Diseases relevant to the ophthalmic anaesthetist

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Patients presenting for ophthalmic surgery frequently have significant co-morbidity with anaesthetic implications. General anaesthesia is needed for diagnosis and treatment of conditions involving the globe or orbit in infants who may have ophthalmic presentations of multisystem congenital syndromes. At the other extreme of age, cataract and glaucoma are common and safe anaesthesia requires an understanding of the ageing process as well as knowledge of conditions associated with the ophthalmic pathology. Rarely, anaesthesia for ophthalmic surgery can precipitate the diagnosis of an underlying disorder. A young patient presenting with cataract or family history of anaesthetic difficulty with strabismus should ring alarm bells as a metabolic disorder or myopathy may underlie the presenting complaint.

Cataract

Cataract occurs when lens protein becomes denatured, producing an opaque precipitate. Any metabolic, traumatic, infective or vascular insult to the lens can cause a cataract (Table 1).

Neonatal cataract is commonly a manifestation of a multisystem syndrome or chromosomal abnormality. Nevertheless, half of childhood cataracts are idiopathic. The commonest surgical approach is lensectomy before 3 months of age to avoid deprivation amblyopia. Multiple general anaesthetics may be needed for contact lens fitting and surgical follow-up. A vast array of muscle diseases may present as cataract in the undiagnosed hypotonic infant with developmental delay and poor weight gain. The hazards of anaesthesia in these patients are major and paediatric intensive care back-up is essential. While age-related change is rare, cataracts associated with diabetes have been described in children as young as 5 years old.

The World Health Organization estimates that 50% of blindness world-wide is caused by cataract. Onset is almost inevitable as the lens matrix ages but the decision to operate depends on local economic factors. The first change is epithelial metaplasia, which is accelerated by smoking, diabetes mellitus, high alcohol intake, myopia, renal disease and chronic exposure to sunlight. As the patient ages, diseases of the elderly accumulate. Concomitant medication may in turn accelerate cataract development.

Congenital causes of cataract

Galactosaemia

This autosomal recessive condition has an incidence of 1 in 45,000. An inability to metabolise galactose leads to failure-to-thrive, vomiting, jaundice, acidosis and hepatosplenomegaly. It is managed by dietary restriction and is fatal if untreated.

Table 1  Associations of cataract

<table>
<thead>
<tr>
<th>Congenital</th>
<th>Acquired</th>
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<tr>
<td>Down's syndrome</td>
<td>Trauma</td>
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<tr>
<td>Myotonic dystrophy</td>
<td>Radiation</td>
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<td>Hypothyroidism</td>
<td>Drugs</td>
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<td>Hypocalcaemia</td>
<td>Corticosteroids</td>
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<td>Galactosaemia</td>
<td>Atopic conditions</td>
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<tr>
<td>Hurler's syndrome</td>
<td>Age-related</td>
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<tr>
<td>Phenylketonuria</td>
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<td>Lowe's syndrome</td>
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<td>Intrauterine infection</td>
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<td>Rubella</td>
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<td>Toxoplasmosis</td>
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<td>Herpes</td>
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Key points

Eye disease may be the presenting feature of a systemic condition or syndrome.

Pre-operative assessment for eye surgery should include consideration of non-ophthalmic features of the condition.

The most frequent anaesthetic problems related to rare causes of eye disease are difficult intubation, muscle disease and cardiac abnormalities.

Patients with muscle diseases have a tendency to respond abnormally to volatile anaesthetic agents and muscle relaxants, including succinylcholine.

Ophthalmic equipment cannot be moved easily. Therefore, the anaesthetist must be able to manage cases at both extremes of age in the ophthalmic theatre.
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untreated. Cataracts occur in 75% of the population and may appear in the first few days of life. Intra-operative problems are related to hypoglycaemia, metabolic acidosis and electrolyte disturbance.

**Neonatal hypocalcaemia**
Neonatal hypocalcaemia is characterised by irritability and seizures and associated with cataracts.

