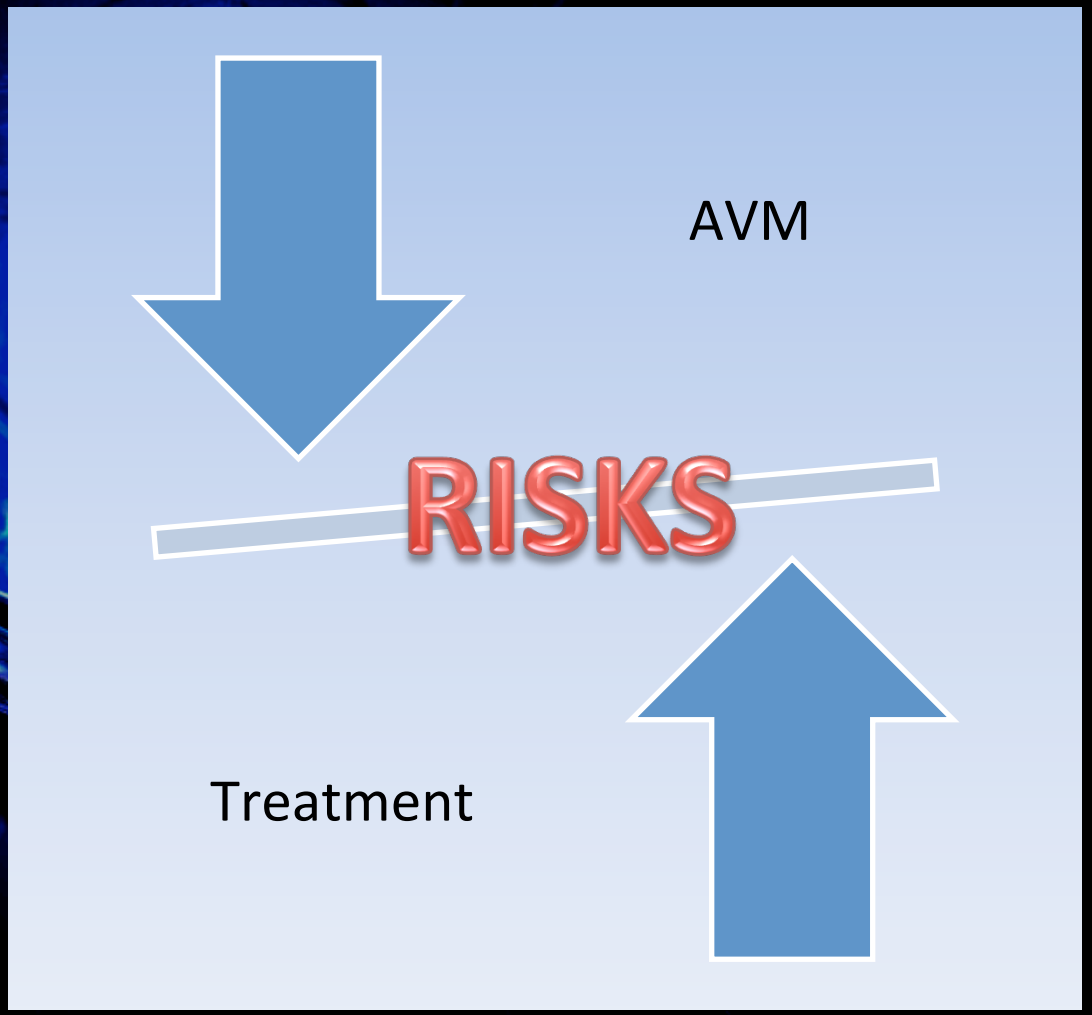
CRANIAL AVM- NATURAL HISTORY AND MANAGEMENT

NATURAL HISTORY OF AVM

- Risk benefit analysis pertaining to treatment needs to be done.



Natural History

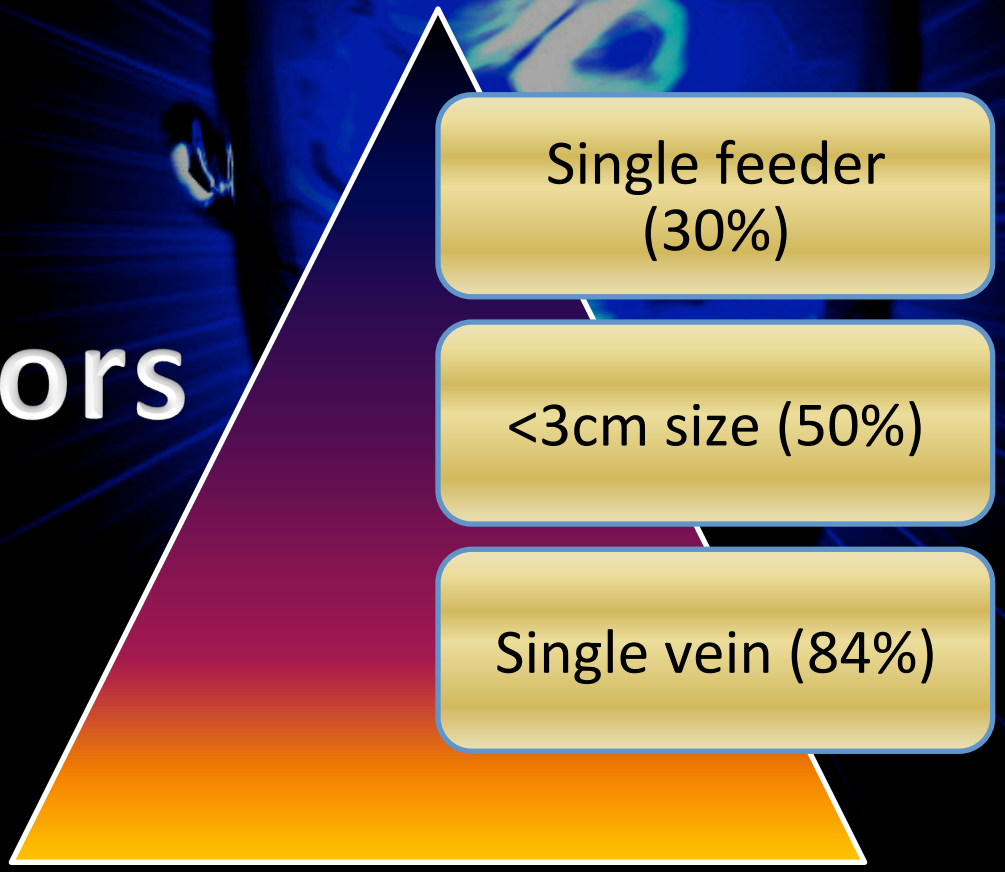
Dynamic change

Enlarge in young

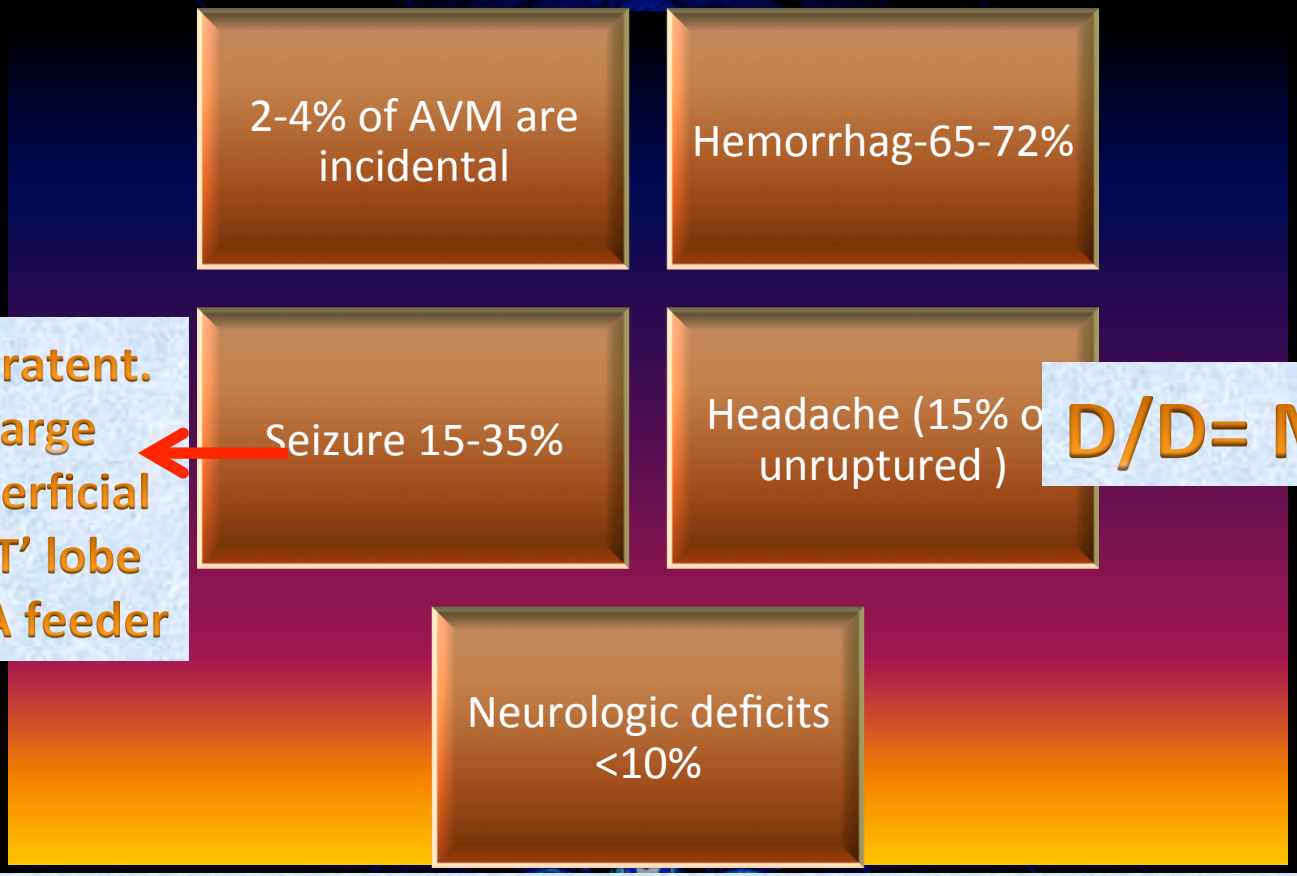
Evident when decompensate

Natural history

Spontaneous obliteration = Rare



AVM symptoms and progression



Subclinical Learning disorder in upto 66%

Risk of Progression = Size+ shunt characteristics

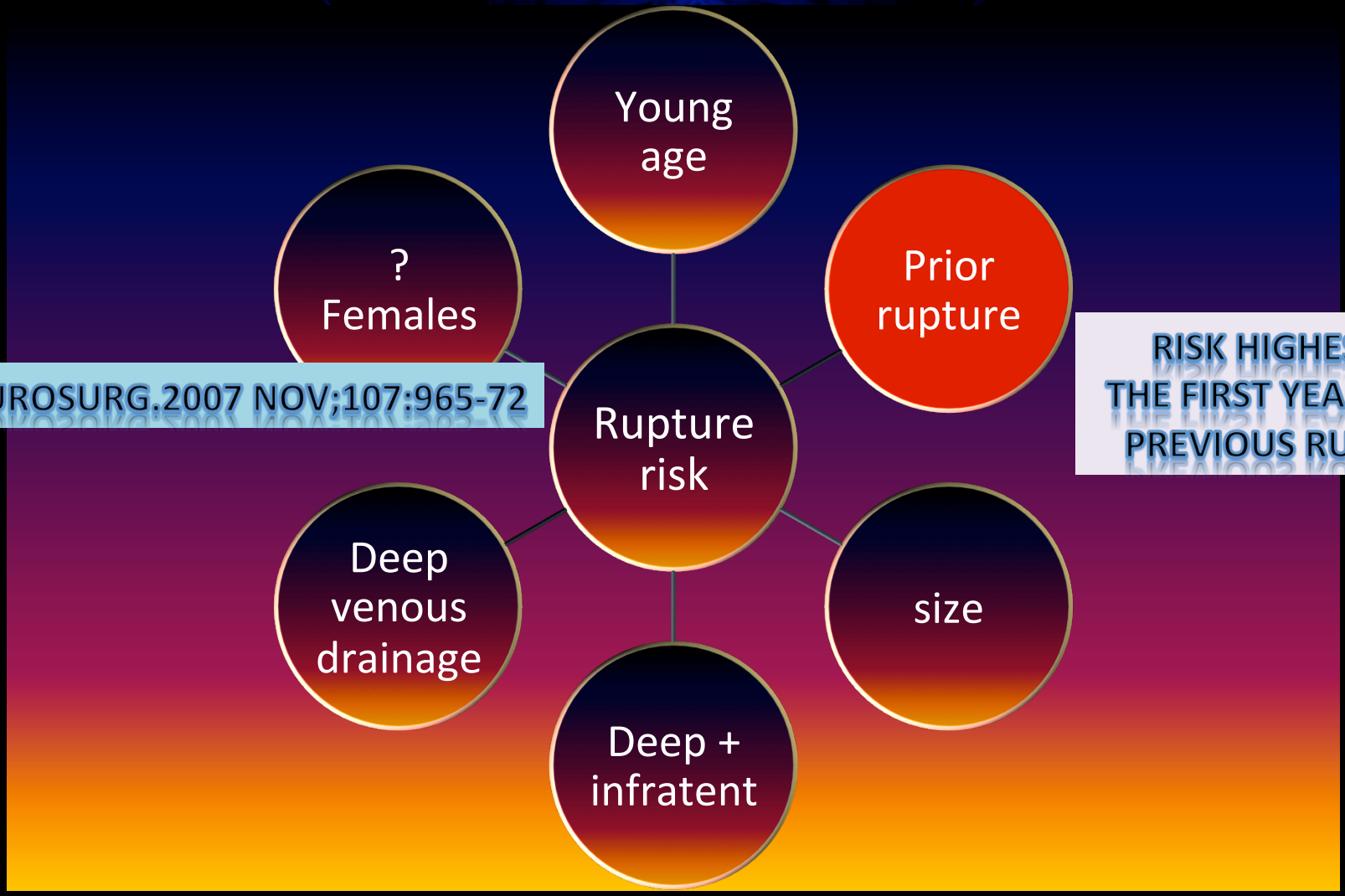
Presentation

- Hemorrhage: *Annual rate*
- First bleed: 2 to 4%/ year
- Recurrent bleed:

6% *Graf (JNS 1983; 58: 331)* to 18%/ 1st year *Fults (Neurosurgery 1984; 15: 658)*

