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The history of the development of any surgical technique is always a fascinating one and the history of stereotactic surgery is no less so. As mentioned, it is based on the simple concept of Cartesian principles, but it also needs a second element - that of a three-dimensional positioning stage.

Its origins are said to have begun with Dittmar in 1873, who published a paper “On the location of the so-called vasomotor center in the medulla oblongata”. Its use in humans began in 1947 with the work of Robert Hayne, Frederic Gibbs, Ernest A. Spiegel and Henry T. Wycis amongst others.

The initial interest in human use was for the treatment of movement disorders such as Parkinson’s disease and hence when medical therapy such as L dopa became available in the 1960s, it fell out of favour.

Its revival came with advancements in neuroimaging and surgical tools. Today, 50 years later, it has wise ranging applications, not only in neurosurgery but also in lung and breast cancer management and now orbital surgery.

The COMS trial started in 1985 and the follow up of patients in the medium tumour trial was completed 18 years later, in 2003. Its aim are primarily the:

- Comparison of enucleation versus radiation for tumors at least 2.5mm but no more than 10mm in height and no more than 16mm in basal diameter, and

- Comparison of standard enucleation versus enucleation preceded by external beam radiation for tumors greater than 10mm in height or greater than 2mm in height and greater than 16mm in basal diameter or greater than 8mm in height if there is optic nerve involvement.

In addition to these two randomized trials, a number of pilot studies and ancillary studies were also conducted.

The incidence of primary choroidal melanoma is about 7 cases per million population and about 30-50% of patients with choroidal melanoma will die within 10 years from diagnosis and treatment.

There is a moral here in these two stories for the debaters about the direction that biomedical research should take in Singapore!

Dr Aliza Jap, Editor
This 59-year-old Chinese gentleman presented with an acute episode of right eye pain and headache. He did not have any past medical or ocular history. Ocular examination showed visual acuity (VA) of 6/60 for the right eye. There were signs of right acute primary angle closure including a hazy cornea, shallow anterior chamber, mid-dilated pupil and an intraocular pressure of 52mmHg. However there was also chemosis with decreased elevation and adduction. The left eye also had a shallow anterior chamber but the intraocular pressure was normal. The patient was treated medically for the acute primary angle closure and bilateral laser peripheral iridotomies were subsequently performed.

Post iridotomy, dilated fundal examination revealed an exudative retinal detachment with a subretinal mass in the right eye (Figure 1).

B-scan showed that the lesion is arising from the choroid-scleral layer with intermediate internal reflectivity and acoustic hollowing (Figure 2).

Computed tomography (CT) scan showed a right intraocular mass arising from the choroid-scleral layer, associated with swelling of right upper eyelid and increased radioopacity in the superior and anterior retroorbital fat (Figure 3).

Systemic workup including liver function test, CT scans of the thorax, abdomen, pelvis and bone scan were normal. The clinical diagnosis was primary choroidal melanoma with orbital inflammation.

In view of the poor visual prognosis indicators in this patient which included large tumour size, rubeotic glaucoma (which he subsequently developed), exudative retinal detachment, vitritis and proximity to optic disc, enucleation was done. Histological examination confirmed the diagnosis of choroidal melanoma, of mixed cell type.

The Collaborative Ocular Melanoma Study (COMS) was a multicentre study begun in the mid 80s to evaluate therapeutic interventions for large and medium-size choroidal melanoma; it also included an observational study for small lesions.
The COMS Large Tumour Trial showed that for treatment of large tumours, (thickness > 10mm, basal diameter>16mm), enucleation versus enucleation preceded by external beam radiation did not result in any difference in the 10-year survival, with a high mortality rate of 61%. Death from metastasis was 40% and 45% for both groups respectively. The main predictors of death were diameter of tumour and older age. Radiation did not result in more serious orbital complications.

The COMS Medium-size Tumour Trial found that enucleation versus radiation for medium-size tumours, (thickness<10mm, basal diameter<16mm) did not result in any difference in 5-year (18%) or 12-year mortality rate. Brachytherapy preserved the globe in 90% of eyes at 5 years. 10% of eyes required enucleation due to treatment failure and pain. 80% of complications occurred within 3 years of treatment and these included cataract, glaucoma, maculopathy, optic neuropathy, vitreous hemorrhage and retinal detachment. 34% of eyes had VA better than 6/36 at 3 years and 60% had VA worse than 6/60. A drop in VA of 6 Snellen lines was seen in 45% of eyes.

