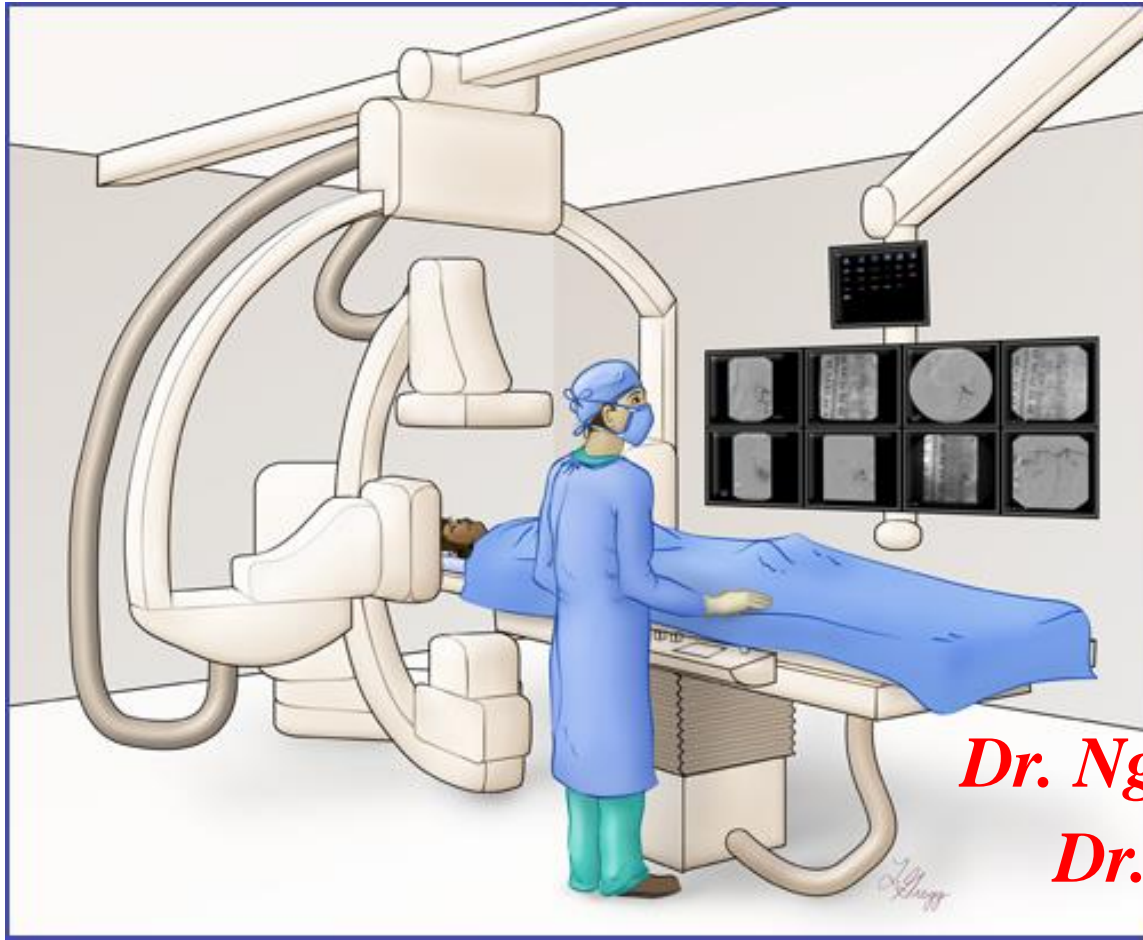
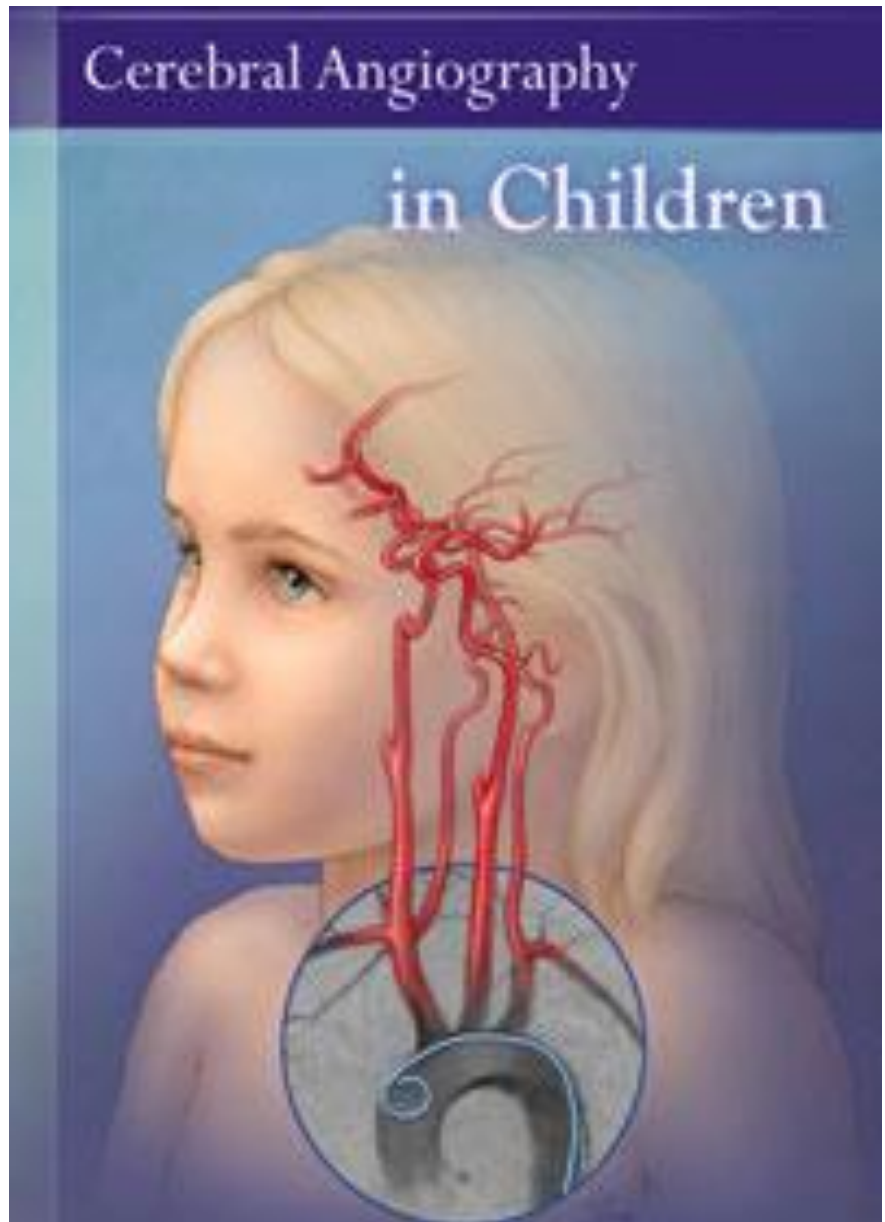