Constant: 4%/ yr *Ondra (JNS 1966; 25: 467)*

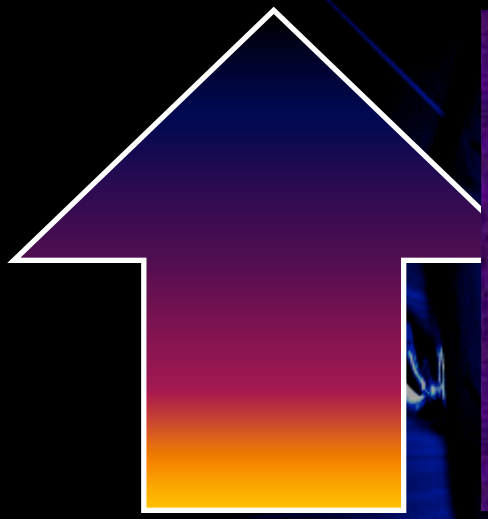
Factors for risk of rupture



J NEUROSURG.2007 NOV;107:965-72

RISK HIGHEST IN THE FIRST YEAR AFTER PREVIOUS RUPTURE

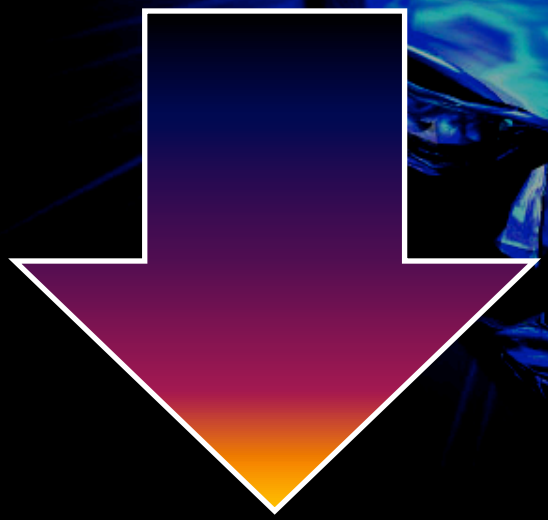
Other Factors



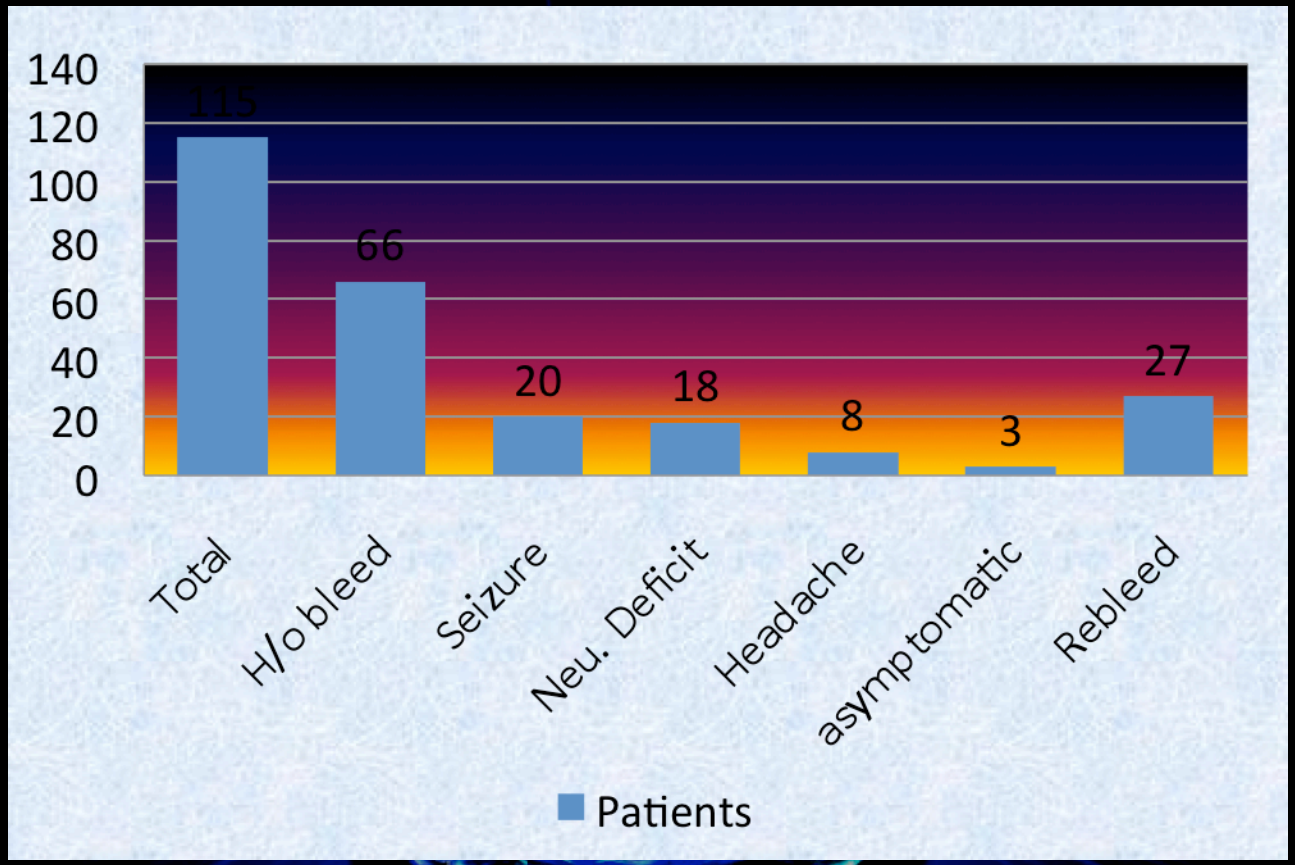
Venous stenosis

Single vein

High feeding art pressure



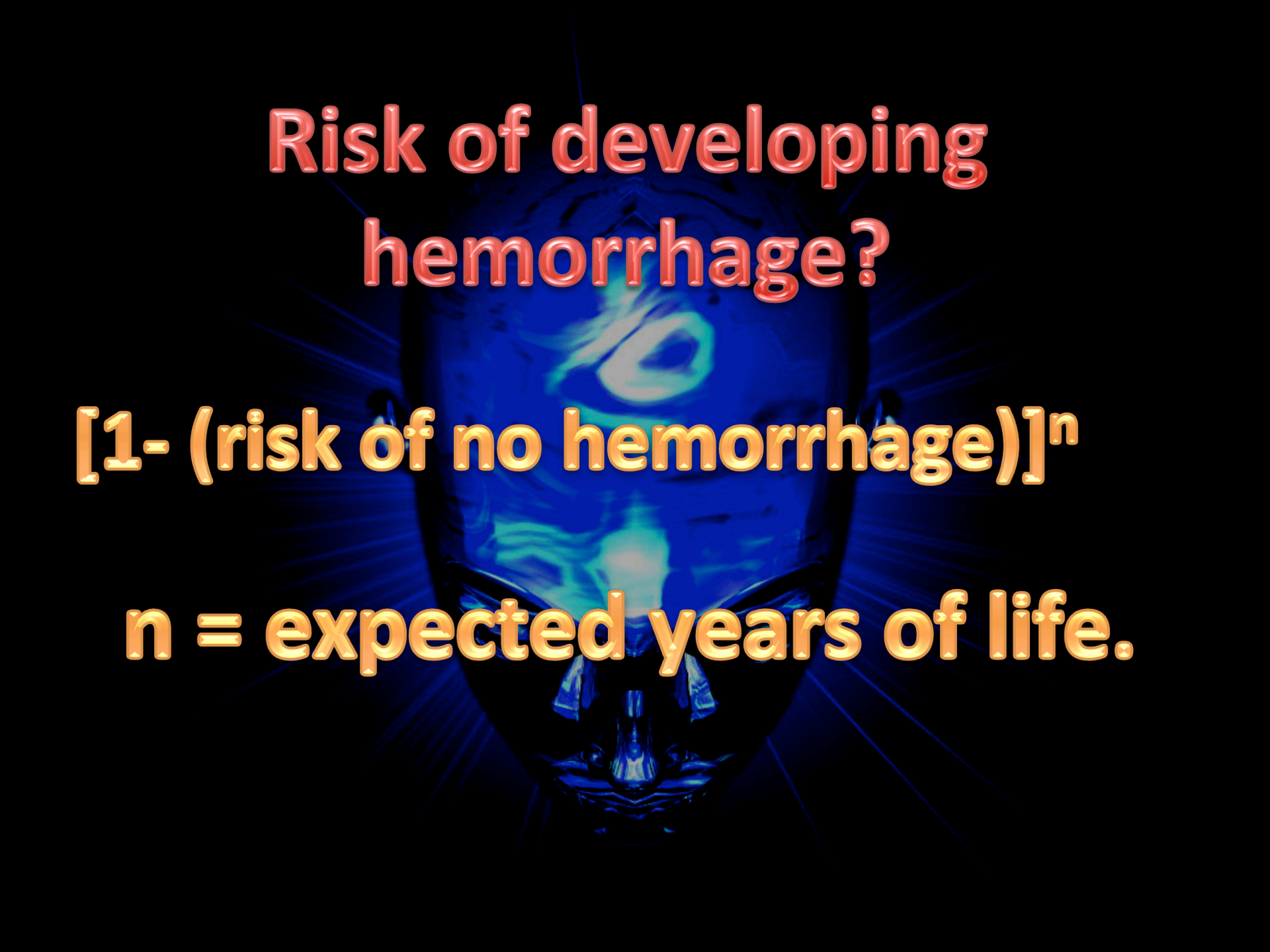
Arterial stenosis

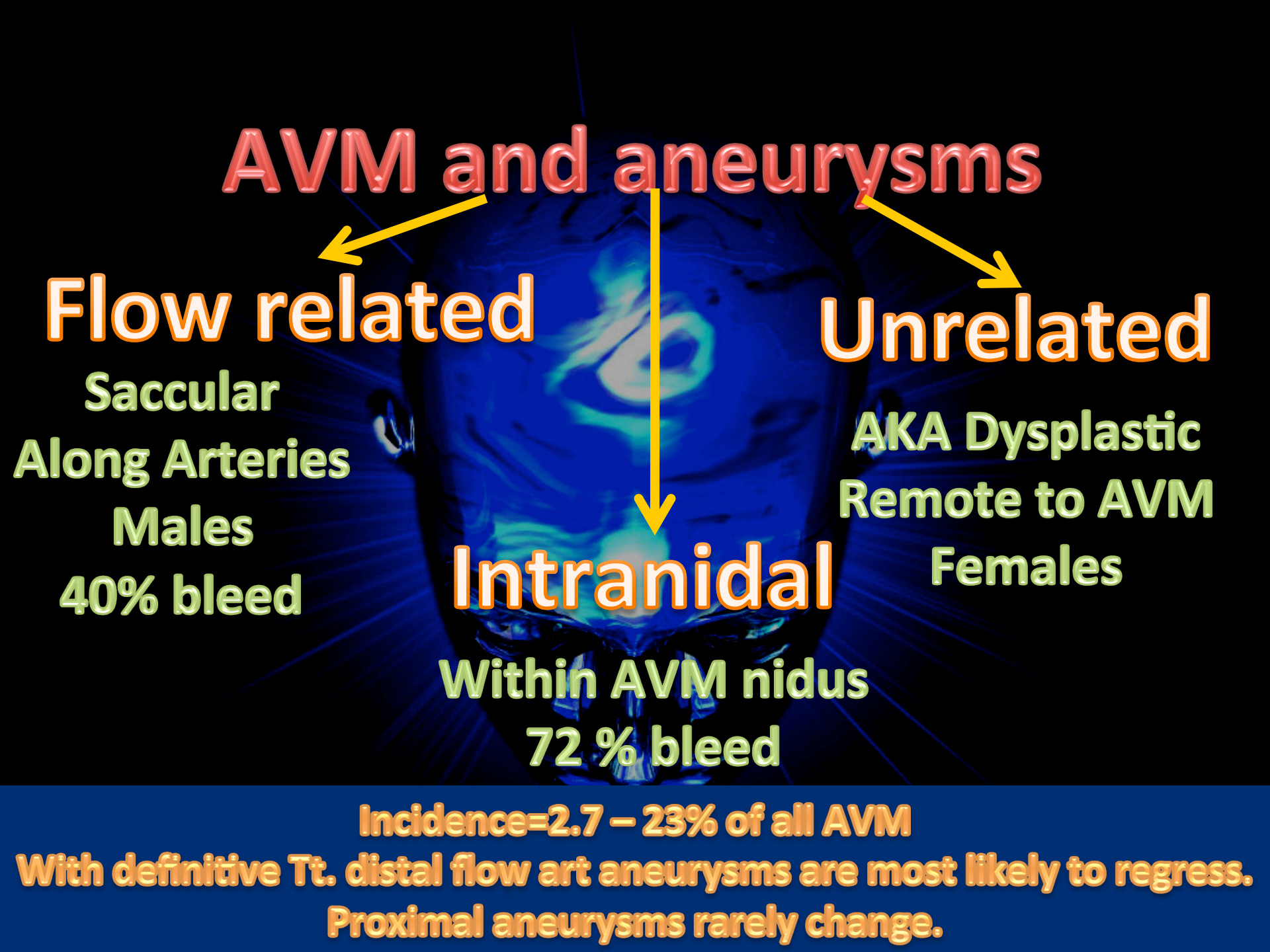


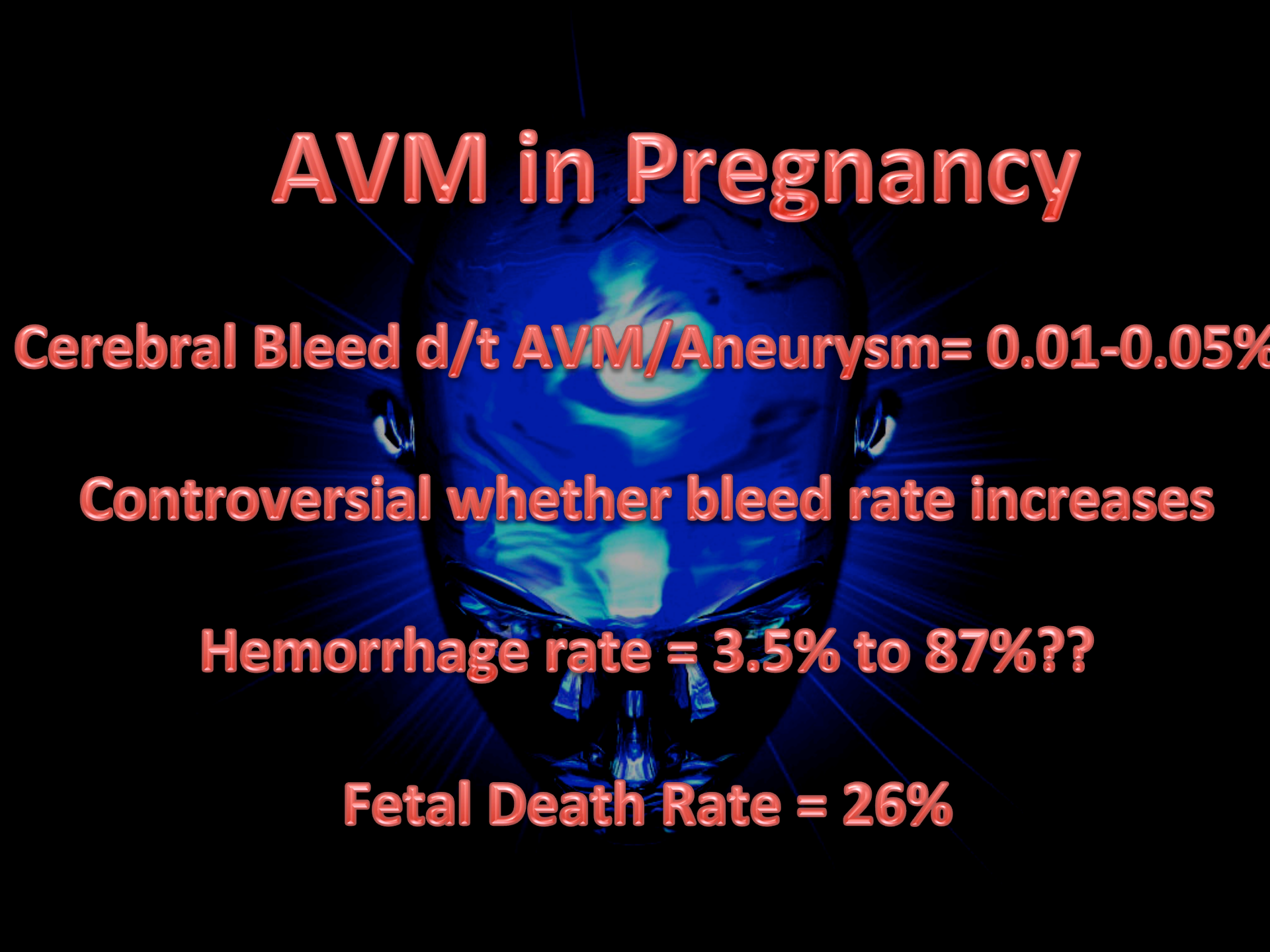
Higher rebleed rate in hemorrhagic & seizure group