The COMS Small Melanoma Trial (height of 1-3mm, 5-16mm in larger basal diameter) was an observational study which found that 31% of small melanomas had grown by 5 years, where 25% reached medium size or more and 40% needed treatment at onset or on follow up. Risk factors for growth included greater initial tumour thickness and diameter, presence of orange pigment, absence of drusens, and absence of areas of retinal pigment epithelial changes adjacent to the tumour. The 5-year all-cause mortality was 6.0%.

However there has since been a change in the treatment trend. For large tumours, enucleation has remained the mainstay of treatment. For medium sized tumour, there has been a shift in emphasis to preservation of vision and the globe.

Tumours are also being detected at smaller sizes due to closer follow up and early recognition.

There is an increasing use of conservative nonenucleation therapy such as observation, laser photocoagulation, thermotherapy, plaque therapy, charged particle radiotherapy or local resection (lamellar sclerouvectomy, pars plana vitrectomy and endoresection).
Combined therapy including brachytherapy with argon or xenon laser photocoagulation, brachytherapy with transpupillary thermotherapy and local resection with brachytherapy are other alternative modalities for the management of small or medium-size tumours.

However it must be noted that conservative treatment was associated with an increase in metastatic disease, with a risk ratio of 1.5 when there was local recurrences (COMS), as well as increased complications from proton beam and cobalt therapy.

Chemotherapy has no role in primary treatment and is still controversial in the treatment of metastasis. Systemic chemotherapy include cisplatin and paclitaxel. Chemoembolization with cisplatin and polyvinyl sponge particles has been used for treatment of liver metastasis.

Periodic observation for choroidal naevus is necessary as 1 in 5000-8000 evolve into melanomas. Risk factors of growth can be summarized in the acronym TFSOM which stands for Thickness>2mm, Fluid (subretinal), Symptoms (blurred vision, flashes/floaters), Orange pigment, Margin touching disc. The presence of 2 or more risk factors is associated with a 50% transformation in 5 years.

Key Learning Points:

1. Small and medium sized tumours may be managed with globe sparing modalities such as plaque therapy.

2. Enucleation is still the mainstay of treatment for eyes with large tumours, ocular complications of rubeotic glaucoma, optic nerve invasion and extrascleral extension.

3. Exenteration is reserved for those with orbital extension and is palliative in nature.
Central Serous Chorioretinopathy (CSC) was first described by Von Graefe in 1866 who called it “idiopathic detachment of the macula”. It is defined as a detachment of the neurosensory macula, with a focal leak at the level of the retinal pigment epithelium (RPE) observed on fundus fluorescein angiogram (FFA). It is an idiopathic syndrome of healthy, young to middle-aged men (M: F ratio = 6:1). It is generally unilateral and found to be more severe in Hispanics and Asians. It is also more common in hypermetropes and emmetropes but rare in myopes.

The clinical presentation includes blurring of vision, a central scotoma, metamorphopsia and micropsia. Clinical findings include a circumscribed neurosensory detachment localized to the macula, RPE detachment, RPE disturbances, an atrophic tract extending inferiorly, bullous inferior detachments, vitreous hemorrhages and retinal neovascularisation.

The most common form of CSC presents as a well-defined neurosensory detachment at the macula in a patient with the typical profile. It may be a focal or multifocal lesion and often has a favorable prognosis.

The chronic form of CSC appears as areas of geographic atrophy with mottling of RPE seen as window defects on FFA.

The more severe type of CSC is usually seen in patients on hemodialysis, transplant patients, and those on systemic steroids. This subgroup typically presents with bullous retinal detachments, typically seen inferiorly (Figure 1).

There are several systemic and ocular associations that have been described in association with CSC in the literature (Table 1).

An FFA clinches the diagnosis and also localizes the area(s) of leakage, enabling laser photocoagulation or photodynamic therapy, when needed. The characteristic patterns seen are ink blot (commonest type) (Figure 2), smokestack (classical type, in 20% of patients), and multifocal leaks. The most common location of the leak is in the supero-nasal quadrant of the macula.
Two diagnostic adjuncts have also been used to study CSC. Indocyanine green (ICG) angiography serves as a marker for the disorder (even in its dormant or quiescent state), by demonstrating the presence of multifocal areas of choroidal vascular hyperpermeability. These hyperpermeable, staining areas seen on ICG angiography do not necessarily have clinical and FFA counterparts, although frank leaks and window defects during FFA are frequently seen.