# Cerebral Angiography in Children



*Dr. Nguyen Ngoc Pi Doanh*  
*Dr. Dang Ngoc Dung*

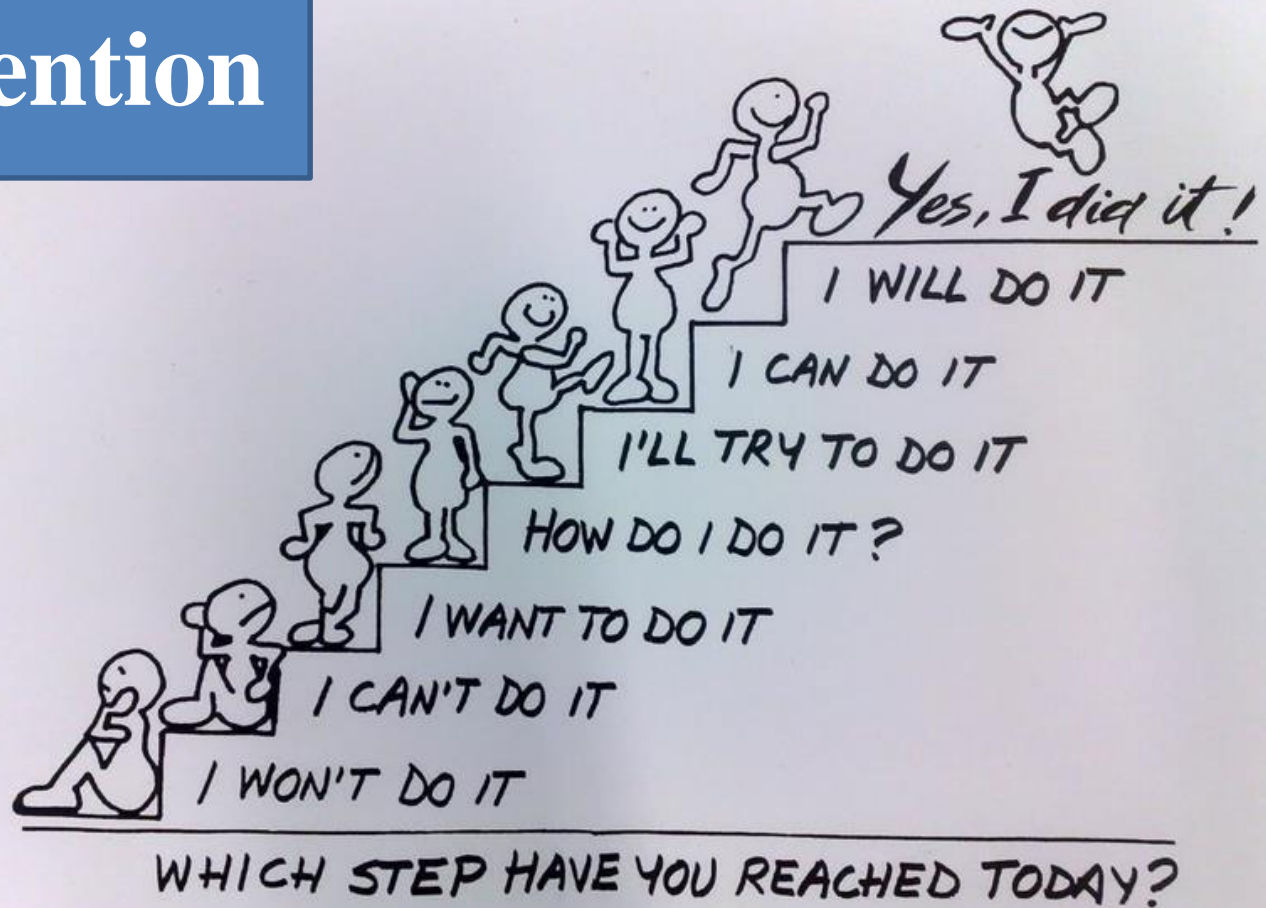
- Angiography is a *minimally invasive medical test* that uses x-rays and an *iodine-containing contrast* material to produce pictures of blood vessels in the brain.
- *Gold standard* for imaging cerebral vasculature