Survival rate=84%; mortality = 1.4%/ year

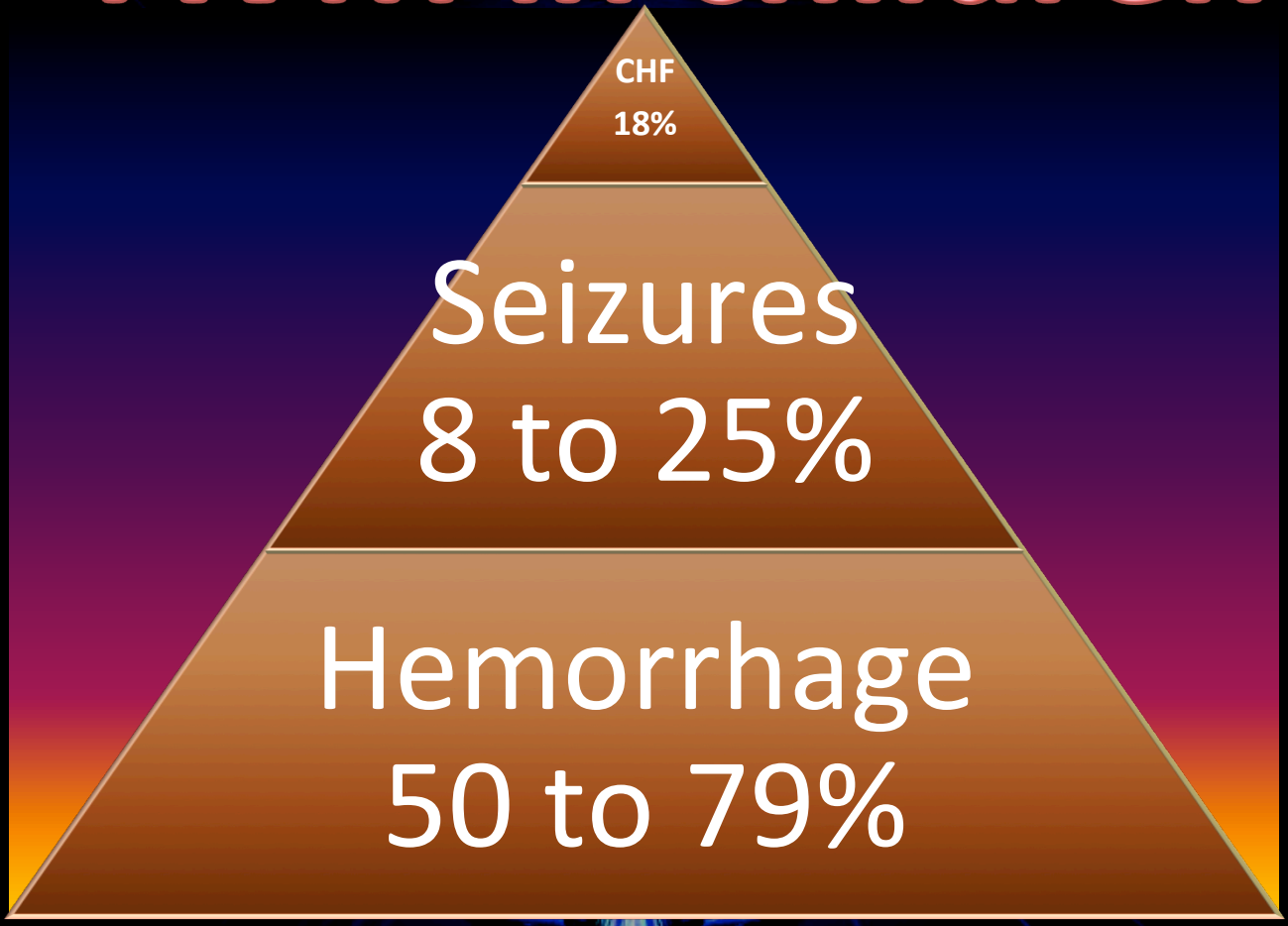
J Clin Neuroscience 1998 Mar ,5 suppl:26-9


Risk of developing hemorrhage?
[1- (risk of no hemorrhage)]n
n = expected years of life.

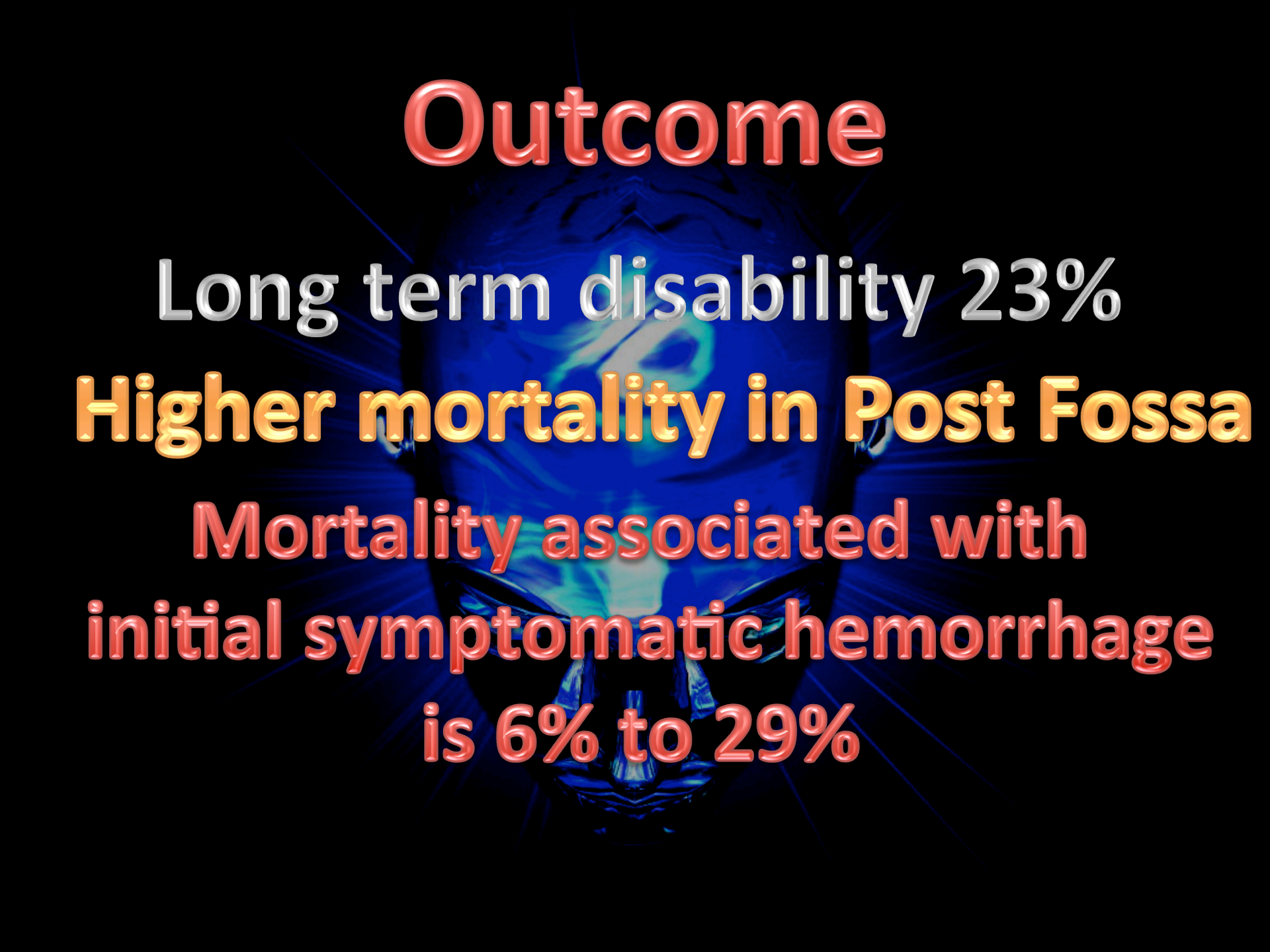

AVM and aneurysms
Flow related
Saccular
Along Arteries
Males
40% bleed
Intranidal
Within AVM nidus
72 % bleed
Unrelated
AKA Dysplastic
Remote to AVM
Females
Incidence=2.7 – 23% of all AVM
With definitive Tt. distal flow art aneurysms are most likely to regress.
Proximal aneurysms rarely change.

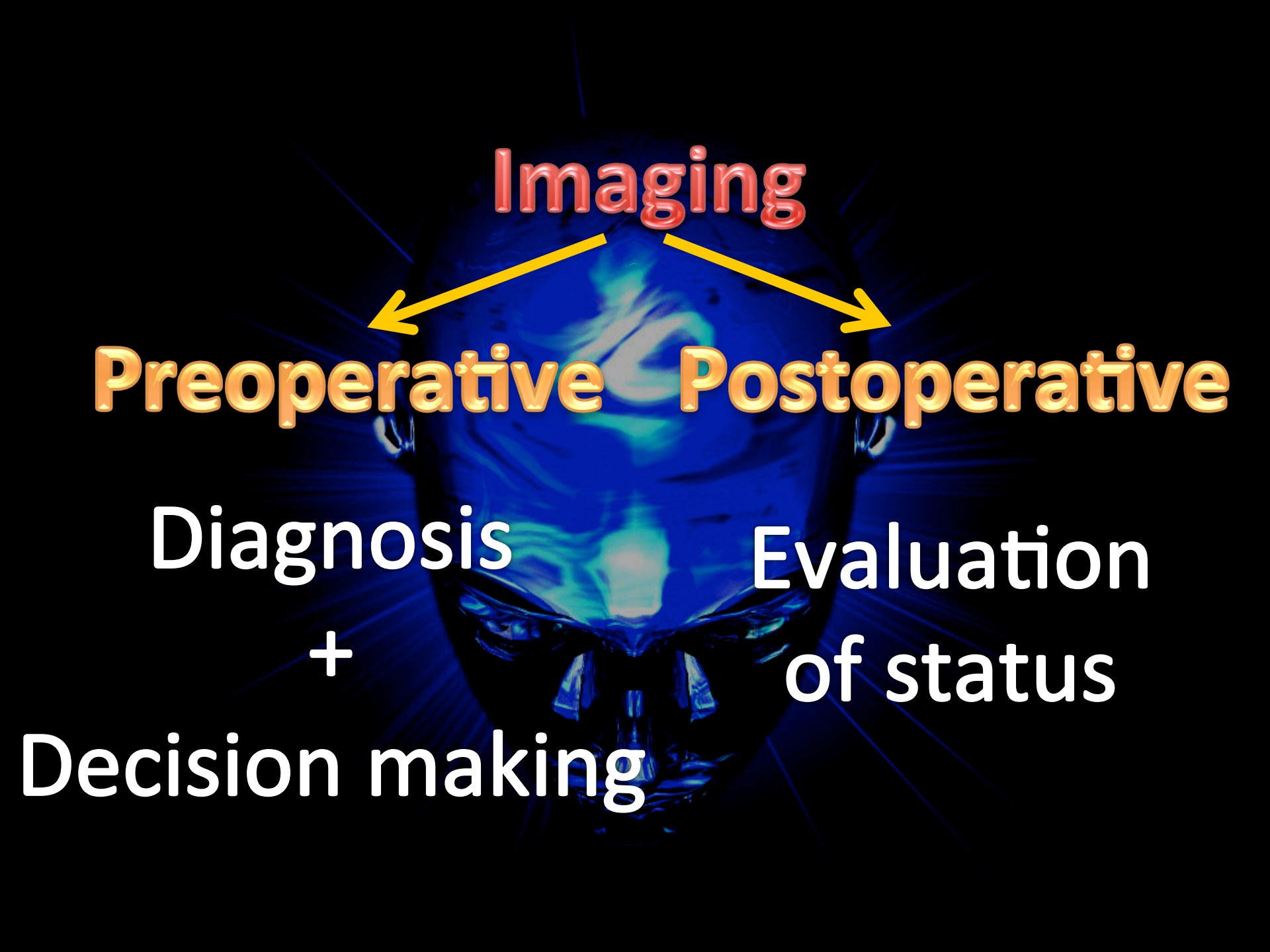

AVM in Pregnancy
Cerebral Bleed d/t AVM/Aneurysm= 0.01-0.05%
Controversial whether bleed rate increases
Hemorrhage rate = 3.5% to 87%??
Fetal Death Rate = 26%

AVM in children



Males/Superficial/ Smaller/Higher Mortality
Better Recovery (72-81%)

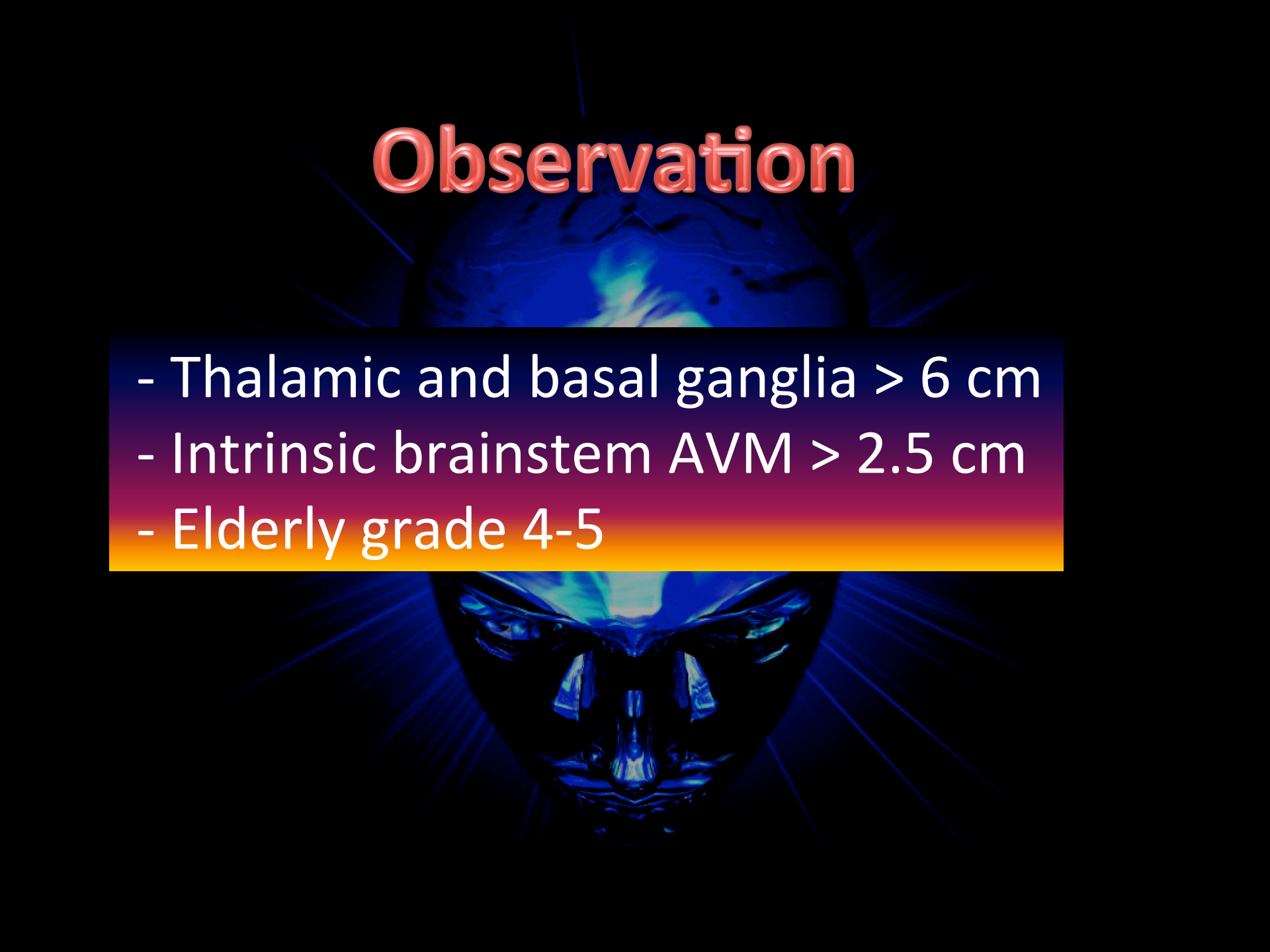

Outcome
Long term disability 23%
Higher mortality in Post Fossa
Mortality associated with initial symptomatic hemorrhage is 6% to 29%


Imaging
Preoperative
Postoperative
Diagnosis
+
Decision making
Evaluation
of status

Treatment options

1 Surgery
2. Gamma Knife
3. Embolisation

Observation



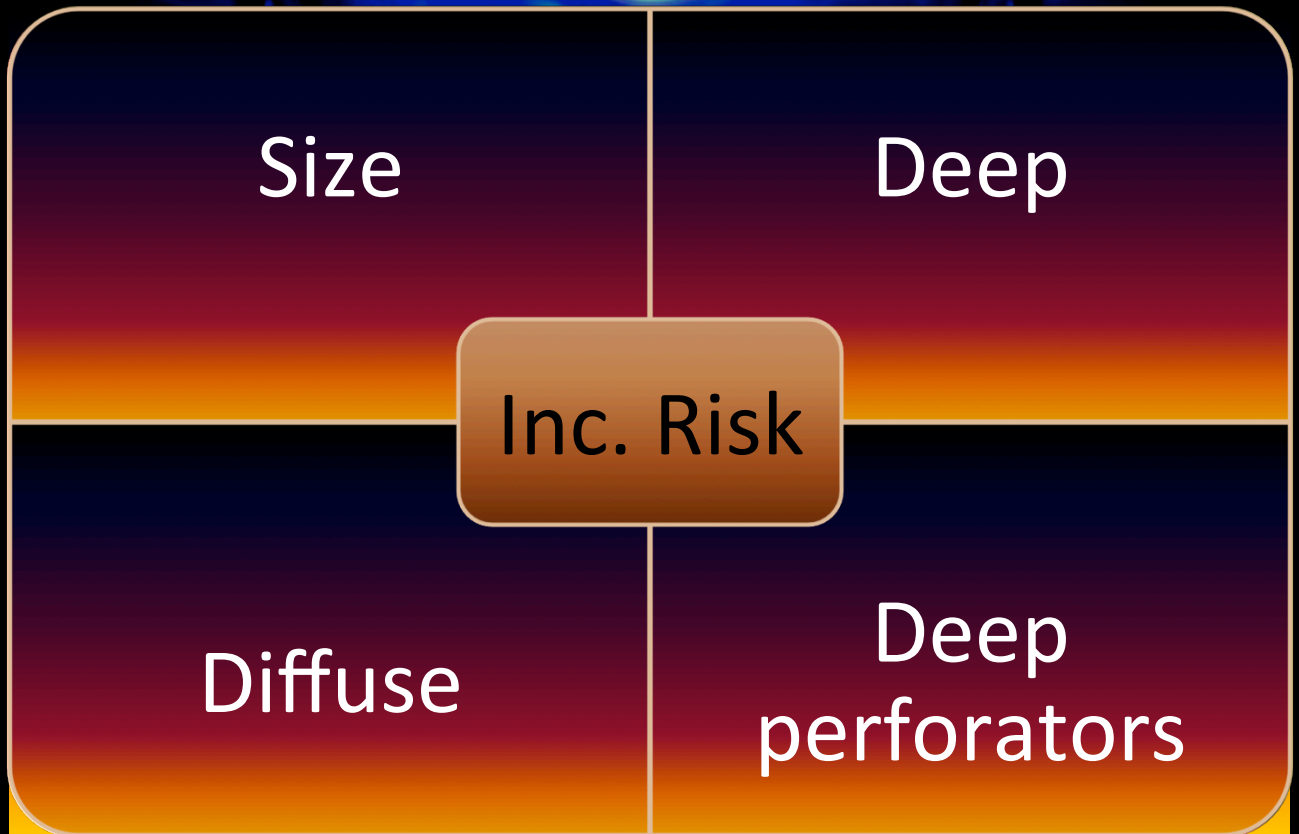
- Thalamic and basal ganglia > 6 cm
- Intrinsic brainstem AVM > 2.5 cm
- Elderly grade 4-5

"There is likely to be a single best management pathway, consumer approach by the patient will greatly increase the risk."

