	0	NA	12	Emergent craniotomy & left hemiplegia
5	No	No	0	3	0	No deficit
6	No	No	0	0	0	No deficit
7	ICH	Yes	5	NA	NA	Ventilator dependent
8	No	Yes	0	2	0	No deficit
9	No	No	0	3	0	No deficit
10	No	No	0	0	0	No deficit

Tips for successful salvage

- Baseline IC until venous phase
- Good support and un-obscured view by ICA GC platform
- Careful handling of delicate wire (Runthrough NS floppy, Fielder FC)
- State-of-the-art MC (Finecross 150)
- Small profile flexible balloon (Ottimo)
- Small profile flexible stent (Tsunami, Driver)

Other methods in literature

- Systemic lytic therapy
  - Recanalization rate only 44%
  - Risk of bleeding
- Thrombus aspiration
  - Low emboli retrieval rate 39.4%
  - Poor device
- Thrombectomy device
  - Availability limited
  - Not reported in CAS complication

Hähnel S, et al. Stroke 2003;34:1723

Gralla J, et al. Stroke 2006;37:3019

Conclusion

- Structured catheter-based approach combining stepwise intra-arterial pharmacological therapy and mechanical emboli manipulation is feasible in salvaging acute embolic complications during CAS
- Angiographic success rate is high, with acceptable clinical salvage outcomes

Experience is the name we give to our mistakes

Oscar Wilde