**Lowe’s syndrome**
Also known as the oculocerebrorenal syndrome, Lowe’s syndrome is an X-linked recessive disorder of amino acid metabolism which causes mental retardation, epilepsy, proteinuria and osteoporosis. Congenital cataracts are universal.

**Intrauterine infections**
Congenital rubella, caused by infection in the first trimester, can cause cataracts in 15% of affected babies. Associations include deafness, a variety of congenital heart lesions, psychomotor retardation, squint, retinopathy and glaucoma. It is essential to remove all lens material as the virus can persist in the lens for 3 years. However, rubella is now uncommon because of wide-spread immunisation. Syphilis, varicella-zoster, toxoplasmosis and herpes simplex are other culprits.

**Down’s syndrome**
Well-known features of Down’s syndrome include widespread soft tissue abnormalities, laxity and cardiorespiratory problems. Ocular features include congenital cataracts, early-onset, age-related cataracts and 35% have convergent squint.

**Turner’s syndrome**
Turner’s syndrome occurs in 1 in 3000 births. Cataract and strabismus are rare complications. A short, webbed neck and coarctation of the aorta are features. Tracheal intubation may be difficult.

**Pierre Robin syndrome**
Pierre Robin syndrome is associated with multiple abnormalities, including cataract, glaucoma, micrognathia and airway difficulties.

**Phenylketonuria**
This autosomal recessive condition with an incidence of 1 in 25,000 causes excessive phenylalaninaemia. Hypertonicity, seizures and mental retardation results. Full-blown disease is rare since the advent of perinatal testing and phenylalanine restriction. Patients are liable to sudden hypoglycaemia and a labile response to catecholamines.

**Wilson’s disease**
In this condition, copper deposition leads to liver damage, disease of the basal ganglia and a characteristic corneal Kayser-Fleischer ring. Cataracts do not usually require conventional removal.

**Hallermann-Streiff syndrome**
Mandibulo-oculofacial dyscephaly (Hallerman-Streiff syndrome) includes cataract, glaucoma and corneal disease. Facial abnormalities make intubation difficult.

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**Syndromes presenting in young adults**

**Myotonic dystrophy**
This classic anaesthetic hazard is characterised by myotonia, baldness, gonadal atrophy, cardiomyopathy and respiratory failure. Cataract develops in 90% of cases by the age of 20 years. Cardiac dysrhythmias, refractory hypotension and respiratory failure can complicate anaesthesia and the unwary administration of succinylcholine can be fatal due to rhabdomyolysis, potassium disturbance or respiratory muscle spasm. Many other muscle and connective tissue diseases are also associated with degeneration of the lens protein. In most muscle diseases there is a tendency to potentiation of non-depolarising block and also a tendency towards pyrexial responses to anaesthesia.

**Neurofibromatosis type 2**
With an incidence of 1 in 40,000, neurofibromatosis type 2 is characterised by acoustic neuromas and CNS tumours. Cataracts develops in two-thirds of patients by the age of 30 years.

**Acquired cataracts**

**Severe neonatal hypoglycaemia**
Severe neonatal hypoglycaemia is associated with infantile cataracts which may resolve spontaneously.
Diabetes mellitus

Amongst diabetics, 10% have cataracts or have had cataract surgery. Cataracts appear early in both types I and II, probably due to microvascular damage when control is poor. Minimally invasive surgery and local anaesthetic techniques have revolutionised the management of this large patient group with multiple co-morbidities.

Atopic dermatitis

Of patients with severe atopic dermatitis, 10% develop early cataracts between the ages of 15 and 30 years caused, only in part, by steroid therapy.

Drugs

Corticosteroid use may cause cataract formation after a relatively brief exposure. Other drugs implicated include phenothiazines, meiotics (cholinesterase inhibitors), gold, amiodarone, busulphan and allopurinol.