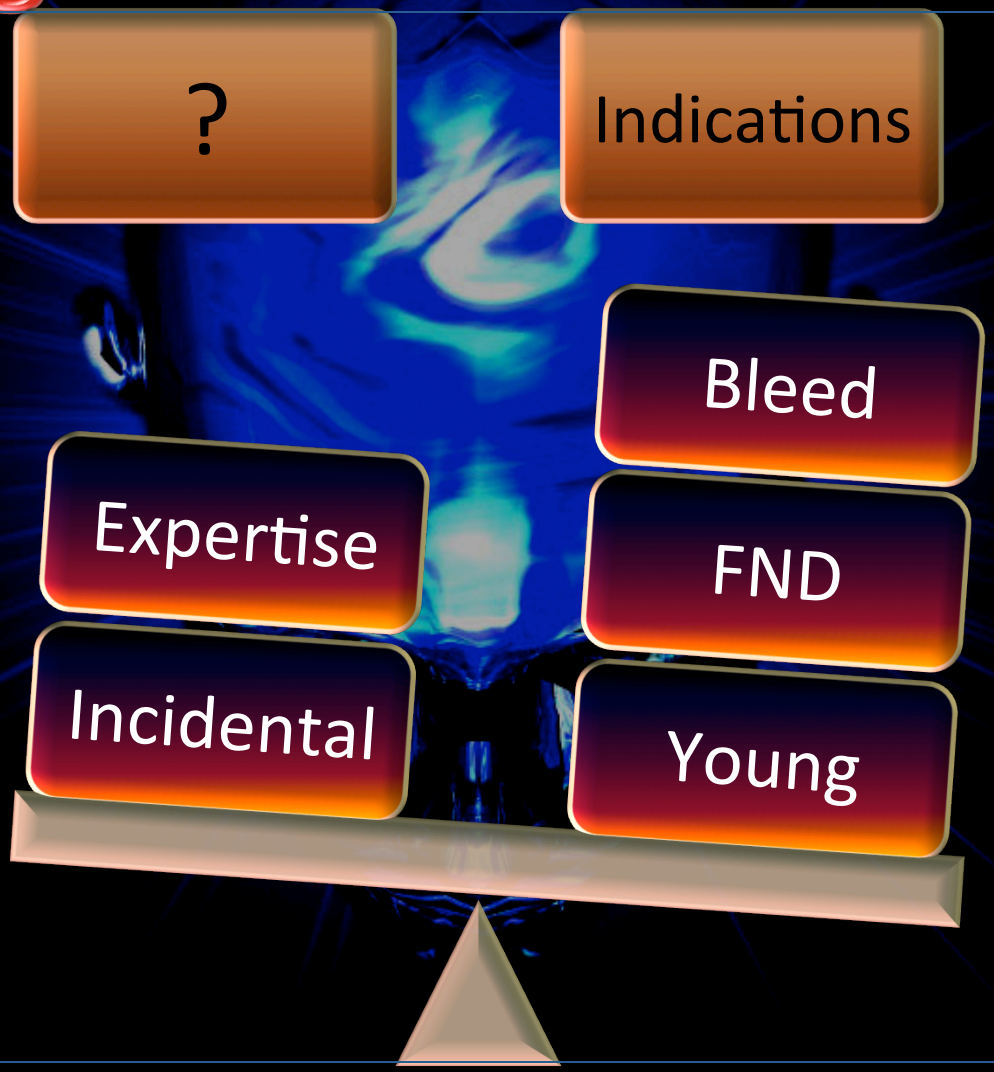
Skill levels of doctor influence the pathway

Microsurgery

- Most effective Treatment
- Not all AVM are amenable



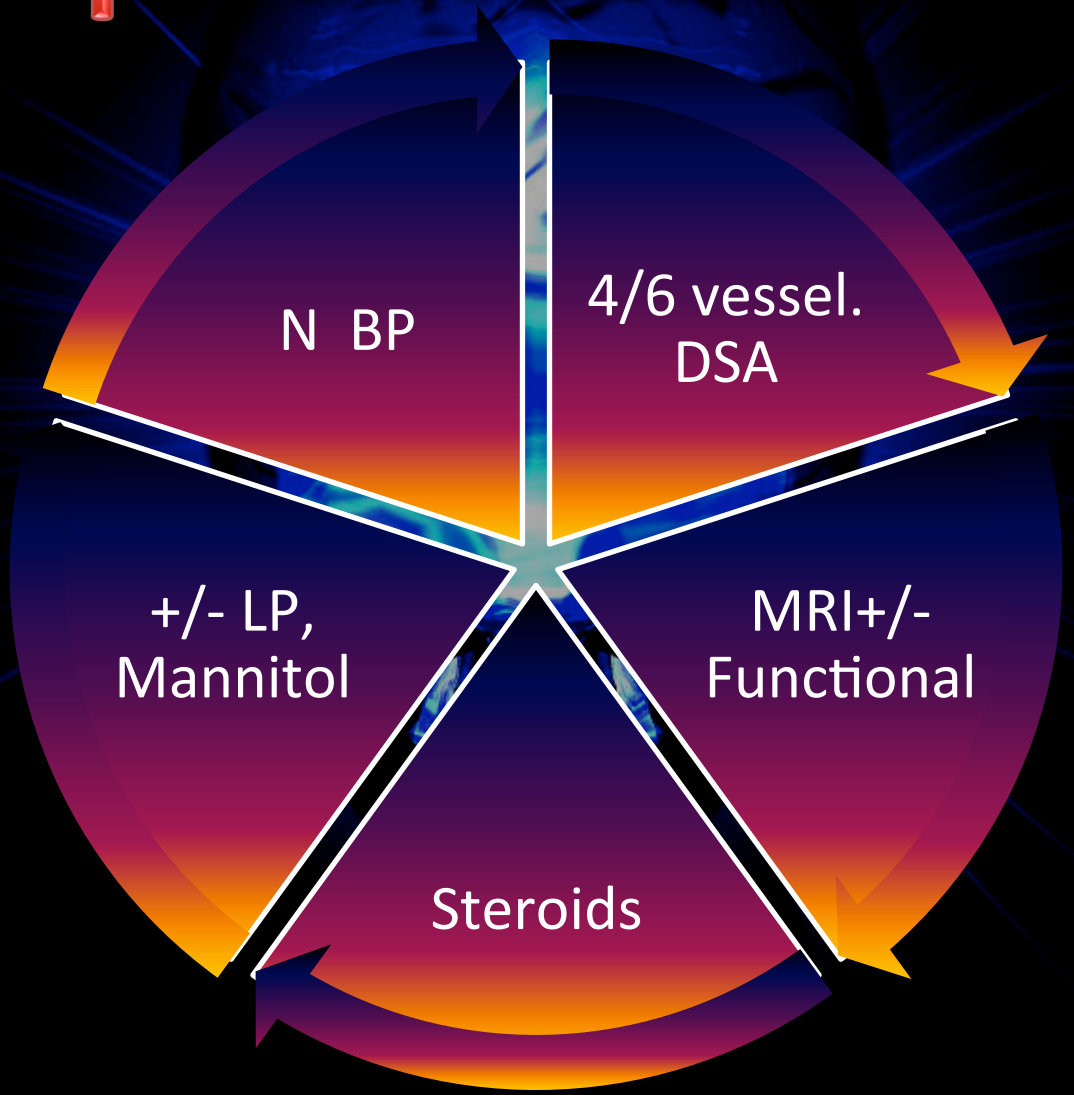
Surgical decision making



Microsurgical Technique Timing

- Elective surgery
- Emergency= Hematoma
- Spontaneous recovery do occur. (deep/eloquent)

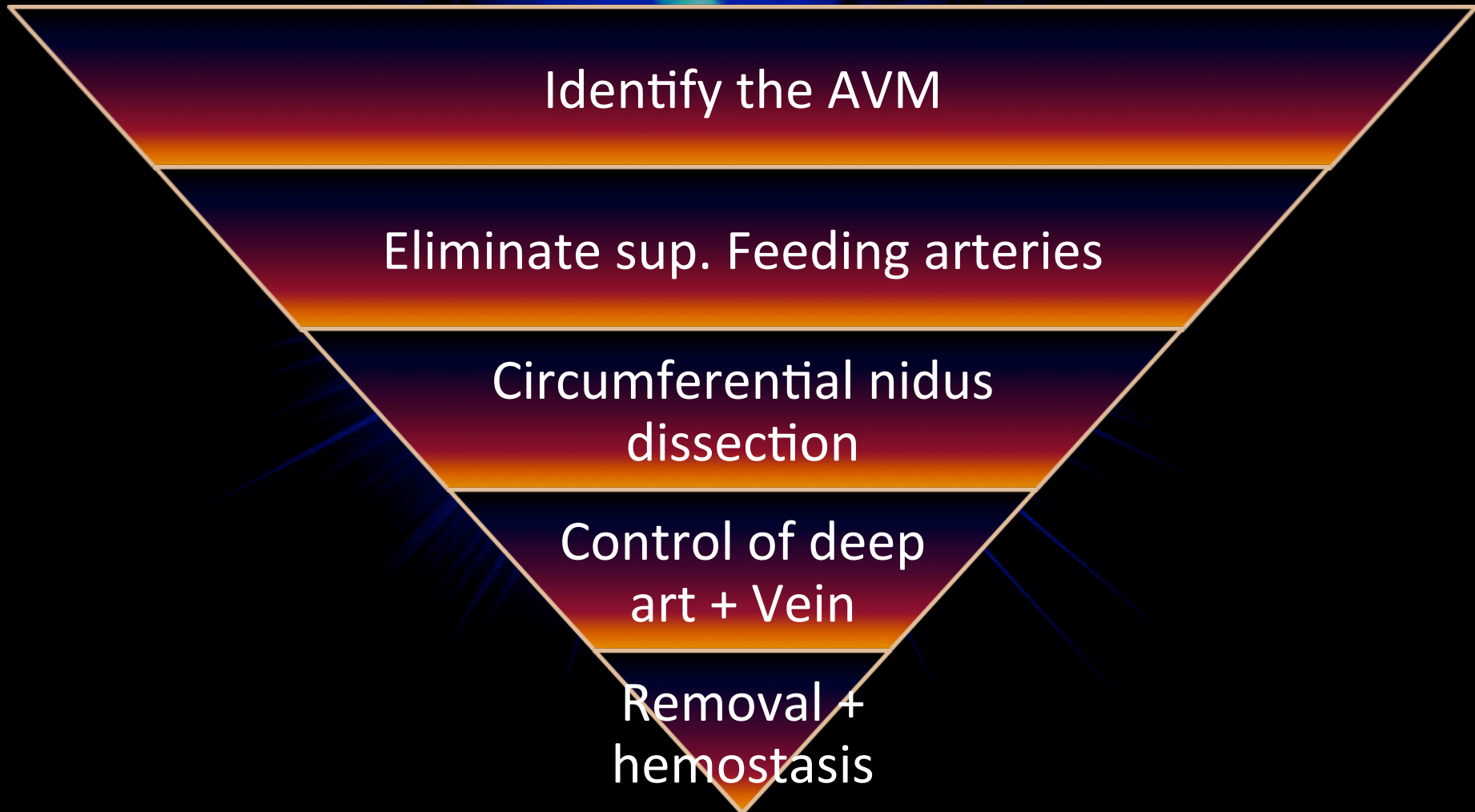
Microsurgical Technique
Preoperative Measures



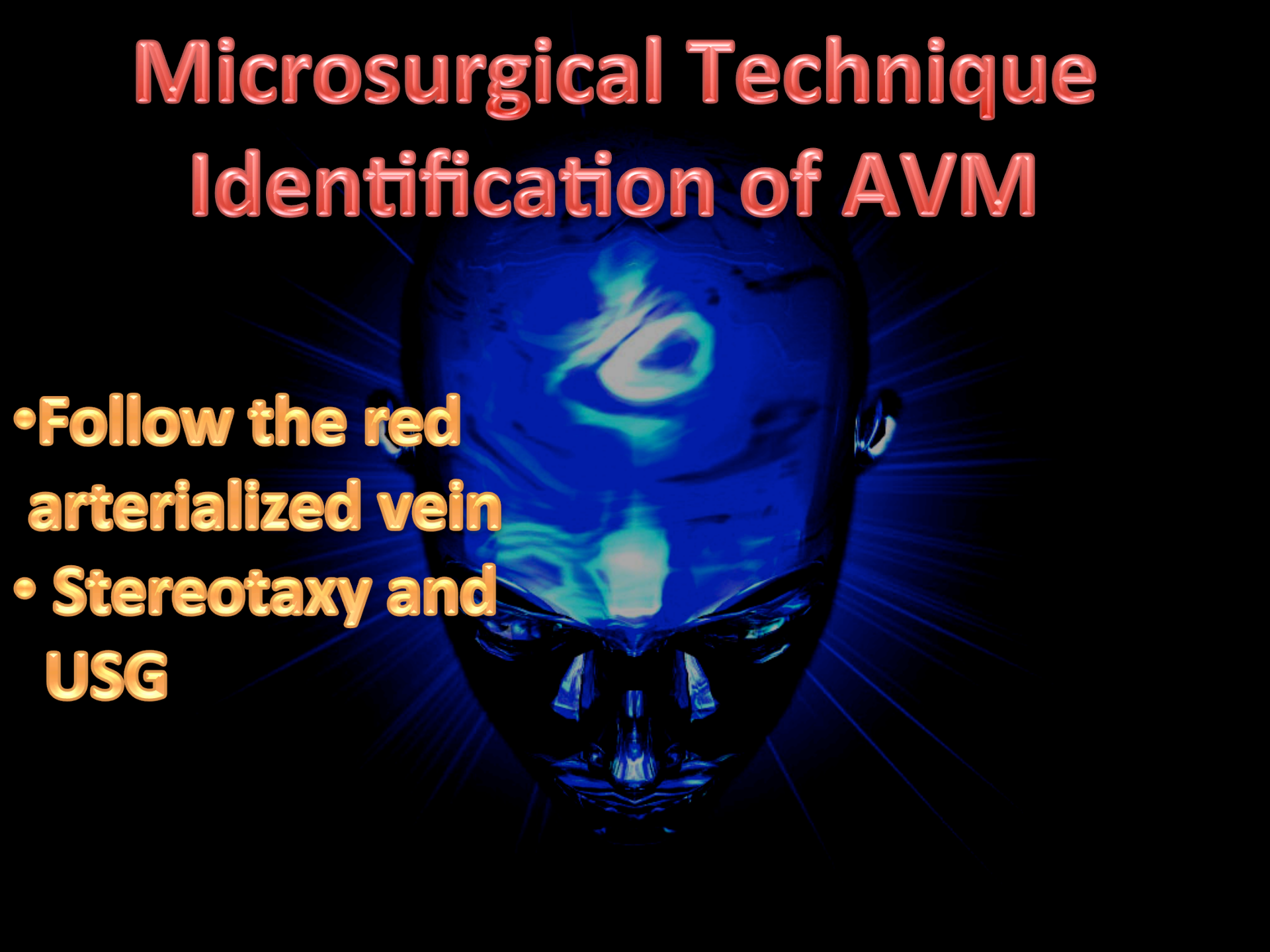
Microsurgical Technique Craniotomy

- Positioning- gravity must aid retraction
- Wide craniotomy aids retraction and helps in identifying feeders.
- Dura is opened towards the major draining sinus.