# Neurointervention



Neuro-  
Angiography



neurointerventional training. Training standards formulated by the American Society of Interventional and Therapeutic Neuroradiology (ASITN), the Joint Section of Cerebrovascular Neurosurgery, and the American Society of Neuroradiology (ASNR) recommend the performance of at least 100 diagnostic angiograms before entering neuroendovascular training.<sup>1</sup> This handbook authors' preference, however, is for a neurointerventionalist-in-training to perform at least 250 diagnostic cerebral angiograms prior to becoming the lead operator in neurointerventional cases.

# Indications

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## 2.1. Indications

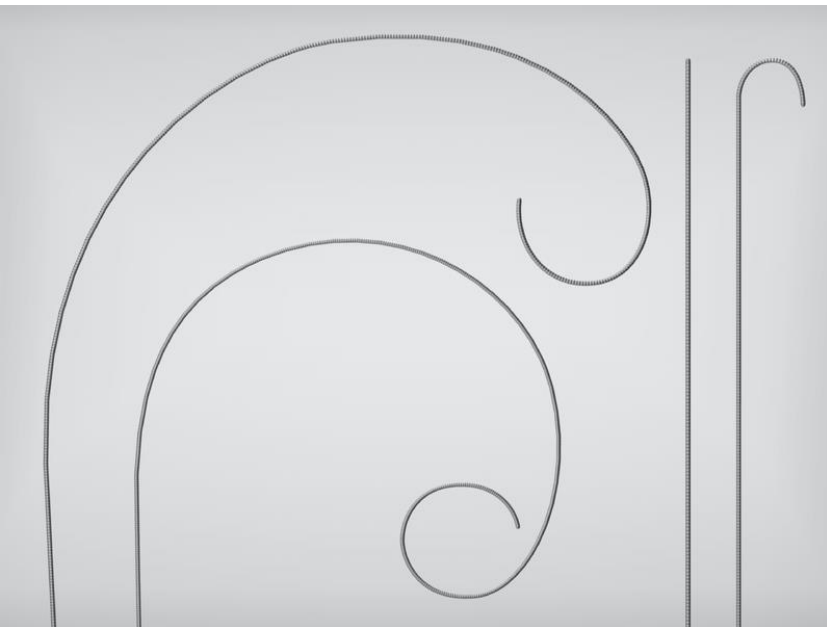
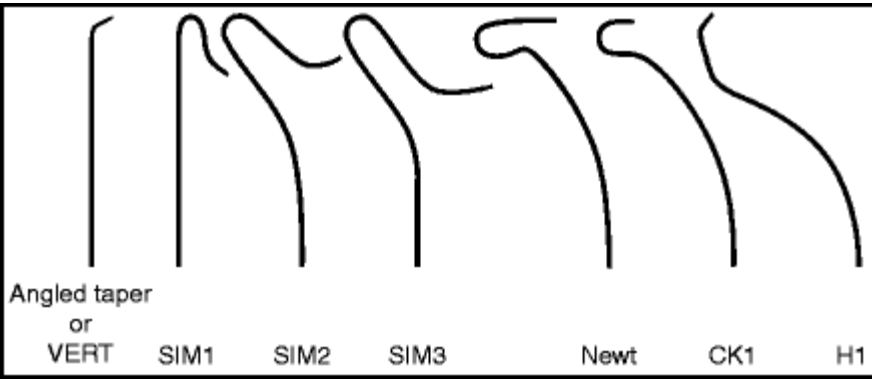
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1. Diagnosis of primary neurovascular disease (e.g., intracranial aneurysms, arteriovenous malformations, dural arteriovenous fistulas, atherosclerotic stenosis, vasculopathy, cerebral vasospasm, acute ischemic stroke)
2. Planning for neurointerventional procedures
3. Intra-operative assistance with aneurysm surgery
4. Follow-up imaging after treatment (e.g., after aneurysm coiling or clipping, treatment of arteriovenous fistulas)

