York and Devoe ([1]) wrote about health issues in surviving premature infants.

They pointed out that premature birth (before 37 weeks) occurs in around 11.6% of all live births.

Technological advances have increased the survival rate amongst premature babies.

However, longer term morbidity should not be overlooked.

One of the risks in preterm infants is intraventricular haemorrhage, which York and Devoe suggest is reported in 35-50% of infants at less than 32 weeks' gestation or weighing less than 1,500g at birth. Indian authors Narayan et al. ([2]) found a 29% incidence.

This is related to fragility of capillaries and poor support of the vascular bed in premature infants. Depending on the grade of IVH (as defined by Papile), there is a potential for long term morbidity. In grade 4 haemorrhages, long-term sequelae are almost inevitable.

One of these consequences is post haemorrhagic hydrocephalus; the acute type arises either as a result of a blood clot impairing normal CSF flow, or obstruction of CSF absorption at the level of the arachnoid villi.

Chronic hydrocephalus is caused by obliterative arachnoiditis or blockage from necrotic debris, reactive gliosis or disrupted ependyma (interfering with CSF flow).

Progressive hydrocephalus is associated with raised intracranial pressure and requires insertion of a shunt to relieve this.

There are of course, a number of recognised shunt complications which can contribute substantially to the long term morbidity.

Professor Andrew Whitelaw and colleagues at Bristol University recently looked at hydrocephalus after intraventricular haemorrhage.

Whitelaw had also been involved with Cherian et al's rat study ([3]), which provided a model for post-haemorrhagic ventricular dilation. Cherian noted that IVH affects about 15% of all premature births.

In babies weighing less than 1,000 g at birth, 10-20% have large haemorrhages that distend the lateral ventricles. Over half develop post-haemorrhagic ventricular dilation (PHVD); 60-80% suffer long-term neurological disability (note also that about 40% of adults who have a large intraventricular bleed develop hydrocephalus).

The authors suggested that defective fibrinolysis in the CSF may be a contributory factor. (Note Jayson's work on arachnoiditis).

Haemorrhage seems to upregulate fibroblast activity within the subarachnoid space.

It also impairs fluid drainage along perivascular spaces within the brain and impedes passage of CSF through the subarachnoid space and arachnoid villi.

The rat study showed that the initial ventricular dilation in response to injection of blood can, and in some cases, does, initiate a progressive pathological process. The rats with more severe hydrocephalus had more severe gliosis.

Whitelaw et al. ([4]) piloted a new treatment called DRIFT, (drainage, irrigation with protein-free CSF, fibrinolytic therapy) aiming to reduce intracranial pressure and decrease inflammatory substances such as cytokines.

Whitelaw remarks that multiple blood clots may obstruct the ventricular system soon after the haemorrhage,

"but lead to a chronic arachnoiditis of the basal cisterns involving deposition of the extra cellular matrix proteins in the foramina of the fourth ventricle and the subarachnoid space."

He suggests that transforming growth factor beta (TGFb) is a key mediator as it is known to be involved with wound healing and fibrosis. TGFb is raised in CSF of adults with post-haemorrhagic hydrocephalus.

Arachnoiditis may also be seen within the context of congenital spinal abnormalities such as dermal sinus tracts (DST).

Ackerman et al. ([5]) described 9 cases of thoracic or cervical DST. In 4, there was

"opacified arachnoid or frank arachnoiditis."

Surgical treatment of congenital spinal defects such as spina bifida, myelomeningocele, MMC (a neural tube defect), is associated with later development of arachnoiditis. MMC arises when the neural tube, the embryonic spinal canal, fails to close in the fourth week of gestation.

In the ?two-hit hypothesis', this is the ?first hit', the ?second hit' being spinal cord injury as result of exposure of the uncovered cord to the amniotic fluid and CSF outflow through the defect.

MMC is the most common form of neural tube defect. The meninges protrude through a midline bony defect of the spine forming a sac containing CSF, with a flat plate of neural tissue.

Often MMC is associated with other nervous system abnormalities such as Chiari II malformation.

Before neurosurgical treatment became established in the 1960s, MMC was usually fatal due to hydrocephalus, meningitis or other problems. Now 14% will survive less than 5 years (35% if there is associated Chiari II malformation).

Most babies with spina bifida have hydrocephalus at birth or develop it later and require shunting.

MMC surgical closure is associated with secondary tethering of the spinal cord. Wagner et al. ([6]) state:

"primary MMC repair is inevitably followed by the development of arachnoiditis, fibrosis and adhesions between spinal structures."

They suggest that about a third of patients develop symptomatic cord tethering, presenting as progressive scoliosis, gait changes, spasticity or pain, and less commonly with changes in bladder function, weakness and contractures in the lower limbs.

Whilst these symptoms can be alleviated by surgical dissection of the arachnoid adhesions, recurrence is common. Wagner and his colleagues state:

"Different procedures for dural closure...have been described, but, to date, there is no effective method known to prevent retethering."

Spinal arachnoid cysts may develop.

40-80% of patients with MMC have intramedullary cavities (hydrosyringomyelia), which may be aggravated by the cord tethering. Large or progressive cavities which are more often found in older children or adults may need to be treated surgically.

Other neurosurgical procedures can be associated with acute meningitis:
Carmel and Greif ([7]) described aseptic meningitis as a syndrome characterised by spiking fever and meningismus (signs of meningeal irritation such as stiff neck).

They noted that an earlier series involved 70% of children with posterior fossa operations developing the syndrome, whilst a new review had put the incidence at slightly over 30%. Aseptic meningitis after operation on structural lesions was 44% (higher than in the tumour group).

As we have seen, meningitis can be a precursor of arachnoiditis.

Children with leukaemia are treated with cytotoxic agents, often administered intrathecally. Arachnoiditis is a recognized complication of this treatment (see above).

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