Microsurgical Technique Dissection Steps



Microsurgical Technique Identification of AVM



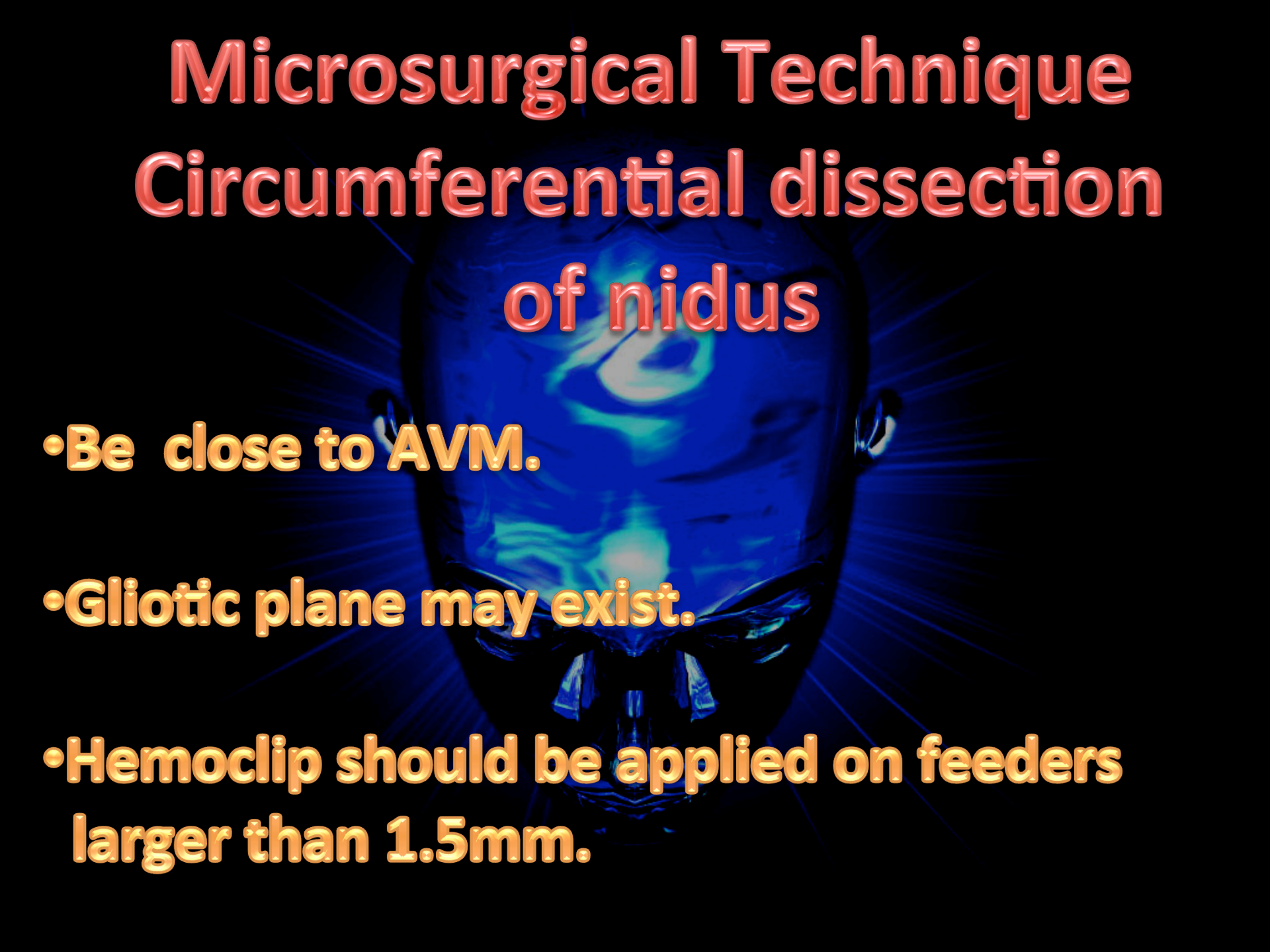
- Follow the red arterialized vein
- Stereotaxy and USG

Microsurgical Technique
Eliminating feeders

- Sulci around AVM can be opened and feeders identified and traced to AVM

- If required a temporary clip can be placed, vein collapses but artery continues to pulsate.

Microsurgical Technique Circumferential dissection of nidus



- Be close to AVM.
- Gliotic plane may exist.
- Hemoclip should be applied on feeders larger than 1.5mm.

Microsurgical Technique
Dissection of apex and deep feeders

- Deep feeders need to be coagulated
- Do not pack bleeding from these vessels
- Microclips can be used

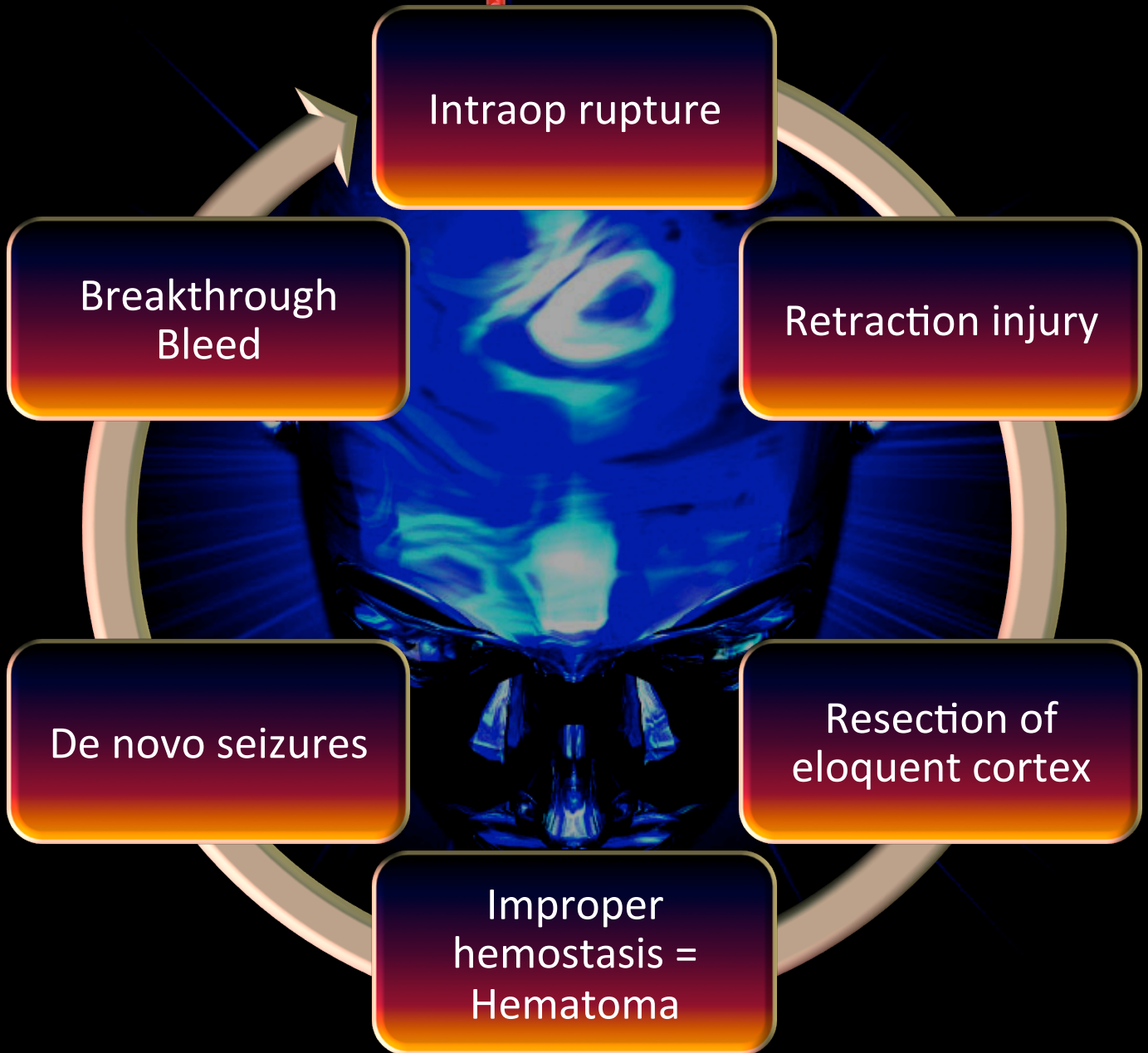
Microsurgical Technique
Venous drainage transection

- At least one major draining vein should be preserved till end of dissection.
- At the end of dissection this vein becomes bluish proving that feeders have been eliminated.

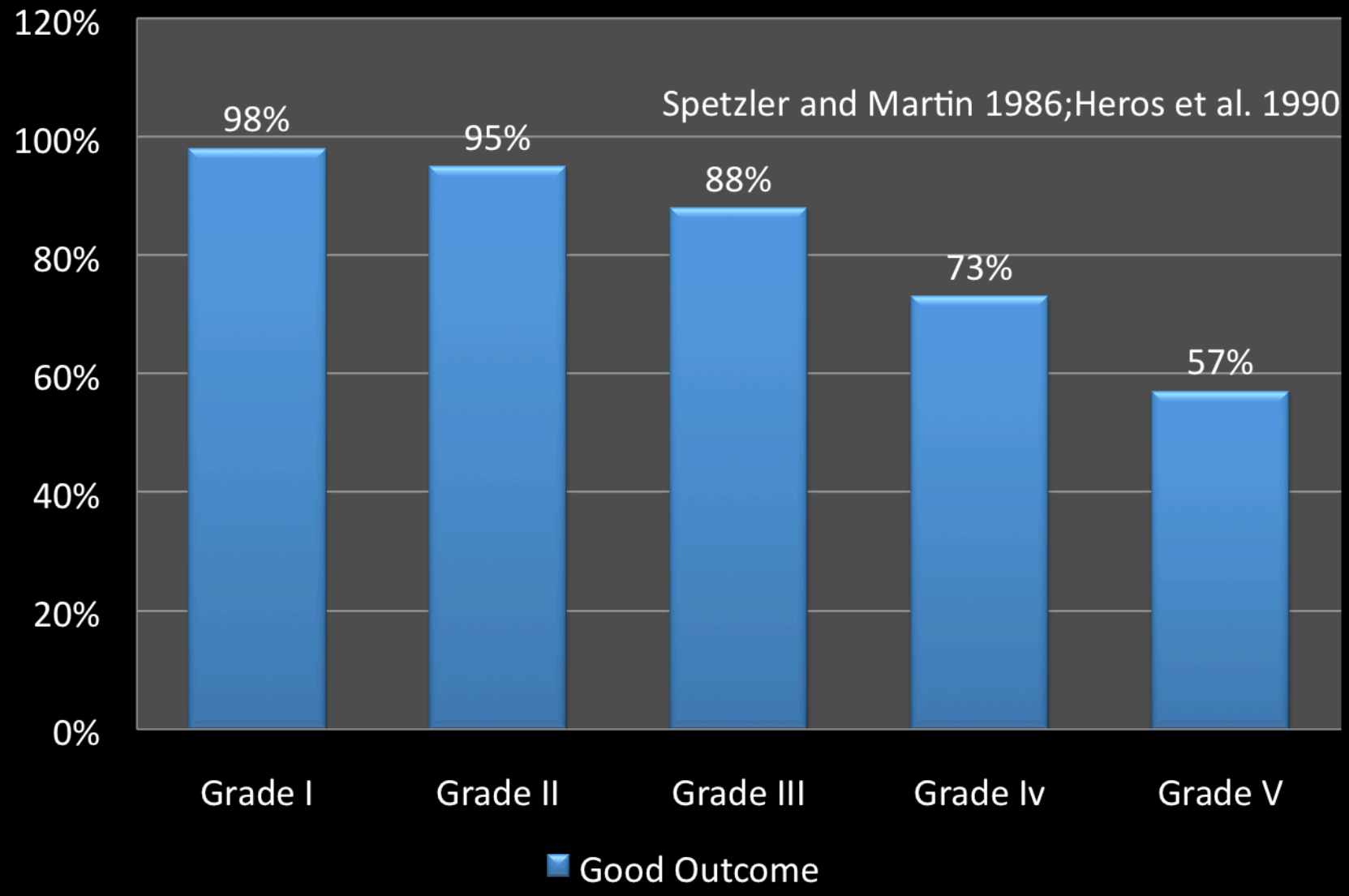
Microsurgical Technique
Hemostasis

- Complete hemostasis at all times & after each single step.
- Bleeding from the wall by gentle rubbing from cottonoid may indicate residual AVM
- After achieving hemostasis BP must not rise for next 24 hrs.

Complications



Microsurgical outcome



Review of Literature

- Meta- analysis of all series of more than 50 patients published since 1990 (25 series, 2452 patients) [Castel and Kantor 2000]
- Global mortality 0- 15% (Mean 3.3%)
- Post op morbidity 1.5-18.7% (Mean =8.6%)
- Small Superficial AVM have low morbidity (1.5 -9.7%) *Pik and Margan 2000, Schaller 1998.*
- Deep seated = high morbidity 17% -25%. [*Lawson 1995, De Oliveira 1997, Sasaki 1998)*

AIIMS series

- 1/1/2000 to 31/7/2008
- 868 patients evaluated for suspected AVM
- 790 had intracranial AVM
- 111 were surgically managed
- Presentations
  - Headache 70%
  - Loss of consciousness 12%
  - Seizure 32%
  - GCS $\leq$ 8: 12%

Location	Frontal	31%
	Temporal	14%
	Parietal	9%
	Cerebellar	13%
	Brain stem	1%
Spetzler Martin Grade	I	14%
	II	40%
	III a	9%
	III b	19%
	IV	16%
	V	2%
Size of AVM	<3cm	46%
	3-6cm	47%
	>6cm	7%
Location of bleed-	Lobar	55%
	Intraventricular bleed	10%
	SAH	7%
Associated findings on IADSA	Aneurysm	12%
	Cavernoma	1%