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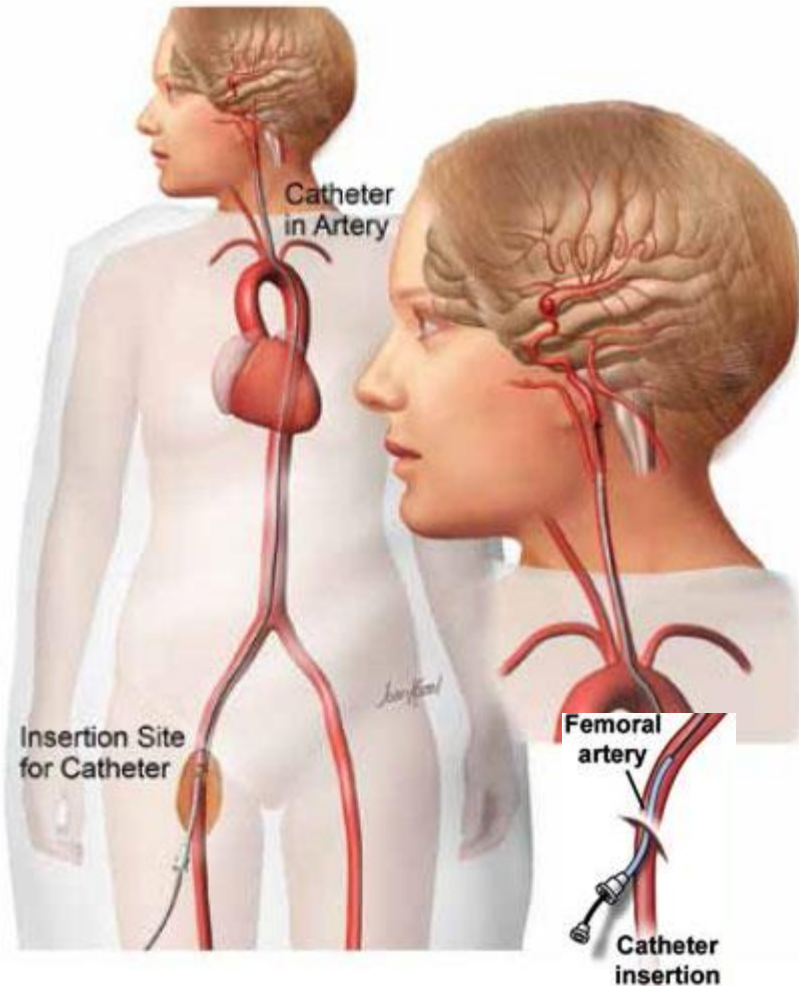
**Handbook of Cerebrovascular  
Disease and Neurointerventional  
Technique**