Radiotherapy and trauma

Cataract formation is a well-recognised complication of cranial radiotherapy and it sometimes follows direct or indirect trauma to the lens (e.g. dehydration, electric shock).

Corneal disease

As a general rule, diseases causing cataracts also tend to cause corneal opacity. In addition, virtually any inflammatory condition or infection may affect the cornea, sometimes resulting in corneal rupture, which is a surgical emergency. Systemic conditions seen in association with peripheral ulcerative keratitis include rheumatoid arthritis, systemic lupus erythematosus, systemic sclerosis, Wegener’s granulomatosis, polyarteritis nodosa, psoriasis and sarcoidosis. General anaesthesia will be needed for a patient with a complex multisystem disease and an inflamed eye, often rendering them unsuitable for local anaesthesia.

In Fabry’s disease, an X-linked disorder, wide-spread deposition of glycosphingolipids occurs. This results in corneal and lens opacities, myocardial ischaemia and arrhythmias, renal failure, hypertension and obstructive pulmonary disease. Cystinosis is an autosomal recessive lysosomal disorder of amino acid metabolism. Cystine accumulation leads to corneal deposits and renal tubular damage. Dyslipoproteinaemias are inherited disorders of lipid metabolism. Corneal clouding is a feature. Ischaemic heart disease at a young age is likely. Cardiovascular instability and pulmonary disease occur in the Riley-Day syndrome. Dry eyes lead to corneal damage.

Paediatric corneal disease

Corneal abnormalities in neonates can lead to serious visual impairment. Initially, examination under anaesthesia will be required. When indicated, corneal transplantation is carried out at 3 months of age. Abnormalities of corneal size are associated with craniofacial anomalies, Down’s syndrome, Alport’s syndrome, Marfan’s syndrome, fetal alcohol syndrome, Ehlers-Danlos syndrome, myotonic dystrophy and achondroplasia. Corneal opacities may be due to congenital infections and storage disorders. In Goldenhar’s syndrome (oculo-auriculovertebral dysplasia) cataracts and squint occur in addition to corneal disease. Difficult intubation and congenital heart disease are common. Hurler’s syndrome is an autosomal recessive condition occurring in 1 in 100,000 births. Large tongue, airway obstruction, cardiac failure and kyphoscoliosis lead to death within the first decade. Corneal transplantation for opacities is not usually successful. A similar syndrome, galactokinase deficiency, is associated with cataract development in the fetus.

Strabismus

Strabismus is misalignment of the visual axes. It is usually an isolated congenital problem or idiopathic. It occasionally occurs after a viral infection such as measles. Rarely, squint may be part of a syndrome or acquired due to another disease process (Table 2). Correction surgery under general anaesthesia is a common procedure in children but it is also performed on adolescents and adults. Traction on extra-ocular muscles may initiate the oculocardiac reflex causing severe bradycardia. Postoperative nausea and vomiting is also a recognised complication. An alternative to surgery is injection of botulinum toxin A, usually under topical anaesthesia. This occasionally requires sedation, especially in children.

Associated well-known conditions

Acquired ocular nerve palsies

Microvascular insufficiency can affect the third, fourth or sixth cranial nerve. Predisposing and co-existing disease (e.g. hypertension, ischaemic heart disease) should be sought. Isolated sixth nerve palsy may be the first symptom of type II diabetes mellitus. Its long intracranial course also renders it vulnerable to raised intracranial pressure. Isolated third cranial nerve palsy may be caused by a cerebral aneurysm.

Thyroid eye disease

This is characterised by acquired strabismus, often in a patient with Grave’s disease. Enlarged extra-ocular muscles cause
mechanical restriction of ocular movements. Strabismus correction may be needed. Optic neuropathy or proptosis with corneal exposure may necessitate orbital decompression and eyelid procedures. Anaesthetic problems relate to goitre causing tracheal compression or deviation, other autoimmune disease, cardiac arrhythmias and cardiac failure. Thyroid storm may be precipitated. Patients are likely to be taking corticosteroids.