Embolization

First described by Lussenhope and Spence in 1960

In some used as a sole Tt. Modality

In rest = Adjunct to Surgery/GK

Clinico-morphologic Analysis

Pt. Factors

Young age +Elderly

Hemorrhage

Neurologic deficits

± SEIZURE/ Headache

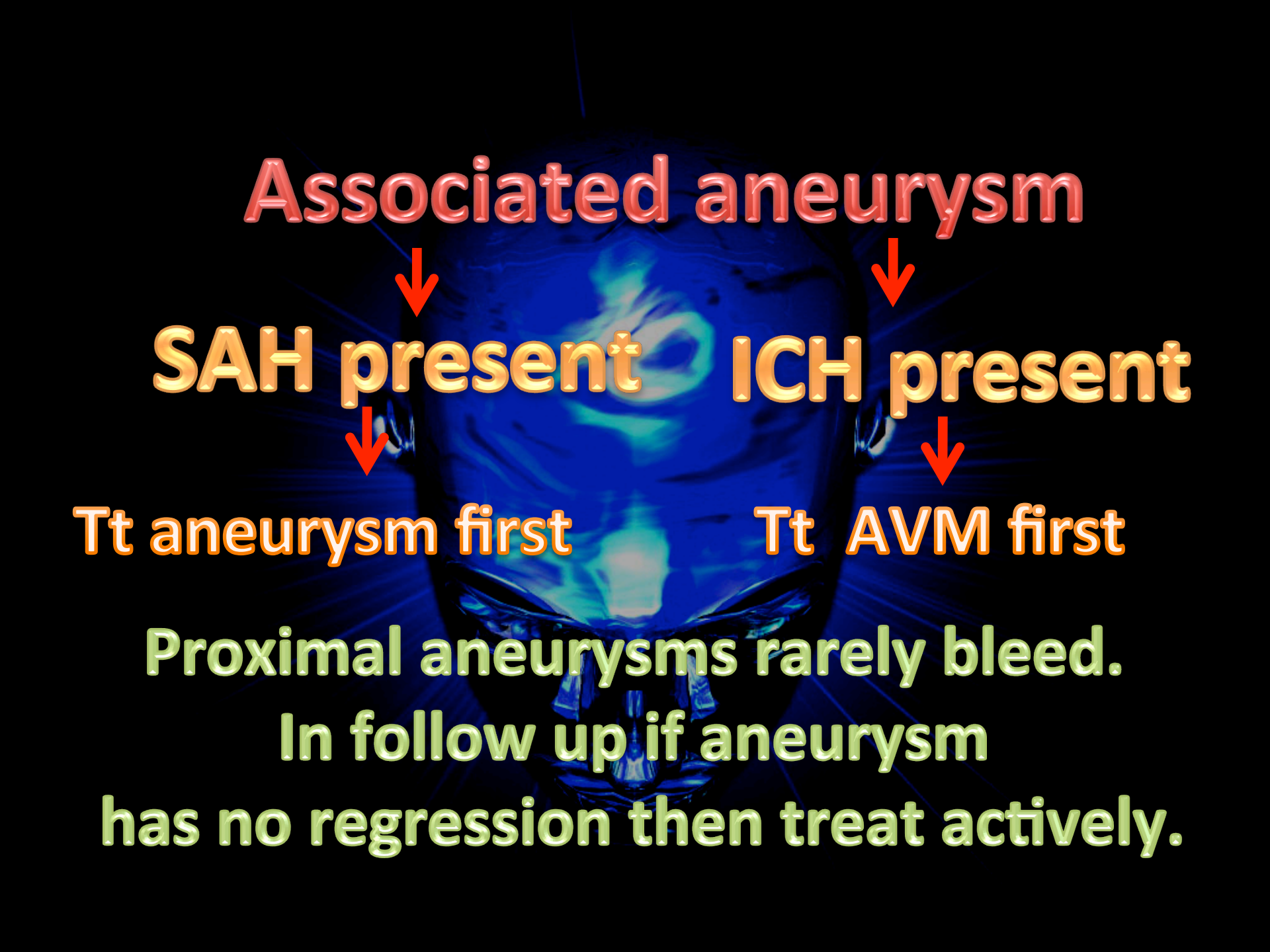
?

Females

Pregnancy


Clinico-morphologic Analysis
Cerebral Angiography
Aneurysm
Venous thrombosis
Venous hypertension
Outflow compromise


Clinico-morphologic Analysis
Cerebral Angiography
“Unlike surgical consideration
Location/size /Deep venous drainage
are a minor concern for a
endovascular surgeon”


Associated aneurysm
SAH present
ICH present
Tt aneurysm first
Tt AVM first
Proximal aneurysms rarely bleed.
In follow up if aneurysm
has no regression then treat actively.

Aims of embolization

- Curative
- Palliative
- Partial
- Pre-op
- Pre- GK

Curative Embolization

Do not use resorbable material or particles

FU angio at 6/12/24 mths -
recanalization/ recruitment

Complete cure = 10 to 40%

Favored in – limited arterial feeders +
sulcal & deep extrinsic AVM.


Targeted / Palliative Embolization
Aim is to reestablish the equilibrium.
Partial /targeted embo may be sufficient.
Target= Weakness of angio-architecture.
Reduction in venous HT is the goal.

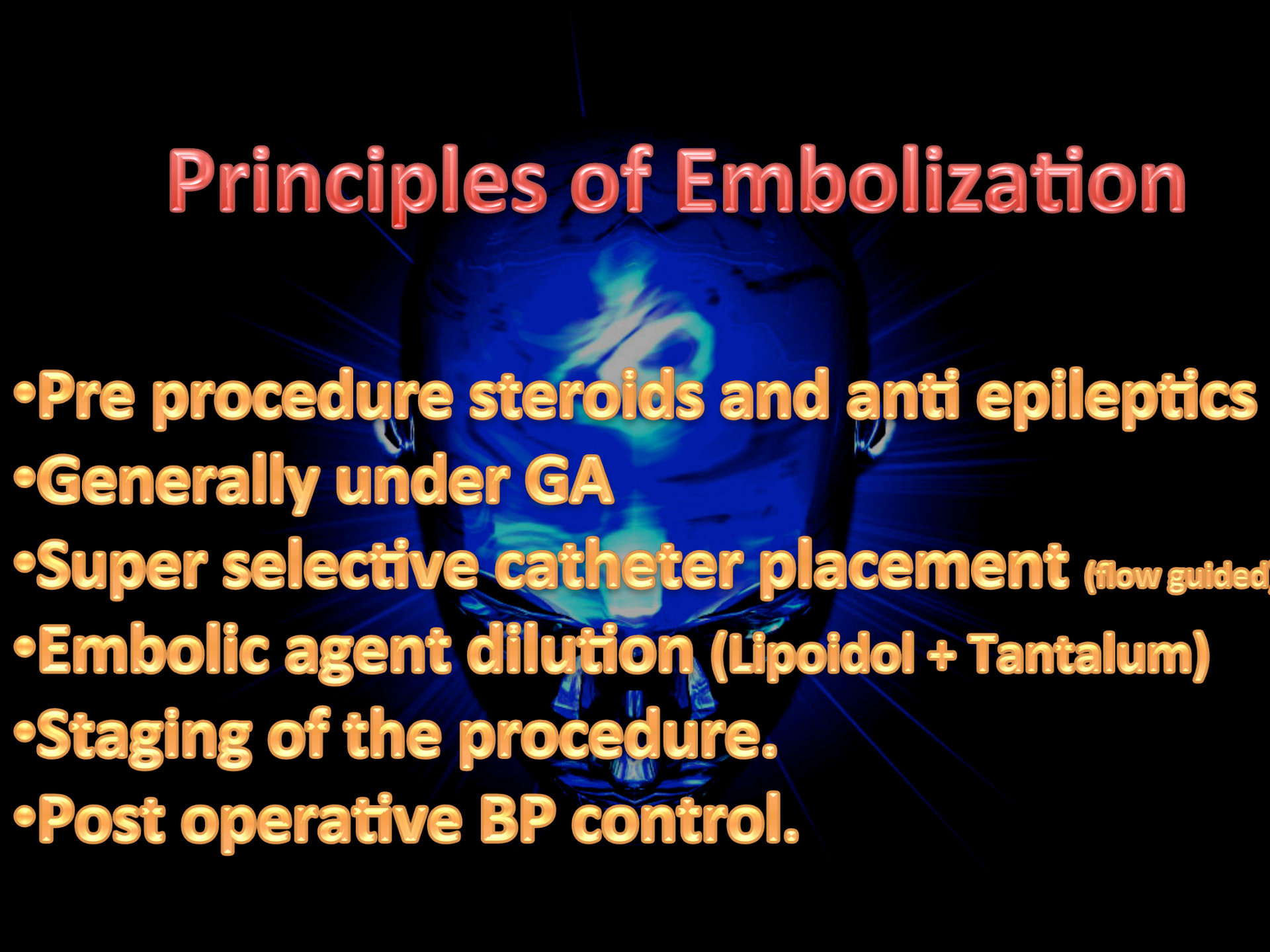
Preoperative Embolization

- Eliminate deep arterial feeder.
- Occlude high flow intranidal fistula.
- Size reduction
- Obliteration of aneurysms.
- N butyl cyanoacrylate >PVA
- Surgery – Ideally after 1 to 3 weeks.

Pre radio surgery

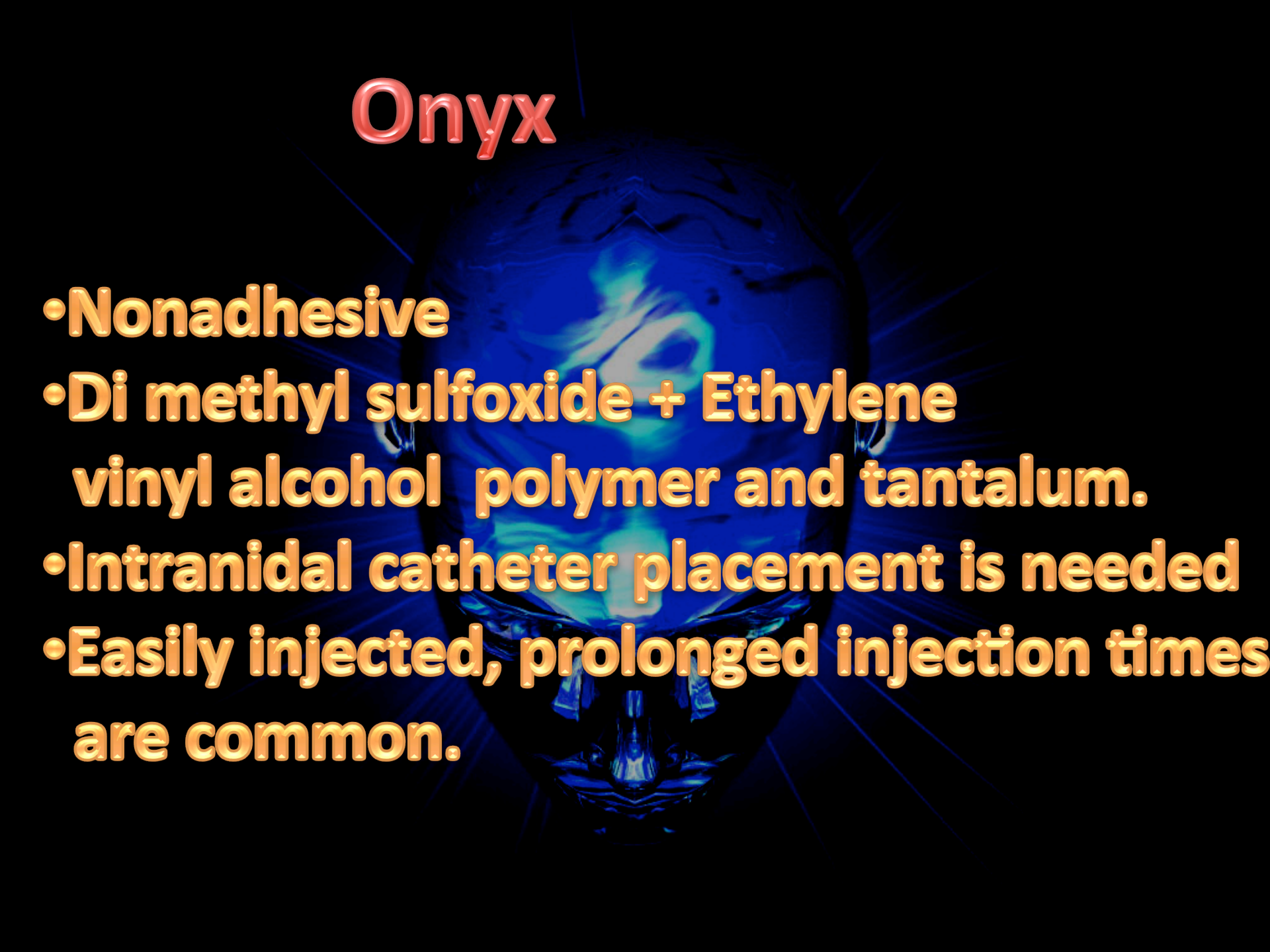
- Size reduction
- Targeted embolization for angio abn. like aneurysms, venous outflow restriction
- NBCA is the material of choice.
- Repeat Angio before RT .

Principles of Embolization



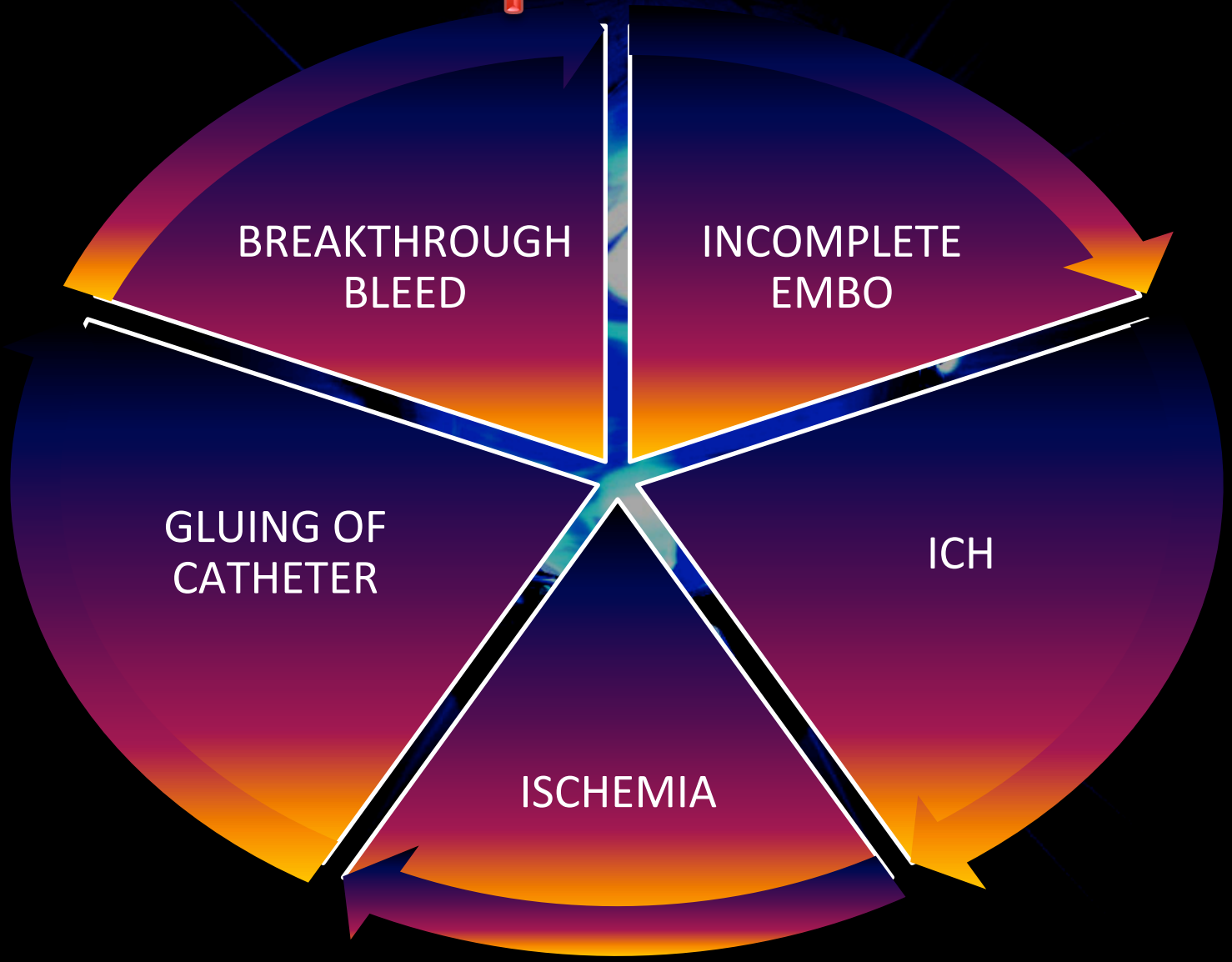
- Pre procedure steroids and anti epileptics
- Generally under GA
- Super selective catheter placement (flow guided)
- Embolic agent dilution (Lipoidol + Tantalum)
- Staging of the procedure.
- Post operative BP control.

Onyx



- Nonadhesive
- Di methyl sulfoxide + Ethylene vinyl alcohol polymer and tantalum.
- Intranidal catheter placement is needed
- Easily injected, prolonged injection times are common.