# Procedure

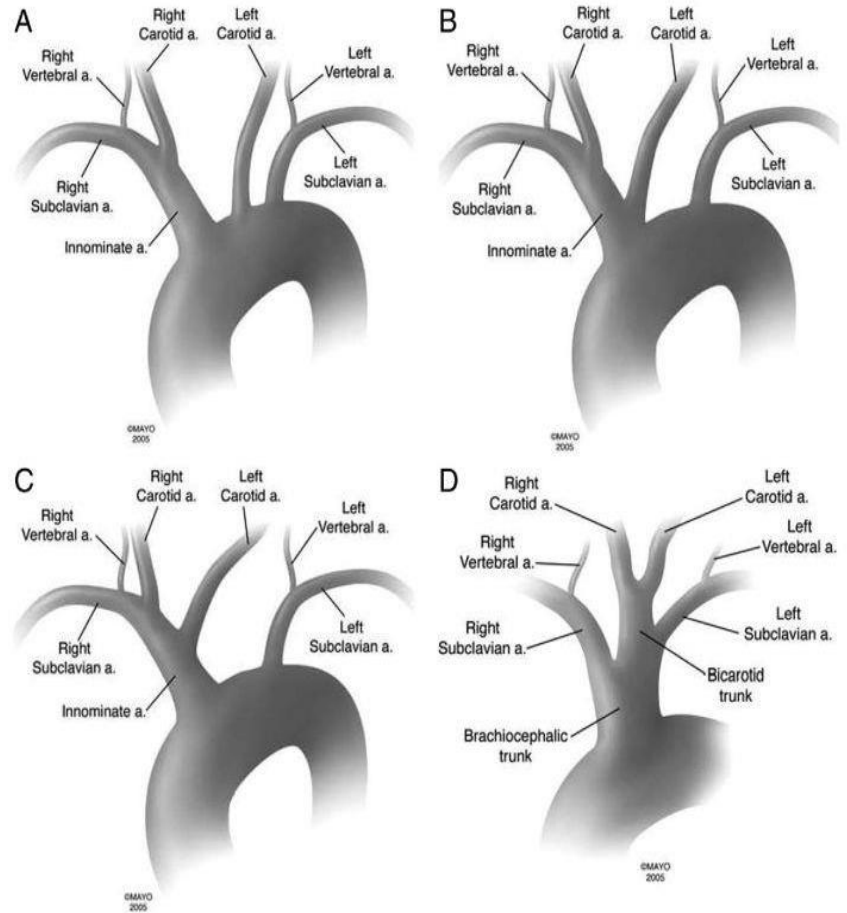




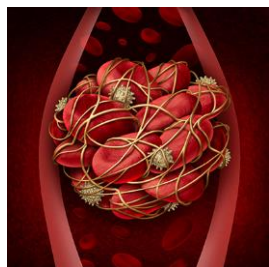
# Procedure



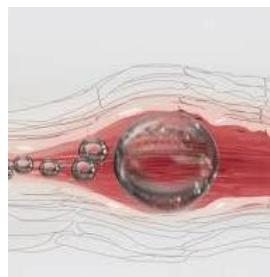
Medscape



# Complications



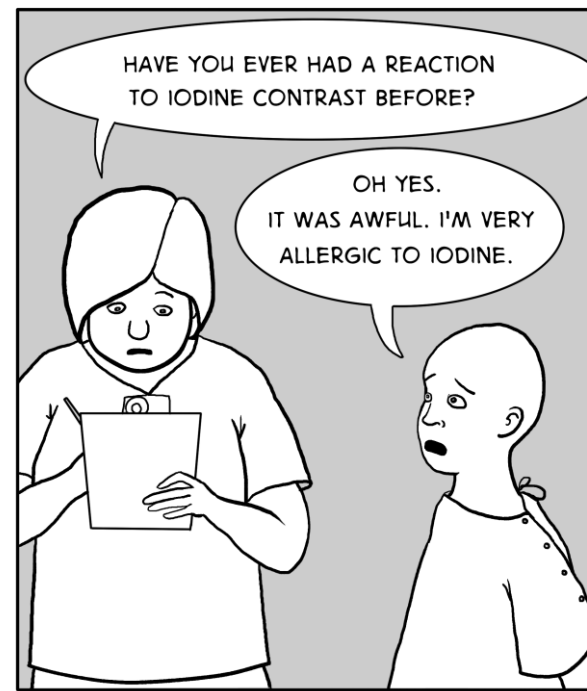
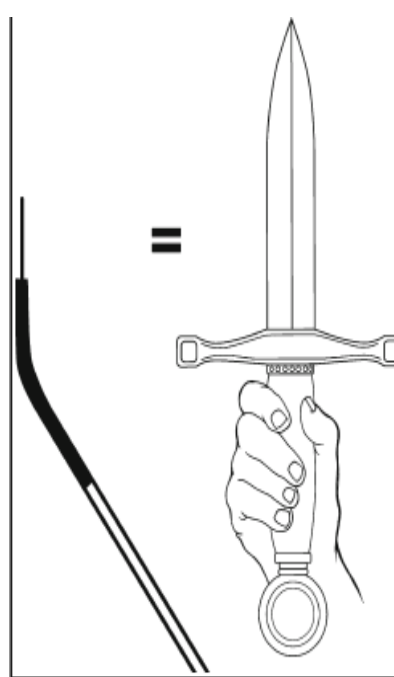
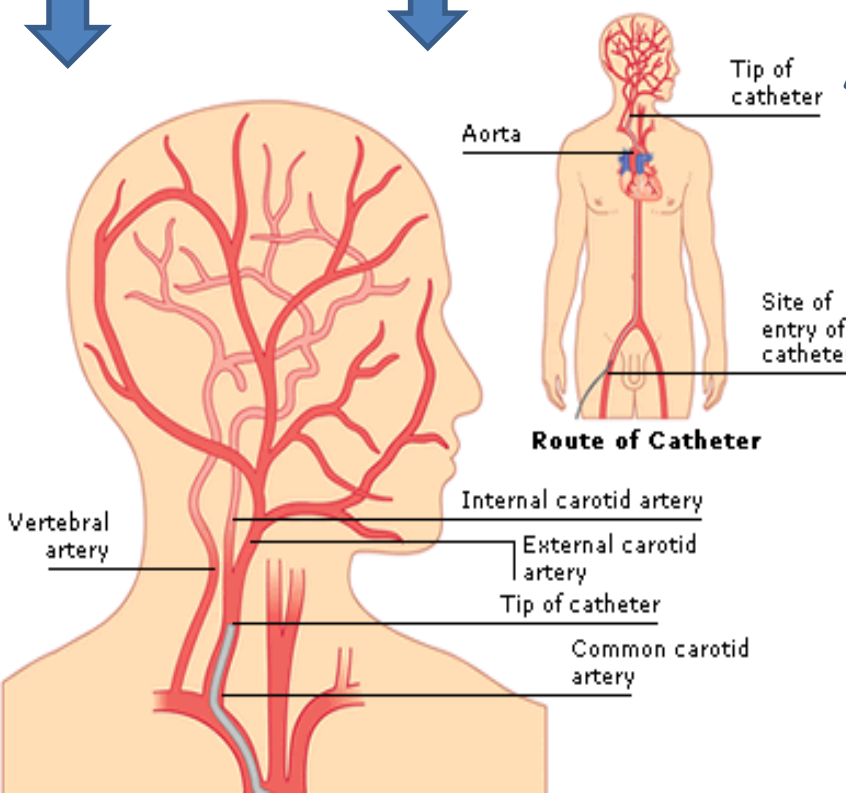
Blood clot



Air



vasospasm



# Complications

## Neurological Complications

- Cerebral ischemia
- Transient cortical blindness
- Amnesia

## Nonneurological Complications

- Hematoma
- Allergic reaction
- Femoral artery pseudoaneurysm
- Nephropathy
- Thromboembolism of the lower extremities
- Pulmonary embolism



# Complications

**Table 2.1 Quality improvement guidelines for adult diagnostic neuroangiography**

		Suggested complication – specific threshold (%)
Neurological complications	Reversible neurologic deficit	2.5
	Permanent neurologic deficit	1
Non-neurologic complications	Renal failure	0.2
	Arterial occlusion requiring surgical thrombectomy or thrombolysis	0.2
	Arteriovenous fistula/pseudoaneurysm	0.2
	Hematoma requiring transfusion or surgical evacuation	0.5
All major complications		2

Adapted from Citron et al.,<sup>26</sup> with permission

*J Vasc Interv Radiol.* 2003 Sep;14(9 Pt 2):S257-62.