**Connective tissue diseases**

Connective tissue diseases can affect extra-ocular muscle function. Relapsing polychondritis may affect the larynx (stridor), is associated with aortic valve disease and may cause extra-ocular muscle palsy and keratitis. Polymyositis and dermatomyositis cause proximal and respiratory muscle weakness. Strabismus occurs in 2–10% of these patients. The lungs and myocardium are also involved.

**Myasthenia gravis**

The extra-ocular muscles are involved in 90% of patients with this autoimmune condition. Corrective surgery may provide benefit in selected patients. Response to muscle relaxants is unpredictable. Myasthenia gravis has been reviewed recently in this journal (see key references).

**Malignant hyperthermia**

Case reports suggest children undergoing surgery for strabismus have an increased incidence of developing this condition. Increased vigilance is crucial for those patients receiving succinylcholine or volatile anaesthetics.

**Associated rare conditions**

**Craniosynostosis**

Premature fusion of the cranial sutures may be isolated or part of Crouzon’s or Apert’s syndrome. Facial abnormalities, proptosis and strabismus may result. Intubation may be difficult.

**Stickler syndrome**

Inherited in an autosomal dominant manner, this condition consists of ocular, orofacial and skeletal abnormalities with a Marfanoid appearance. Surgery may be required for strabismus, cataracts and retinal detachment. Airway management is made difficult by cleft palate, maxillary hypoplasia, micrognathia and kyphoscoliosis. Mitral valve prolapse may occur.

**Möbius syndrome**

This is congenital bilateral facial paralysis with bilateral sixth cranial nerve palsy. A bulbar palsy makes pulmonary aspiration a risk. Facial skeletal abnormalities mean difficult intubation is likely.

**Incontinentia pigmenti**

This rare X-linked disease affects skin, eyes, teeth, brain and heart. When undergoing surgery for strabismus or retinal detachment, anaesthetic considerations include cardiac abnormalities, epilepsy and spastic paralysis.
Morning Glory syndrome

Ocular abnormalities include strabismus, retinal detachment and optic disc abnormality. Basal meningomyeloceles, craniofacial defects and cardiac abnormalities may be associated. Difficult intubation may be encountered. Basal meningomyelocele would make nasal intubation hazardous.

Chronic progressive external ophthalmoplegia and Kearns-Sayre syndrome

Ophthalmoplegia and retinitis pigmentosa are features of both these multisystem mitochondrial disorders. Muscle weakness and cardiomyopathy are prominent in the Kearns-Sayre syndrome.

Vitreoretinal disease

Hypertension and diabetes mellitus are the commonest associations of vitreous haemorrhage and detached retina. Laser therapy, cryotherapy, intra-ocular repair with vitrectomy and scleral buckling are procedures performed for retinal detachment, while haemorrhage may require vitrectomy. Untreated hypertension with a diastolic > 110 mmHg may be associated with disastrous expulsive choroidal or retinal haemorrhage while the eye is open and is a major contra-indication even for local anaesthesia.

Numerous other conditions are associated with vitreoretinal disease (e.g. systemic lupus erythematosus, polyarteritis nodosa, sickle cell disease, Marfan’s syndrome and Stickler syndrome). In sickle cell disease, retinal haemorrhages and detachment occur; anaemia is typical. To avoid a sickling crisis, hypoxaemia, dehydration and infection should be avoided. Careful anaesthetic consideration needs to be given to patients with diseases affecting multiple organ systems.

Retinopathy of prematurity

This is a multifactorial disease affecting preterm neonates with predictable anaesthetic difficulties. Features are retinal neovascularisation and haemorrhage, fibrovascular proliferation and retinal detachment. Cryotherapy or laser treatment is carried out in the neonate under general anaesthesia or sedation. Laser treatment is less painful and has a lower incidence of cardiovascular complications. There is a risk of cataract formation after argon-laser exposure.