Complications



Embolization Outcome

- Complete obliteration =10 – 40%
- Staging may be needed.
- Gobin et al (1996) 11% obliteration rate
- Bernstein et al (1990) 17%

AIIMS series

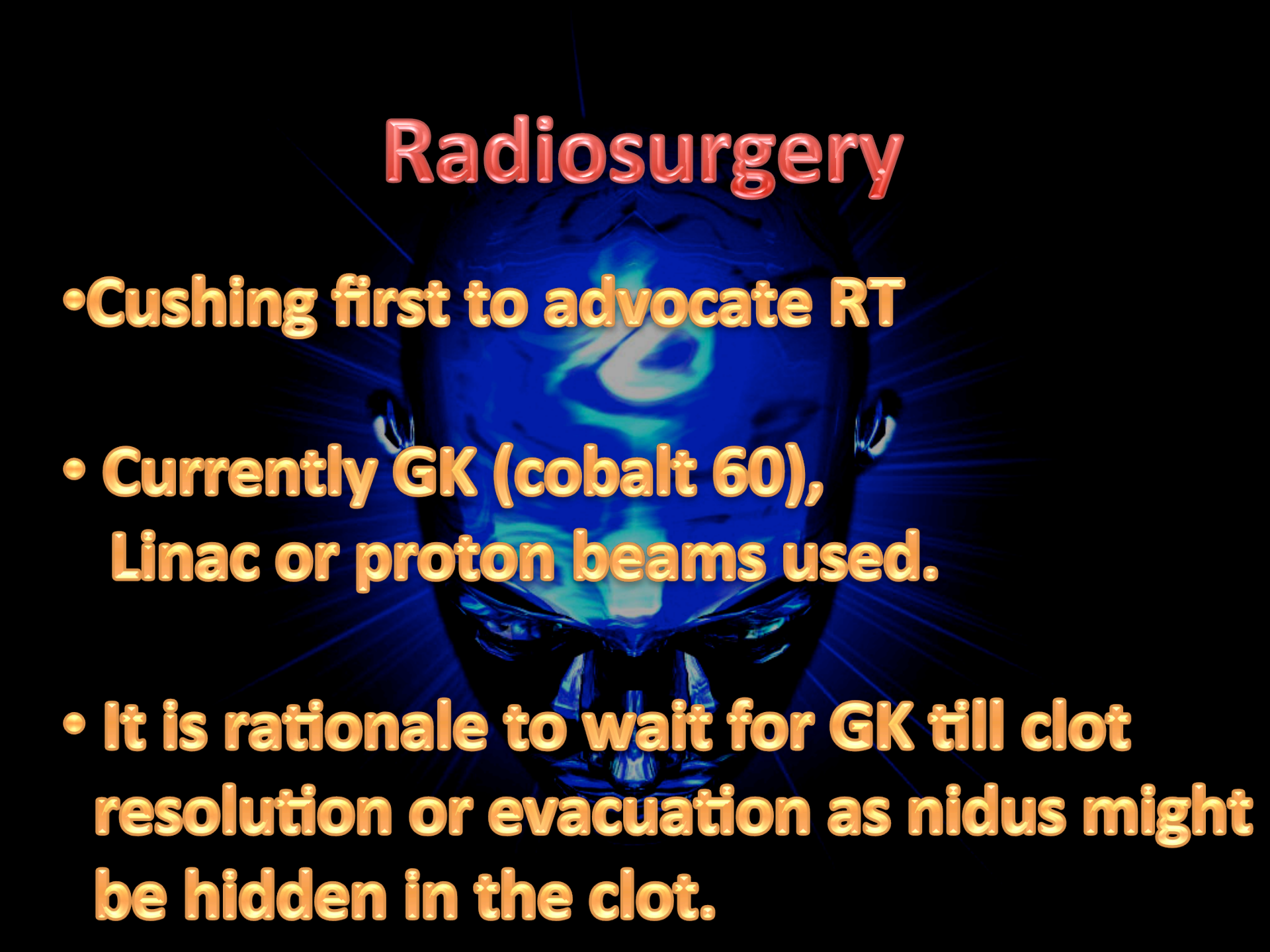
TCD evaluation of Blood flow velocity changes In basal cerebral arteries in cerebral AVMs following embolization and surgery

Neurology India 2000, 48:112-115

SK Tyagi, Ak Mahapatra, N.K. Mishra

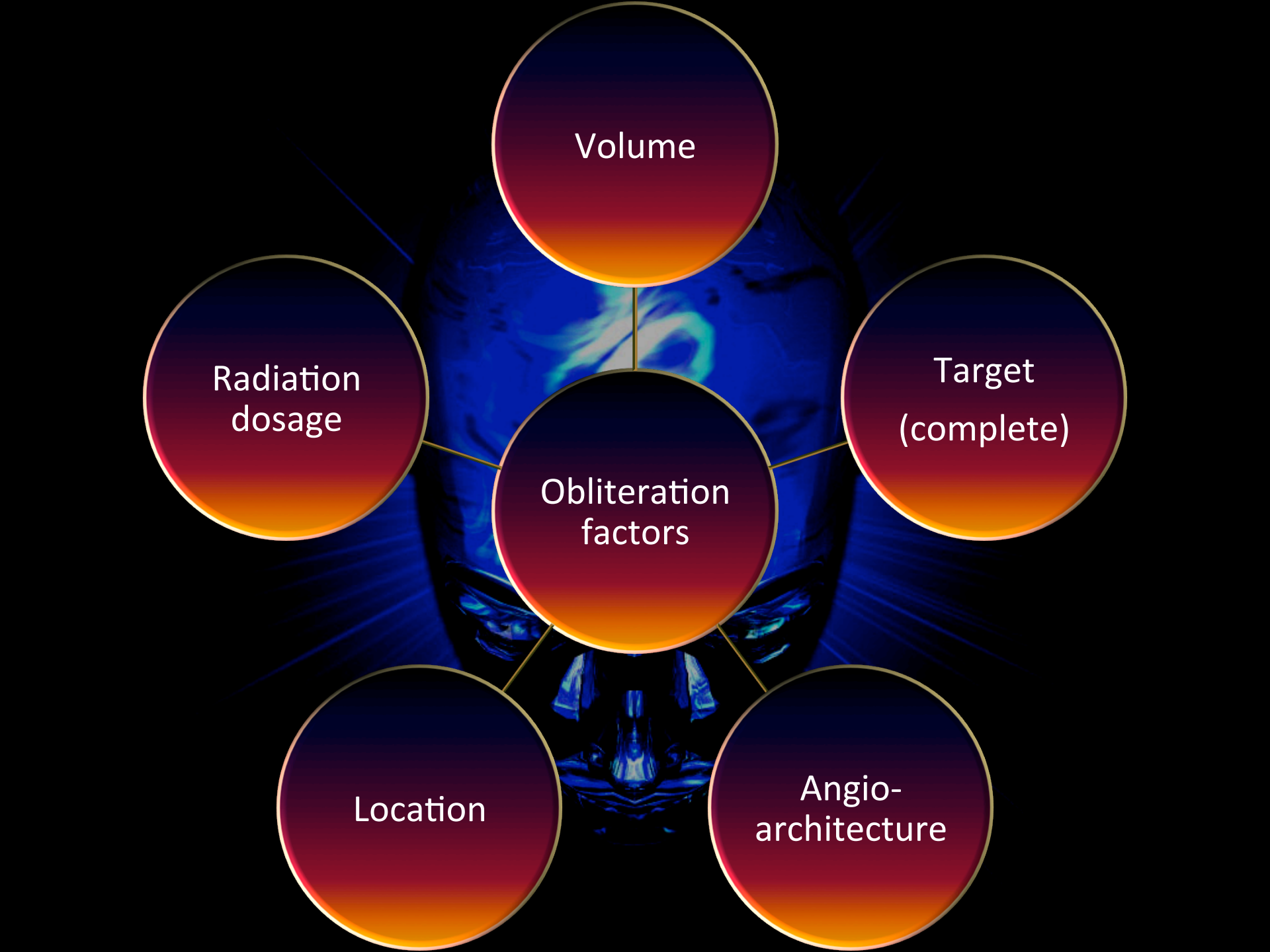
"Decrease in blood flow velocity has been observed after embolization and surgery"

Radiosurgery

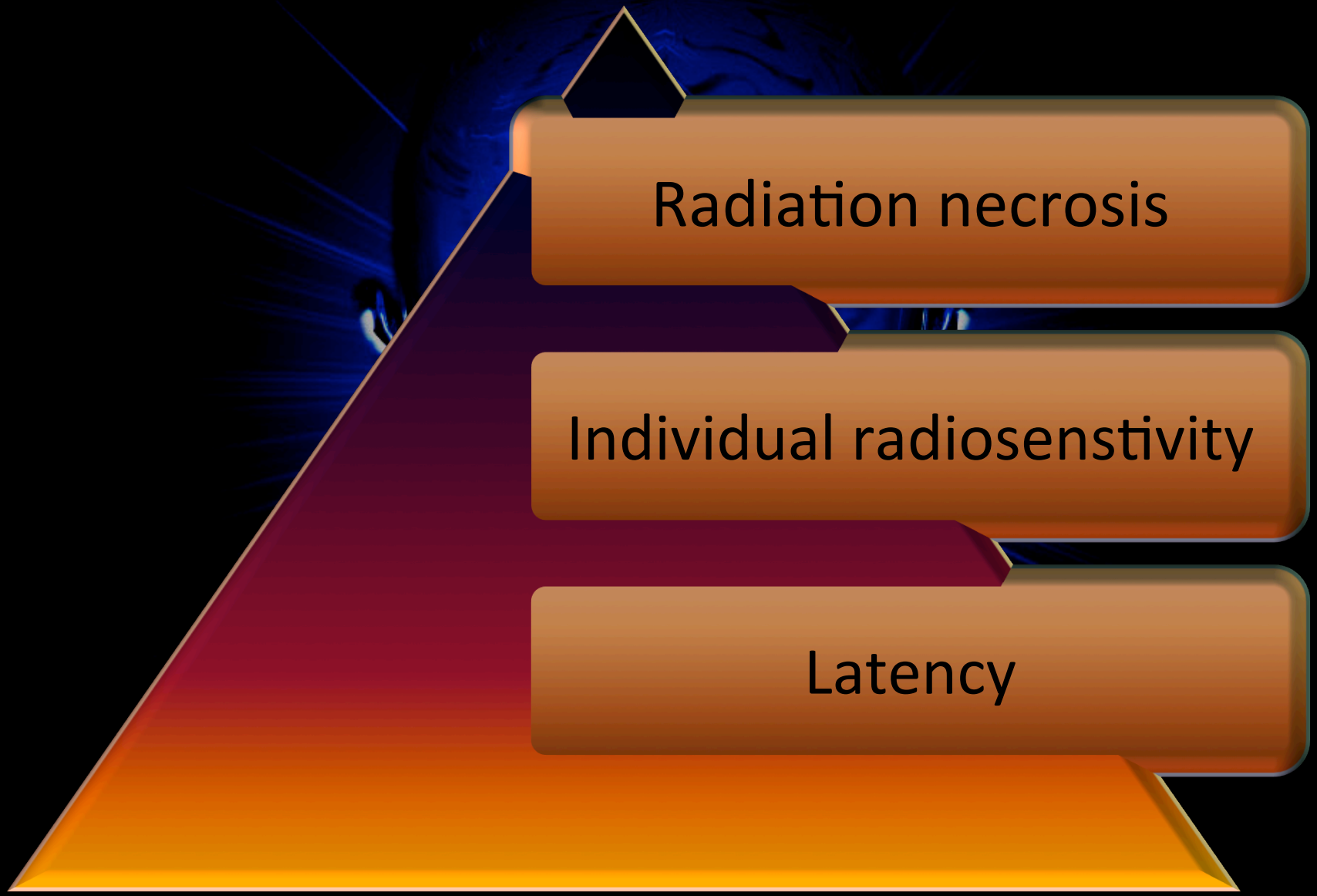


- Cushing first to advocate RT
- Currently GK (cobalt 60), Linac or proton beams used.
- It is rationale to wait for GK till clot resolution or evacuation as nidus might be hidden in the clot.

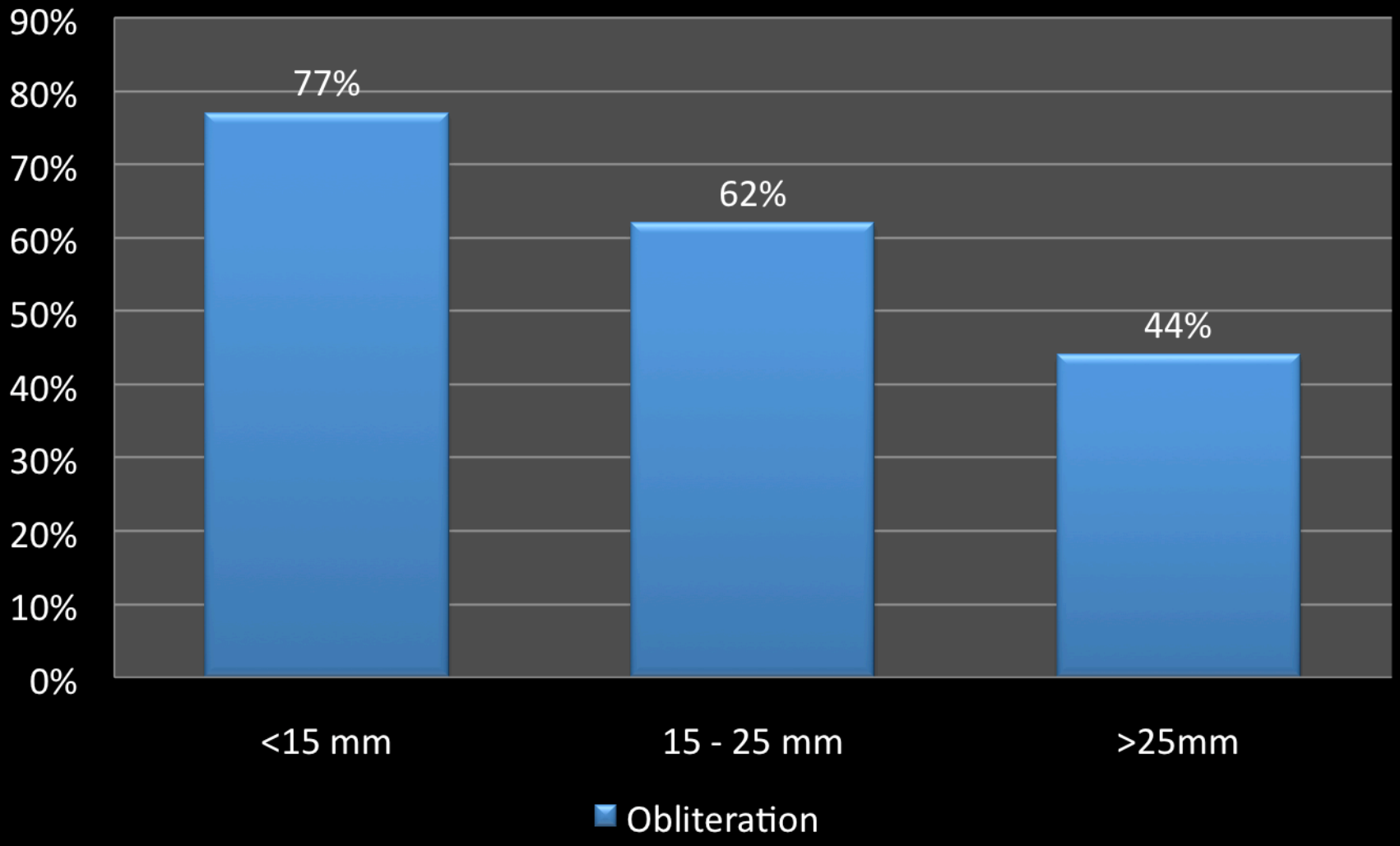

Radio-surgery
Radiation dose causes
Endothelial damage
Smooth muscle cell proliferation
Progressive sclerosis
Thrombosis of nidus channels


Volume
Radiation dosage
Target (complete)
Obliteration factors
Location
Angio-architecture

