

Natural history of cerebrovascular lesions:

1. Aneurysms: Natural history and figures to quote.

- The risk of haemorrhage of unruptured aneurysm is about **1-2% per year**. **Juvula** et al (natural history of unruptured intracranial aneurysms, J Neurosurg, 2000). **Tsutsumi** et al (Risk of rupture from incidental aneurysms, J, Neurosurg, 2000). Unruptured intracranial aneurysms: a review by **Bryce Weir**, J Neurosurg.2000.
- The risk of haemorrhage after bleeding is 4% in the first day, 25 per day in the first 2 weeks (25% in the first 2 weeks) (13% first week, 12% second week) and 50% in the first 6 weeks. After the first year the risk drops to 3% per year(**international cooperative study**)
- The risk of death from the second bleeding is 50%. During the first bleeding 1/3 never reach the hospital.(**cooperative study**)
- For asymptomatic aneurysms the risk of haemorrhage is higher when there is history of previous haemorrhage from other aneurysm, if the aneurysm is larger than 1 cm.). ISHUIA
- In the **ISUIA** study the quoted risk of rupture for **unruptured** intracranial aneurysms was 0.05% for aneurysms<1cm in diameter (New England J of Medicine 1998). Widely criticised study
- The incidence of SAH is 6-10/100000 per year(**Review of 6 series Pakarinen 1966**. 77% was due to ruptured aneurysms)
- The incidence of aneurysms in 89000 autopsy cases was 1.6%. 1% was ruptured and 0.6% incidental. The approximate incidence of aneurysms in the population is **0.2-9 % (autopsy studies)**. **Common quoted figure 5% (Sekhar)**
- 0.5-2 % of aneurysms occur in children < 18 years of age
- 55 cases of aneurysms reported in children < 2 years of age
- In children aneurysms are more common in boys 60%.
- 85% of the aneurysms occur in the anterior circulation, 10-15% posterior circulation (**International cooperative study on timing of clipping. Kassel et al. 1996** “3521 aneurysms”-MCA-22%, ACA-39%, ICA-20%)
- Aneurysms are multiple in **15%** of cases (Suzuki et al in review of 10795 cases). In 71% 2 aneurysms, 23% -3 aneurysms, 6% multiple. Multiple aneurysms are **more common in females**. In 47% the other aneurysm is on the other side and there is tendency of symmetrical aneurysms in ICA and MCA aneurysms. **5% chance of posterior circulation aneurysm in case of ruptured anterior circulation aneurysm**, hence the need for 4 vessel angiogram in all cases.
- **Nehls et al** proposed algorithm to identify ruptured aneurysm in case of multiple aneurysms (exclude extradural aneurysm, look for local clot on CT scan, check local mass effect or focal vasospasm on angio, the largest, the irregular aneurysm with bleb is more likely to bleed, choose the aneurysmal site with most likelihood of rupture (A-com), occasionally third nerve palsy or retroorbital headaches may point to P-com aneurysm.

- The peak of aneurysm rupture is the **6th decade 28%**. First decade 1%, second-2%, 3-d-6%, 4th 15%, fifth-26%.
- More common in females F: M ratio **1.6: 1**(cooperative study). Before the age of 40 males and females are equally affected.
- **5%** of intracranial aneurysms are **bacterial** (streptococcus viridans from SBE). These usually occur on the distal branches of MCA. 1% is traumatic. **5% of aneurysms are giant**.
- **Familial aneurysms**: aneurysms occurring in two or more first to third degree relatives. The incidence is about **6 %**(W& R). There is aggregation of aneurysms in families with **Ehler-Danlos** syndrome (defect in type 3 collagen). Aneurysms tend to rupture at smaller size and younger age. Increased risk of aneurysms in patients with autosome dominant **polycystic kidney disease** 4-40%.
- The critical size beyond which the aneurysm became unstable and likely to rupture is 4 mm. The figure given by the **cooperative study is 7mm**.
- Aneurysms are **acquired lesions** that result from haemodynamic degeneration of internal elastic membrane and media (muscularis) at the point of bifurcation. This **haemodynamic stress** is increased by **hypertension**, increased flow as in **AVM** (6-12 % have concomitant aneurysms, 28-40% of which are multiple and in 40-80% they occur on the feeding artery and many of these regress after obliteration of the AVM) and in case of **hypoplasia of near by arteries** (A-com aneurysms are commonly associated with hypoplasia of contralateral ACA). In one series **14%** of 232 patient with **persistent trigeminal artery** (persistent Carotico-basilar anastomosis) had associated aneurysms. **14% incidence of aneurysms on collateral Moyamoya vessels**.
- Infundibulum: less than 3 mm funnel shaped dilatation at the origin of artery (commonly p-com) are not aneurysmal or preaneurysmal. 8 reported cases of aneurysms developing at the site of infundibulum.
- Relationship of **hypertension and aneurysms** 4/5 published studies showed no association although the multiplicity of aneurysms was higher in the hypertensive group.
- Relationship of carotid stenosis and occlusion to intracranial aneurysms: controversial some studies showed increased incidence of aneurysms on the contralateral side of carotid occlusion, others did not.
- The most common presentation of aneurysm is SAH 90%, mass effect 6%, incidental 4%. Rare presentation is TIAs from distal embolisation(thrombosed giant aneurysms)
- 5% of aneurysms are giant, 60% of giant aneurysm are partially thrombosed, 60% occur in females, 43% in the ICA (O-21%, bifurcation 12%, cavernous-7%), 16% MCA, 12% vertebrobasilar. These aneurysms commonly present with mass symptoms and TIAs from distal embolisation.
- **3-15% of patients with SAH** have no identifiable causes (always exclude spinal causes). Repeat angiogram or MRA IN 2-3 weeks if the initial angiogram shows vasospasm).