**Quality improvement guidelines for adult diagnostic neuroangiography. Cooperative study between ASITN, ASNR, and SIR.**

# Complications of Diagnostic Cerebral Angiography: Evaluation of 19 826 Consecutive Patients LEGACY

## Author List

Timothy J. Kaufmann, MD, John Huston, III, MD, Jay N. Mandrekar, PhD, Cathy D. Schleck, BS, Kent R. Thielen, MD, and David F. Kallmes, MD

RSNA  
Radiology

June 2007

Volume 243, Issue 3

- 19.826 pts
- 1981-2003
- Neurologic complications: 522 (2.63%)
  - stroke with permanent disability : 27 (0.14%)
  - Death : 12 (0.06%)
- Access-site hematoma : 4.2%

# Neurologic Complications of Cerebral Angiography: A retrospective study of complication rate and patient risk factors

A. Leffers , A. Wagner

- 2000, Denmark
- 483 cerebral angiography/ 454 pts

*Results:* The frequency of all neurologic complications was 2.3%, the frequency of persistent neurologic deficits was 0.4%. Non-neurologic complications were observed in 14.7% of the examinations. Of all the parameters studied, the only factor that significantly increased neurologic risk was a normal angiogram, a finding we are inclined to ascribe to chance. Performance of a compression series showed a trend towards increasing the neurologic risk.

## **Complications of cerebral angiography: a prospective analysis of 2,924 consecutive procedures.**

Dawkins AA<sup>1</sup>, Evans AL, Wattam J, Romanowski CA, Connolly DJ, Hodgson TJ, Coley SC.

- 2001-2006, 2.924 diagnostic Cerebral Angiography, - U.K
- Clinical complications: 23 (0.79%)
  - Puncture-site hematoma: 12 (0.41%)
  - Transient neurological events: 10 (0.34%)
  - Nonfatal reaction with contrast agent : 1
  - Permanent neurological Complications : 0

# Safety of Cerebral Digital Subtraction Angiography in Children

## Complication Rate Analysis in 241 Consecutive Diagnostic Angiograms

Ingrid M. Burger, Kieran J. Murphy, Lori C. Jordan, Rafael J. Tamargo, Philippe Gailloud

**Results**—Our population included 115 boys and 90 girls, with age ranging from 1 week to 18 years (mean±SD, 12±5 years). All angiograms were technically successful. No intraprocedural complication was noted; in particular, there was no occurrence of iatrogenic vessel injury (dissection) and no transient or permanent neurological deficit secondary to a thromboembolic event. One child with a complex dural arteriovenous fistula experienced a fatal intracranial rehemorrhage secondary to a posterior fossa varix rupture 3 hours after completion of an uneventful diagnostic angiogram. The rates of intraprocedural and postprocedural complications were therefore 0.0% (95% CI, 0.0% to 1.4%) and 0.4% (95% CI, 0.012% to 2.29%), respectively.

**Conclusions**—The rate of immediate complications occurring during diagnostic cerebral angiography in children is very low. No intraprocedural complication was documented in the reported series. DSA performed by experienced angiographers is a safe procedure that can provide critical diagnostic information. (*Stroke*. 2006;37:2535-2539.)

<http://stroke.ahajournals.org/>



# Complications of cerebral angiography in children younger than 3 years of age

CAITLIN E. HOFFMAN, M.D., ALEJANDRO SANTILLAN, M.D., LAUREN ROTMAN, B.S.,  
Y. PIERRE GOBIN, M.D., AND MARK M. SOUWEIDANE, M.D.

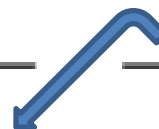
*Department of Neurological Surgery, Weill Cornell Medical College, NewYork-Presbyterian Hospital,  
New York, New York*

TABLE 2: Diagnostic and therapeutic indications for CA

Indication	No. of Patients (no. of ops)
intraarterial chemotherapy for retinoblastoma	75 (292)
vascular malformation	3 (8)
stroke assessment	4 (4)
tumor embolization	2 (2)
intracranial hemorrhage	3 (3)
total	87 (309)

TABLE 3: Summary of CA complications for 309 procedures performed in 87 children

Complications	% of Ops
overall	4.2
neurological	0.0
nonneurological	2.9
contrast allergy or bronchospasm	2.3
access-related	0.6
radiographic	1.3



**Radiographic: vasospasm , intraarterial dissection**

J Neurosurg Pediatrics 13:414–419, 2014

©AANS, 2014

# Complications

TABLE 1: Literature review for CA in children

Authors & Year	No. of Patients	Age Range/Mean	Radiographic Complications (%)	Nonneurological Complications (%)	Neurological Complications (%)	Mortality Rate (%)
Newton & Gooding, 1968	86	0–13 yrs	0.00	0.00	0.00	0.00
Goto et al., 1975	71	0–7 yrs	0.00	4.20	0.00	0.00
Cerullo et al., 1980	1869	1 mo–6 yrs	1.10	1.80	0.00	0.00
Pettersson et al., 1981	3731	2 days–18 yrs/8 yrs	0.00	0.00	0.40	0.00
Fung et al., 2005	176	0–19 yrs/7.3 yrs	0.00	4.50	0.00	0.00
Burger et al., 2006	241	1 wk–18 yrs/12 yrs	0.00	0.00	0.00	0.40
Wolfe et al., 2009	46	3.7 mos–8 yrs/9.9 yrs	0.00	0.00	0.00	0.00
present report	309	1 mo–3 yrs/1.2 yrs	1.30	2.90	0.00	0.00

# Safety of neuroangiography and embolization in children: complication analysis of 697 consecutive procedures in 394 patients