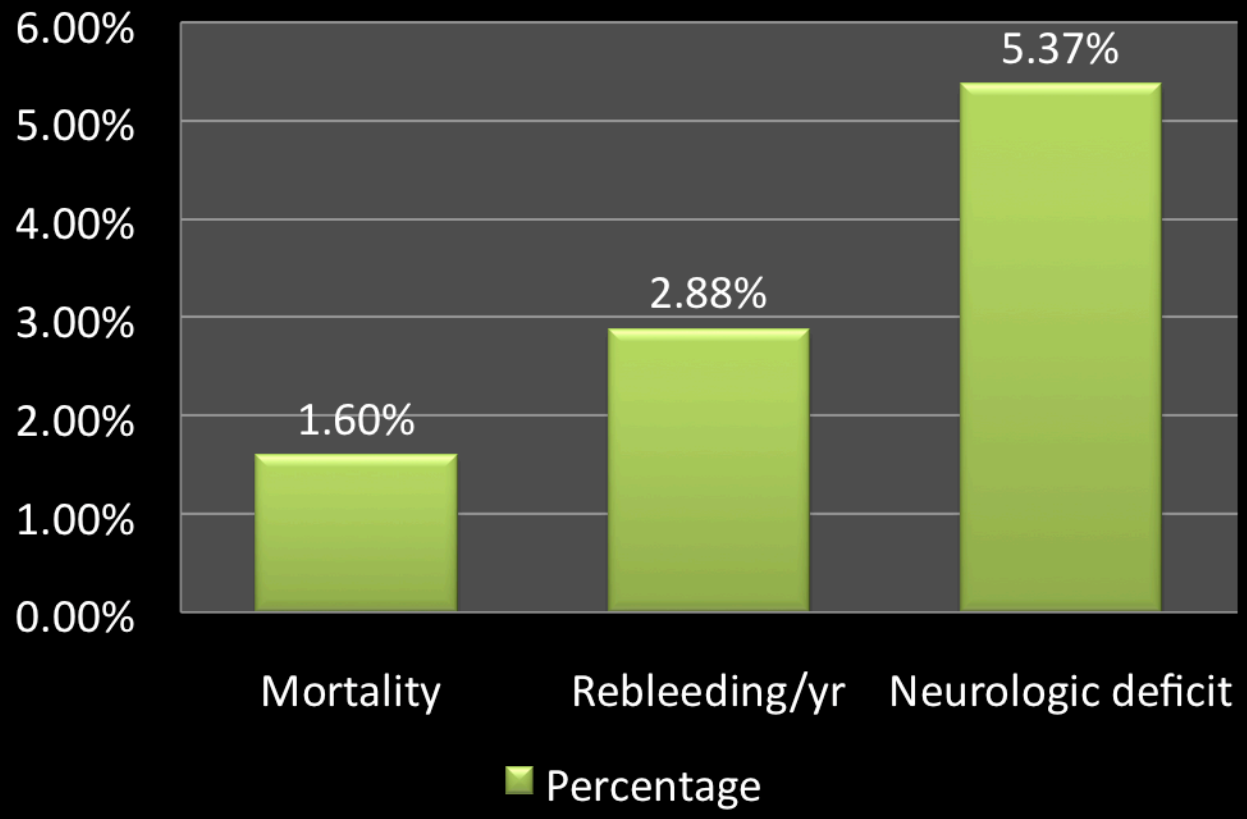
Drawbacks of Radiosurgery



Radiosurgery Outcome



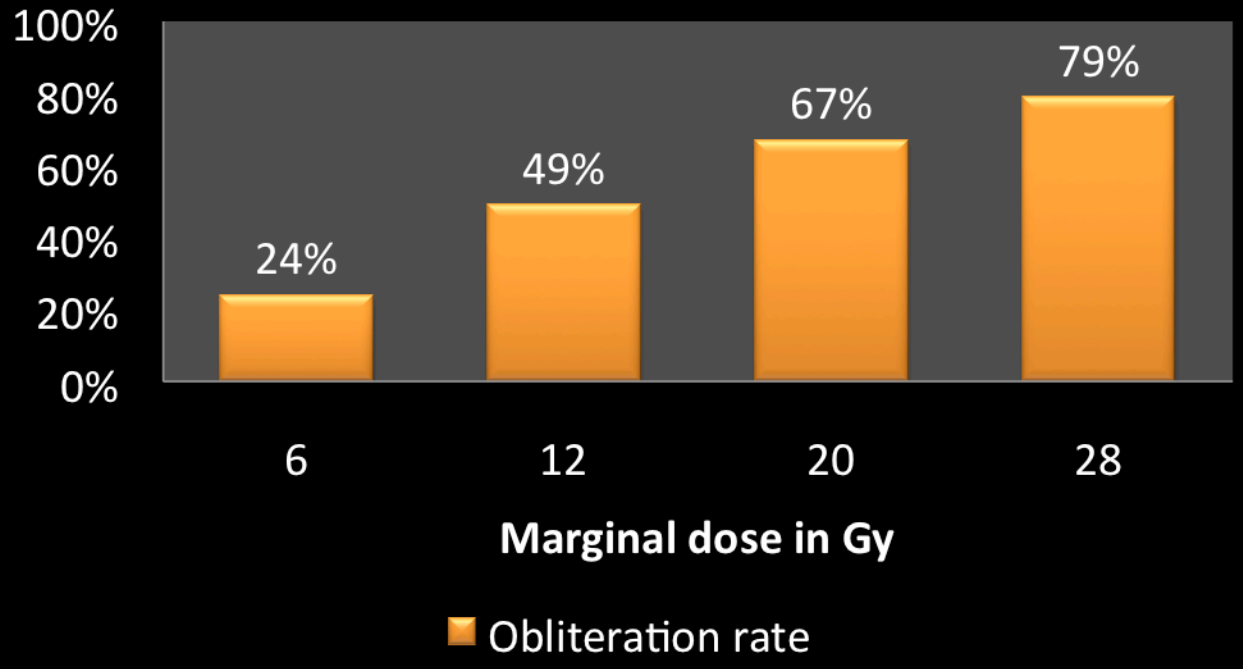
Radiosurgery Outcome



Nataf et al (2001) results of series of 705 AVM treated by radiosurgery Neurochirurgie 47:268-282

Radiosurgery Outcome

- Marginal dose is most significant factor
- Obliteration Probability =
  35.69 X ln (marginal dose -39.66)



AIIMS Data

Does hemorrhagic presentation in cerebral arteriovenous malformations affect obliteration rate after gamma knife radiosurgery?☆

Manish Kumar Kasliwal, Shashank Sharad Kale*, Aditya Gupta, Narayanam Anantha Sai Kiran, Manish Singh Sharma, Deepak Agrawal, Bhawani Shanker Sharma, Ashok K. Mahapatra

Department of Neurosurgery and Gamma Knife, Neurosciences Centre, All India Institute of Medical Sciences, New DelhiIndia

Received 26 November 2007; received in revised form 1 May 2008; accepted 13 May 2008

Series of 106 patients showing no difference in obliteration rate and chances of hemorrhage between the two groups. (p=0.672)

Clinical Neurology and Neurosurgery 110 (2008) 804–809

AIIMS Data

Outcome after hemorrhage following Gamma Knife surgery for cerebral arteriovenous malformations

Series of 494 patients

J Neurosurg 110:1003–1009, 2009

Results. The mortality rate was 0% and there was a 7% risk of sustaining a severe deficit following rebleeding after GKS. None of the patients sustained rebleeding after complete obliteration. Patients with Spetzler-Martin Grade III or less had increased chances of hemorrhage after GKS ($p < 0.002$). The presence of deep venous drainage, aneurysm, venous hypertension, or periventricular location on angiography was common in patients with hemorrhage after GKS.

Gamma knife radiosurgery for arteriovenous malformations of basal ganglia, thalamus and brainstem—a retrospective study comparing the results with that for AVMs at other intracranial locations

Narayanam Anantha Sai Kiran · Shashank Sharad Kale · Manish Kumar Kasliwal · Sandeep Vaishya · Aditya Gupta · Manish Singh Sharma · Bhawani Shankar Sharma · Ashok Kumar Mahapatra

Acta Neurochir
DOI 10.1007/s00701-009-0335-0

tients with central AVMs presented at a younger age (mean age 22.7 years vs. 29 years), with a very high proportion (81% vs. 63%) presenting with hemorrhage. Significantly higher incidence of radiation edema (15% vs. 5%) and lower obliteration rates (74% vs. 93%) were seen in patients with central AVMs.

Gamma Knife surgery for intracranial arteriovenous malformations in children: a retrospective study in 103 patients

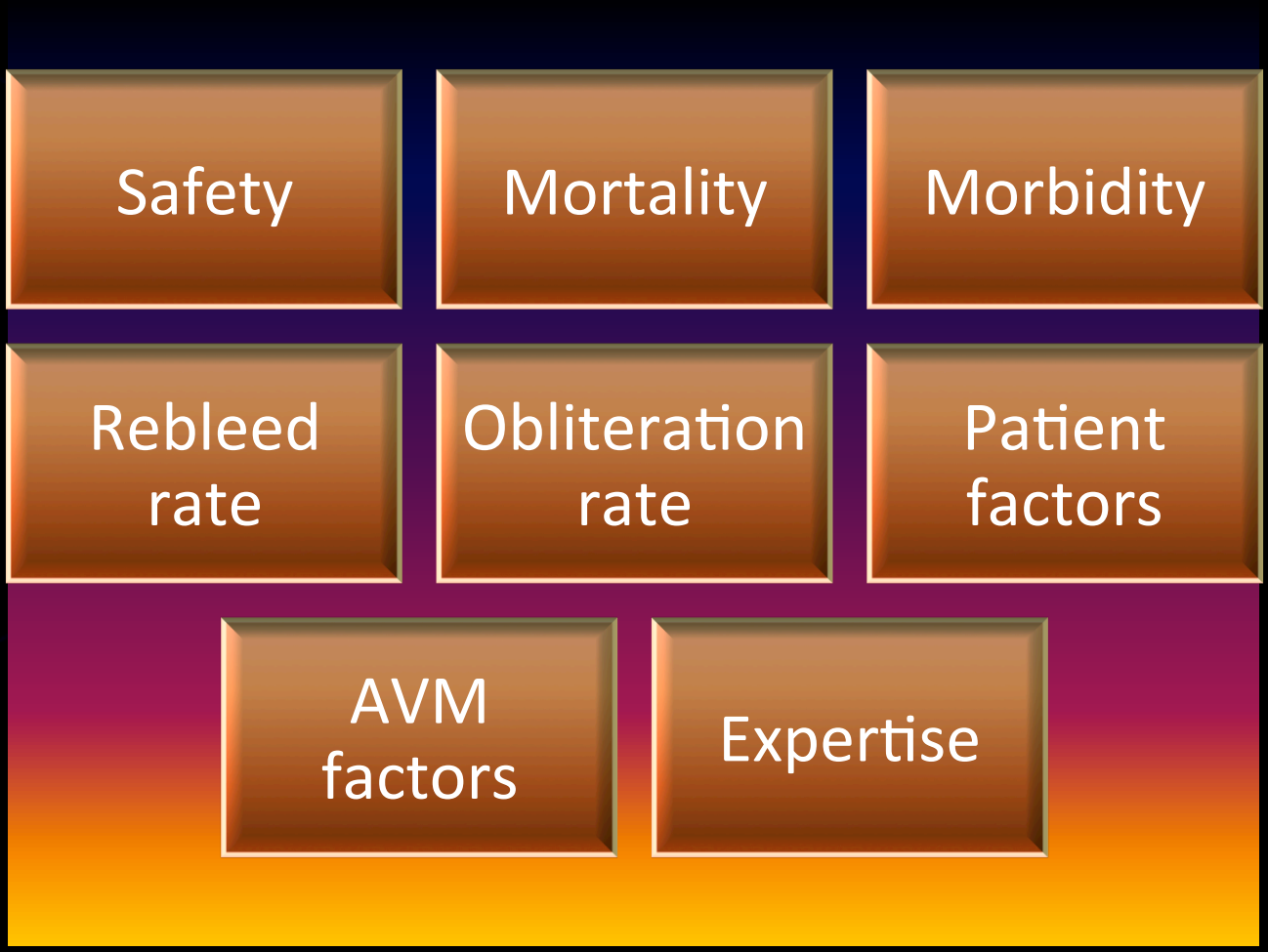
J Neurosurg (6 Suppl Pediatrics) 107:479–484, 2007

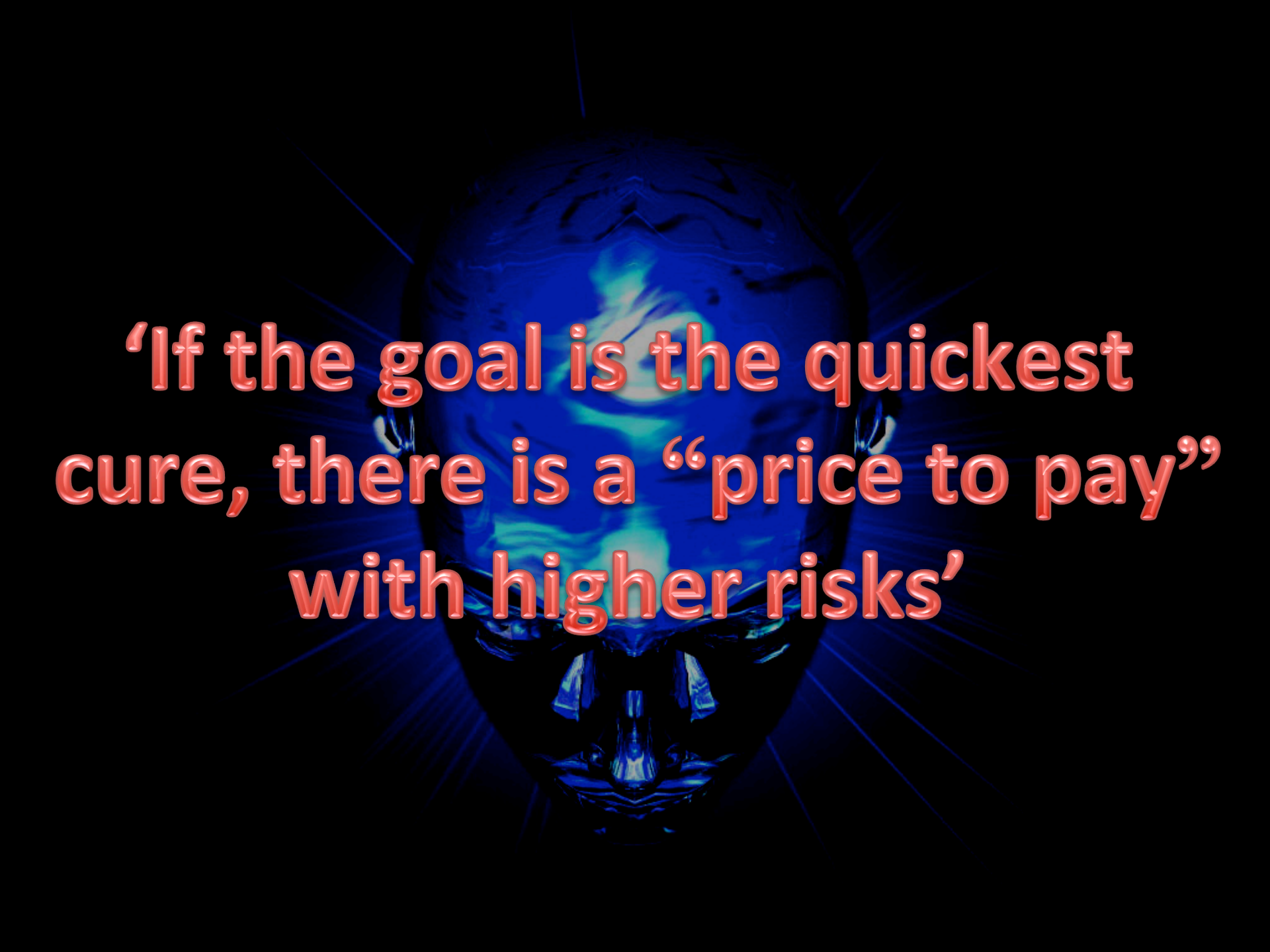
Results. Complete obliteration of the AVM was documented in 34 (87%) of the 39 patients with complete angiographic follow-up. The 3- and 4-year actuarial rates of nidus obliteration were 66 and 86% respectively. Three patients (2.9%) experienced bleeding during the latency period, and symptomatic radiation-induced edema was noted in four patients (3.8%). A significantly higher incidence of radiation edema was noted in patients with AVM volumes greater than 3 ml and in patients with Spetzler–Martin Grade IV and V AVMs.

Microsurgery Vs Radiosurgery

Neurosurgery. 2007 Jul;61(1):39-49

Comparison of Microsurgery and Radio-surgery




‘If the goal is the quickest cure, there is a “price to pay” with higher risks’

Team Approach

Stereotactic radiosurgeon

Neurosurgeon

Neuroradiologist

Neurologist

General recommendation

SM grade	Deep perf Vessel	Size	1st choice	2 nd choice
1 & 2	-	-	Sx	GK
3	Absent		Sx	Gk
3	Present	<3 cm	GK	Palliation
3	Present	>3 cm	Palliation	GK+Embo +/- Sx
4 & 5	Absent		Emb+ Sx	Palliation
4 & 5	Present		Palliation	Gk +/- Sx/embo.


Thank you