Optical coherence tomography (OCT) (Figure 3) is also useful for documenting and monitoring shallow neurosensory retinal detachments and for analyzing the integrity of the parafoveal retina, to establish the visual prognosis.

The pathophysiology of CSC is primarily a choroidal vascular hyperpermeability, which is observed on ICG angiography. This leads to an increase in choroidal tissue hydrostatic pressure, which supersedes that of the retina, thus reducing or stopping solute flow across the RPE. The RPE transforms from an absorbing state to a secretory state beginning with accumulation of exudate in the inner choroid (Figure 4). This leads to detachment of the RPE (serous Pigment Epithelial Detachment or PED).

In the acute form of the disease, there is presumed to be a mechanical breakdown of the detached RPE, usually at or near the junction between the attached and detached RPE. This microrip, or “blowout,” leads to serous leakage beneath the neurosensory retina and serous PED formation, characteristic of the disorder.

Multifocal ERG (mfERG) has also been used to evaluate patients with CSC. Studies have shown that the mfERG is not only depressed in affected eyes and reduced beyond the areas of detachment but also throughout the posterior pole of clinically normal fellow eyes which had only a few small retinal pigment epithelial abnormalities. These mfERG abnormalities can persist for as long as 23 months following resolution of CSC. However the Full field ERG is usually normal. These findings suggest that a diffuse
The natural history of CSC is that of a benign self-limiting disorder with average time to spontaneous resolution being 3-4 months. More than 90% of patients achieve a visual acuity of 6/9 or better. However, recurrences are seen in more than 50% of patients, usually within 1 year of the initial episode and lasting up to 10 years.

The management of CSC includes medical therapy (NSAIDS, beta blockers, sedatives, antihistamines), stress management and counseling, focal laser photocoagulation and photodynamic therapy (PDT).

Laser photocoagulation has a risk of inducing choroidal neovascularisation (CNV) in up to 1% of treated eyes and the risk increases with age and proximity to the fovea.

PDT is useful in subfoveal and certain juxtafoveal lesions. The primary effect of PDT seems to be that of damage to the choriocapillaris endothelium and a direct occlusive effect on choroidal perfusion in a dose related response.

**Key Learning Points:**

1. CSC affects areas of retina beyond the boundaries of the clinically visible detachment and also throughout the posterior pole of fellow eyes.
2. The pathophysiology is that of choroidal vascular hyperpermeability and choroidal vascular remodeling.
3. Most resolve spontaneously but a few require laser photocoagulation or PDT. The risk of CNV needs to be kept in mind in patients undergoing laser therapy.

**SYSTEMIC ASSOCIATIONS**

- Emotional strain
- Type A personality
- Pregnancy
- Organ transplantation
- Lupus erythematosus
- Increased levels of endogenous corticosteroids
- Treatment with corticosteroids
- Psychopharmacologic medications
- Hypertension
- Paraproteinemias
- Hemodialysis
- Bone marrow transplantation
- Crohn’s disease
- Ulcerative colitis
- Weber–Christian disease
- Membranoproliferative glomerulonephritis
- Ginseng (Panax ginseng)

**OCULAR ASSOCIATIONS**

- Optic disc pit
- Subretinal neovascular membrane
- Choroidal tumors

Table 1: Systemic and ocular associations seen in CSC.
Stereoanatomy refers to the use of the cartesian principles to define a fixed point in three dimensional space. Stereotactic techniques can be used in the pre-operative surgical planning as well as intra-operative surgical navigation. Initially, frame-based stereotactic surgery was directed at the ablation of specific intracranial targets in animals to study brain function. Today, rather than using external cranial landmarks in corroboration with a brain atlas, imaging techniques such as CT and MRI are employed to identify internal anatomical landmarks. Technological advancements have also allowed for the development of frameless systems, which requires the co-registration of a probe relative to the patient’s anatomy. In such systems, the patient’s head is rigidly fixed to a reference device and the probe is used to outline the external anatomical contours in a pre-defined stereotactic space, allowing for the determination of the probe tip position intra-operatively.