Glaucoma

The commonest surgical option is trabeculectomy. Risk factors for chronic glaucoma include diabetes mellitus, myopia and thyroid eye disease. Childhood glaucoma can be primary or secondary. Factors associated with secondary glaucoma include:

- Congenital cataract surgery, retinopathy of prematurity
- Neurofibromatosis, Sturge-Weber syndrome, von Hippel-Lindau disease
- Lowe’s syndrome, homocystinuria, Hurler’s syndrome
- Congenital rubella, cytomegalovirus
- Retinoblastoma
- Down’s syndrome, Patau’s syndrome, Turner’s syndrome, Pierre-Robin syndrome
- Marfan’s syndrome, homocystinuria, Ehlers-Danlos syndrome

Tumours

A large array of intra-ocular and orbital tumours may require surgery. Uveal melanoma may be treated by local resection or enucleation. Retinoblastoma, although rare (1 in 20,000 births), is the most frequently encountered paediatric ocular malignancy. Patients (usually < 3 years of age) present for cryotherapy, enucleation or radiotherapy.

Rare causes of intra-ocular tumours

Von Hippel-Lindau syndrome

Features of this syndrome include retinal angiomas, cerebellar haemangioblastoma and phaeochromocytoma.

Tuberous sclerosis

Problems associated with tuberous sclerosis include epilepsy, retinal tumours (50%), cardiac rhabdomyomas, pulmonary lymphangiomatosis (causing recurrent pneumonia and pneumothorax) and renal impairment.

Neurofibromatosis type 1

This is characterised by hamartomas of the choroid, glaucoma, optic nerve glioma, wide-spread neurofibromas, skeletal abnormalities, phaeochromocytoma and renal artery stenosis.

Sturge-Weber syndrome

Cerebral haemangiomas cause epilepsy while choroidal lesions may cause retinal detachment. Glaucoma requiring filtration surgery has a high risk of bleeding. Other features include retinal neuroblastoma, lens subluxation and angiomas of the lower airway.
Paediatric orbital disease

This includes a variety of developmental, neoplastic and inflammatory entities including dermoid cysts, congenital orbital teratomas and capillary haemangioma. The latter has systemic complications including high-output cardiac failure, thrombocytopenia and haemolysis and extensions causing upper airway obstruction. Steroid injection into the lesion is the usual treatment. Rhabdomyosarcoma can present for debulking.

Lens dislocation

Non-traumatic lens dislocation is rare and associated with a variety of connective tissue disorders.

Associated conditions

Marfan’s syndrome

Another anaesthetic hazard, Marfan’s syndrome is autosomal dominant, characterised by tall stature, kyphoscoliosis, high arched palate, long limbs, aortic dilatation and dissection, mitral valve prolapse and aortic regurgitation. Lens subluxation occurs in 80% of cases. Retinal detachment, glaucoma and corneal clouding all occur.

Homocystinuria

This is an inherited metabolic disorder with an incidence of 1 in 200,000. Ocular features are lens subluxation and glaucoma. The incidence of major thromboembolic events is 50% without prophylaxis. Hypoglycaemia is a risk.

Weill Marchesani syndrome

This syndrome is characterised by short stature, Marfanoid appearance, platelet stickiness and thromboembolic phenomena. Patients develop lens subluxation by the age of 10 years. Glaucoma is a common association.

Other associations

Other associations include hyperlysinaemia and Ehlers-Danlos syndrome which has anaesthetic risks including valvular disease, bleeding tendency and cervical spine instability.

Conclusions

There is a vast array of associated anaesthetic hazards in a population presenting for a small number of ophthalmic procedures, often in an isolated environment. Related syndromes, which may have multiple or eponymous names and have anaesthetic implications, may be very complex and clinically variable. A useful addition to conventional medical textbooks is the Internet, which can produce instantaneous access to information about almost any syndrome.

Key references