- Hydrocephalus develops in 30% of patients with SAH, 10% require a shunt. **Rebleeding rate is higher in the EVD group 43% in comparison with those without EVD 15% in one study.**
- Epilepsy develops in 1-10% (review of 5 series) of patients after SAH. Risk factors include MCA aneurysm (25% in one study), IC haematoma, resection of rectus gyrus, retraction of medial temporal lobe. 70% occurred in the first year and 94% in the first 2 years. The rate of epilepsy is not increased if the fit occurred at the time of aneurysm rupture.

2. Venous angioma:

- The risk of haemorrhage, if any is minimal and is commonly from associated cavernous malformation.
- This malformation gives the appearance of caput medusae on angiograms (radially arranged anomalous veins that converge into large draining vein)
- The veins of this malformation drain normal brain and in case of haemorrhage one should aim at excising the associated cavernoma and avoid disturbing the venous angioma because of the low risk of bleeding from these lesions and the increased risk of venous infarction.

3. AVM:

- 2-4% annual risk of haemorrhage
- 6% risk of haemorrhage in the first year after the initial haemorrhage
- 10% risk of mortality and 30-50% risk of irreversible deficit with each bleed
- The risk of haemorrhage is higher for small AVM,
- The risk of mortality and morbidity from surgery is low for Martin- Spetzler grade 1-3 AVM, the risk of major morbidity is 20% for grade 4 and 5 AVM in Spetzler series
- 50% of patients with epilepsy get control of their seizures with or without medications and 15% develop de novo seizures

4. Cavernous angioma (cavernoma):

- The annual risk of haemorrhage from supratentorial cavernomas is **0.25-0.75%**. The risk of haemorrhage is higher in those whose initial presentation in haemorrhage **1.5-4%**
- The annual risk of haemorrhage for infratentorial cavernomas is about **4%** (The discrepancy between the incidences of haemorrhage in the two groups could be due to the fact that most haemorrhages in the brain stem and posterior fossa become symptomatic and diagnosed while many supratentorial haemorrhages may remain asymptomatic. After the first haemorrhage the incidence of recurrent haemorrhage is **4-8%** in the first year. The haemorrhage rate for infratentorial cavernomas may be 30 times that of supratentorial ones.
- **50-70%** of patients develop epilepsy (more than with other vascular malformations,? Hemosiderin and gliosis)
- Cavernomas rarely result in catastrophic haemorrhage

5. Dural Arterio-venous fistulas:

- The risk of haemorrhage is 1.5% per year in the absence of leptomeningeal venous drainage. In the presence of leptomeningeal retrograde venous drainage the risk of haemorrhage is much higher 15-35%. Treatment is indicated only if there is history of haemorrhage, neurologic deficit “venous hypertension”, or angiography showing leptomeningeal venous drainage.
- Spontaneous cure and thrombosis of dural AVF has been reported following angiography or simple compressive manoeuvres.

6. Carotid artery stenosis:

- NACET (North American Carotid Endarterectomy Trial): **17%** reduction in the incidence of ipsilateral stroke between surgical and nonsurgical groups (best medical therapy) with **symptomatic (in the last 6 months) > 70% carotid stenosis.**
- European Carotid Surgery Trial: **6%** reductions of stroke in the surgical group with **> 70% stenosis with 3 years** follow up