CLINICAL ARTICLE

J Neurosurg Pediatr 16:432–438, 2015

Ning Lin, MD,<sup>1,2</sup> Edward R. Smith, MD,<sup>2</sup> R. Michael Scott, MD,<sup>2</sup> and Darren B. Orbach, MD, PhD<sup>3</sup>

TABLE 3. Periprocedural complications in diagnostic and interventional cases\*

Complication	Procedure		All Patients (n = 697)
	Diagnostic Angiography (n = 429)	Neurointervention (n = 268)	
All	3 (0.7)	18 (6.7)	21 (3.0)
Nonneurological	3	15	18
Contrast allergy	2	0	2
Heparin hypersensitivity	0	1	1
Hair loss	1	2	3
Bradycardia	0	3	3
Groin site bleeding	0	4	4
Decreased pulse at groin site	0	1	1
Coil/Onyx migration	0	2	2
Retained catheter	0	1	1
Numb patch after facial embolization	0	1	1
Transient neurological	0	1	1
Cranial nerve palsy	0	1	1
Nontransient neurological	0	2	2
Ischemic stroke	0	1	1
Hemorrhage	0	1	1







\* Values represent the number (%) of procedures.

# O-016 Radiation exposure during cerebral angiography and neuroembolization in children: analysis of 357 consecutive cases

N Lin<sup>1</sup>, J Manchester<sup>2</sup>, E Smith<sup>1</sup>, M Scott<sup>1</sup>, D Orbach<sup>3</sup>

others (6). Overall, the observed cumulative dose and DAP correlated well ( $r=0.87$ ). The average cumulative skin entry dose for the cohort was 365.9 mGy (range: 21–2707 mGy). Radiation exposure during neurointervention was significantly higher than during diagnostic angiography (566.3 and 191.0 mGy, respectively,  $p<0.001$ ). Patients with spinal AVM (939.8 mGy), aneurysms (777.5 mGy), and AVF (730.5 mGy) received higher doses of radiation. During the mean follow-up period of 2.1 years, one short-term complication (transient hair loss) related to radiation was noted.

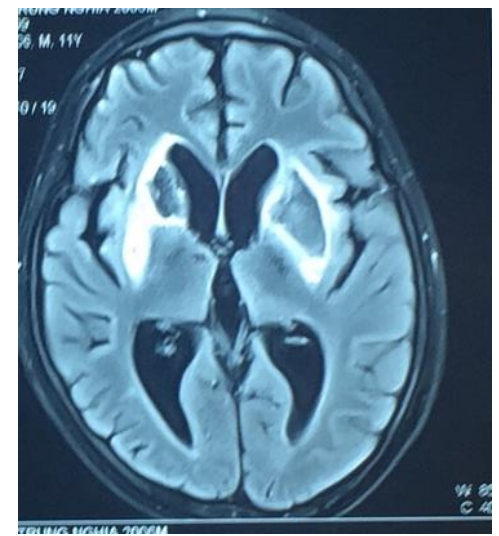
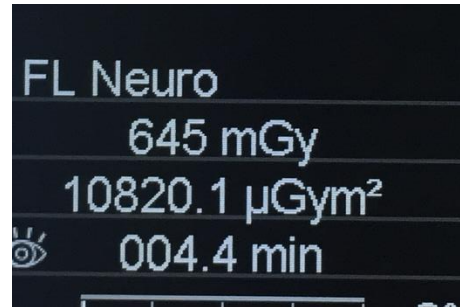
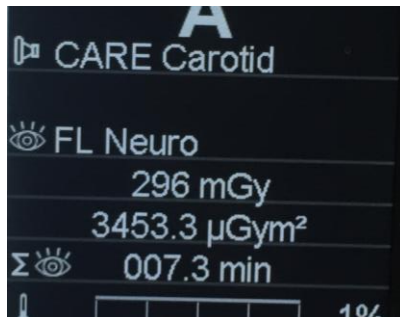
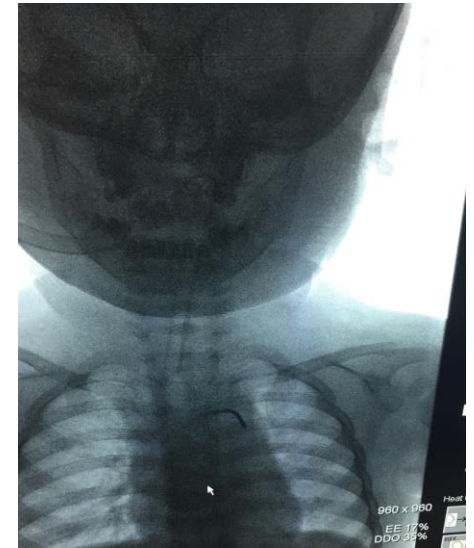
# Radiation Dose to Adults From Common Imaging Examinations