Stereoanatomy surgery is applicable in orbital cases in which the lesion is composed largely of bone or of a non-mobile component and in cases where precise localization is important. It is less accurate for soft tissue lesions, as lesion shift occurs so that its intra-operative location differs significantly from that seen on earlier imaging. Surgical access may influence the selection of the reference device in orbital surgery. If the head needs to be freely mobile during surgery, a FrameLock™ head-tracking reference device may be used instead of rigid head fixation in cranial tongs.

Two cases were described to illustrate the use of stereotaxy in orbital surgery. The first case was a 50-year-old lady with a large left medial sphenoid wing meningioma, which had caused left optic nerve compression with visual loss and visual field defect (Figures 1 & 2).

The Dextroscope™ (a device which allows for virtual reality three dimensional reconstruction from imaging data) was used to evaluate the various potential surgical approaches to the lesion pre-operatively (Figures 3 & 4).
Essentially, virtual simulation of the planned procedure was executed to obtain a better understanding of the applied anatomy. Standard frameless neuronavigation was used intraoperatively, in collaboration with the neurosurgeons, to guide the surgeon in the excision of the sphenoid wing meningioma. At 6 months postoperatively, the patient’s best-corrected visual acuity had improved from 6/12 to 6/7.5.

The second case illustrated the use of neuronavigation in orbital decompression to eliminate proptosis in thyroid eye disease. This was a young, 27 year old, female patient who had been treated for hyperthyroidism. She found her ‘staring’ appearance secondary to the proptosis unacceptable and wanted to improve her appearance through orbital decompression (Figure 5). Intra-operative stereotactic localization of the surgical field allowed the surgeon greater confidence in drilling the deep posterolateral orbital wall in order to achieve more decompression (Figures 6 & 7) whilst avoiding inadvertent entry into the temporalis fossa and/or intracranial cavity.

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Key Learning Points:
1. Stereotactic guidance with the Dextroscope™ is useful in the pre-operative planning as well as the intra-operative management of challenging orbital cases.
2. Neuronavigation to aid deep posterolateral orbital wall decompression, though not entirely essential, is also useful as it helps minimize surgical risk, particularly for surgeons in the early part of the learning curve.
This 80 year-old lady has pseudophakic bullous keratopathy and underwent a procedure to correct this condition on 14/8/06. At the end of the procedure an air bubble was injected into the anterior chamber. On examination the following day the patient was in marked discomfort with the intraocular pressure in the operated eye being 55mmHg. The air bubble was not in the anterior chamber.

What procedure did the patient undergo?
What has happened on the first post-operative day to cause the spike in intraocular pressure and where has the air bubble gone?

Please send your entries to: cmenewsletter@snec.com.sg or fax to: (65) 6226 3395 Attention: Ms Chia Hui Yien
Winners will each receive a 128 MB thumbdrive and will be notified by post. The answers will be published in the next issue.

The winners for the last photo quiz are:

Dr Yip Chee Chew
Consultant Ophthalmologist
Alexandra Hospital

Dr K. S. Kumar
Consultant Ophthalmologist and Vitreo Retinal Specialist
Kumar Nethralaya, Bangalore

They have each won a 128MB thumbdrive.

The figure shows a traumatic iris cyst. In general iris cysts may be primary (developmental) or secondary. The latter result from the traumatic implantation of ocular surface epithelial cells into the iris, and may occur after both surgical and accidental penetrating trauma.

A variety of treatment options have been used for this condition, ranging from Argon or YAG laser cystotomy to definitive surgical excision. Simple laser or needle cystotomy may be associated with transient spikes in intraocular pressure, relatively high rates of cyst recurrence and the theoretical possibility of an anterior chamber epithelial ingrowth disorder. Recently a case report described the successful use of dilute mitomycin C (0.01 mg/ml) combined with needle aspiration to eradicate a large traumatic iris cyst without any anterior chamber or endothelial cell morbidity. After partial cyst aspiration, MMC was injected to partially fill the cyst for 5 minutes, followed by needle drainage of the MMC and intracyst lavage with balanced salt solution. In many cases of significant, recurrent or enlarging iris cysts, or iris masses of uncertain nature, surgical excision remains the procedure of choice with high cure rates and provides a specimen for histological evaluation.

Reference