Procedure		Approximate effective radiation dose	Comparable to natural background radiation for
 <b>ABDOMINAL REGION</b>	Computed Tomography (CT) — Abdomen and Pelvis	10 mSv	3 years
	Computed Tomography (CT) — Abdomen and Pelvis, repeated with and without contrast material	20 mSv	7 years
	Computed Tomography (CT) — Colonography	6 mSv	2 years
	Intravenous Pyelogram (IVP)	3 mSv	1 year
	Radiography (X-ray) — Lower GI Tract	8 mSv	3 years
	Radiography (X-ray) — Upper GI Tract	6 mSv	2 years
 <b>BONE</b>	Radiography (X-ray) — Spine	1.5 mSv	6 months
	Radiography (X-ray) — Extremity	0.001 mSv	3 hours
 <b>CENTRAL NERVOUS SYSTEM</b>	Computed Tomography (CT) — Head	2 mSv	8 months
	Computed Tomography (CT) — Head, repeated with and without contrast material	4 mSv	16 months
	Computed Tomography (CT) — Spine	6 mSv	2 years
 <b>CHEST</b>	Computed Tomography (CT) — Chest	7 mSv	2 years
	Computed Tomography (CT) — Lung Cancer Screening	1.5 mSv	6 months
	Radiography — Chest	0.1 mSv	10 days
 <b>DENTAL</b>	Intraoral X-ray	0.005 mSv	1 day
 <b>HEART</b>	Coronary Computed Tomography Angiography (CTA)	12 mSv	4 years
	Cardiac CT for Calcium Scoring	3 mSv	1 year



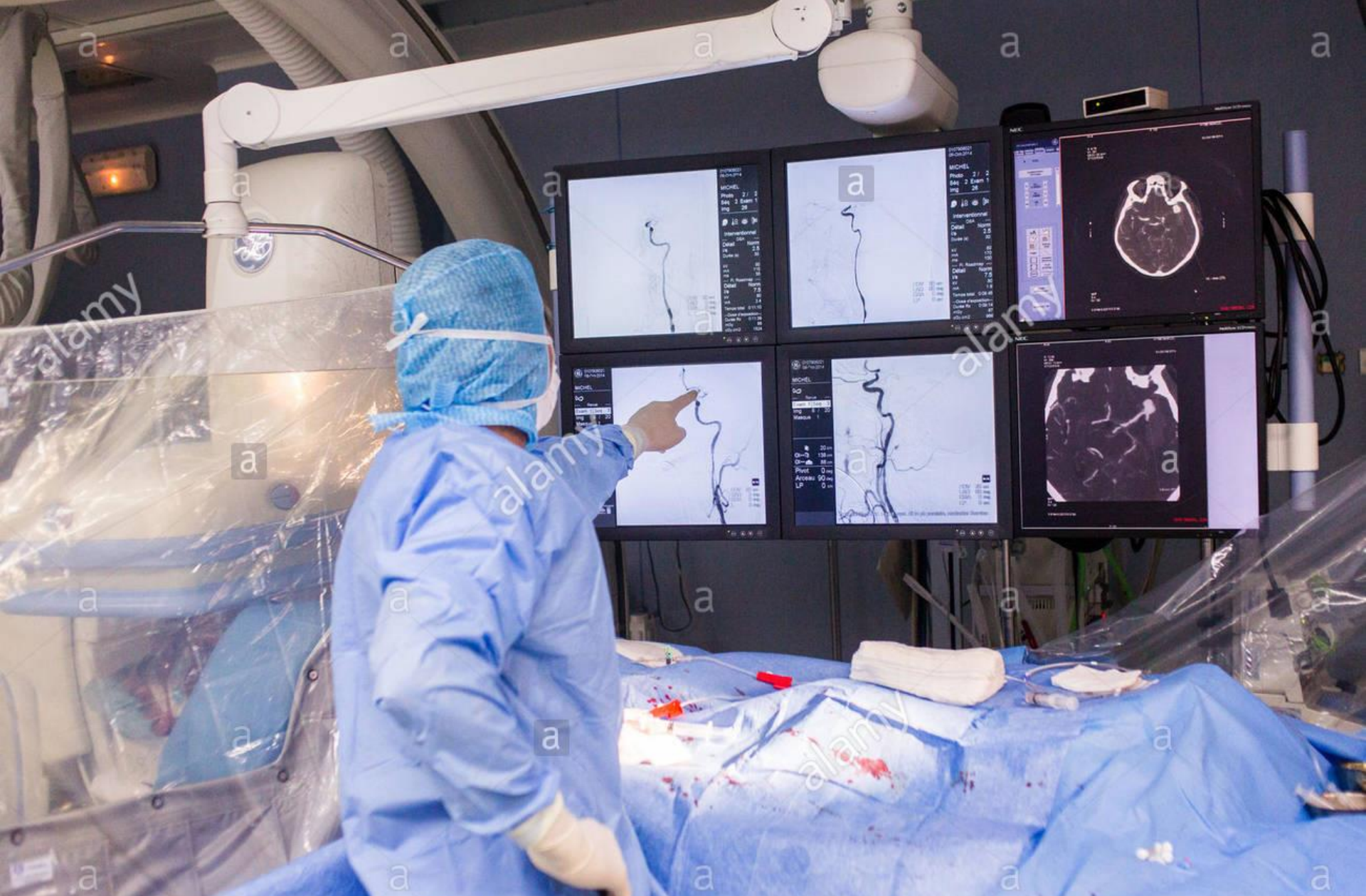
# In our Department

- > 100 Diagnostic Cerebral Angiography/ year
- 2 complications
  - 1 Broken catheter ← Reuse
  - 1 Permanent neurological Deficit.



# Conclusion

- Gold Standard
- Invasive procedure- low complications  
0-2% (neurological deficit)
  - Indication
- Anatomy, skill, training



*Thanks for your attention*