

## Learning and Cognitive Effects of Acquired Brain Injury

Meningitis and septicaemia can be a cause of acquired brain injury (ABI). This is an injury to the brain that has happened after birth.

This fact sheet includes information about problems with thinking, learning and making decisions as a result of ABI after meningitis and septicaemia.

ABI can adversely affect the way a child is able to use and develop cognitive skills such as memory, attention, concentration and executive functions such as reasoning, problem solving and the use and understanding of language. This in turn can have a significant impact on all aspects of learning. Because different mental abilities are located in different parts of the brain, ABI as a result of meningitis and septicaemia can affect some, but not necessarily all, of these skills.

The brain takes over 20 years to fully develop. Difficulties with cognitive skills may not be immediately apparent when a child leaves hospital because they may be too young to have developed certain skills. If a young child has meningitis or septicaemia, it may be months or even years before any problems become evident. Older children will probably retain skills that have already developed, but there may be problems with skills that usually develop at a later stage.

Additionally, children who demonstrate problems at an early stage may make progress in these areas over time but then go on to experience different problems as they continue to develop. It is really important that you report any concerns about your child's development to your GP as soon as possible.

Sometimes cognitive problems will become apparent when a child starts school for the first time, but this will not always be the case. Some problems may not become apparent until a child goes to secondary school when they are expected to show more independence, planning and responsibility compared to primary school. This, along with more homework and tighter deadlines, can make it very difficult for a child with a brain injury to keep up with their peers without getting some appropriate additional support.

The special educational needs of children with ABI are often complex, sometimes difficult to identify and generally different from those of other children with special educational needs. An individual education plan (IEP) is often needed to ensure that the child's specific needs are met. Other professionals, such as educational psychologists, may be involved in the assessment and support of children with ABI.

### Memory problems

Different areas of the brain are responsible for the many processes that make up our memory ability. ABI can affect some or all of these processes to varying degrees, so each person who experiences memory problems will have their own individual, specific strengths and weaknesses.



For memory to function properly, the brain needs to be able to gather, store and categorise information so that it can be easily retrieved when needed. If any of these stages are affected by ABI, a memory can be impaired.

**Encoding** is the term used for “taking in” information that is read, heard, seen or experienced and then registered in the brain. The ability to do this relies on other factors, such as attention, that can also be adversely affected by ABI

**Storage** is a complex process by which information is filed away for future reference. There are different levels of storage e.g. on a short or long term basis

**Retrieval** of information that has been stored completes the memory process. This can be deliberate e.g. remembering a fact to answer a question, or automatic e.g. remembering how to get dressed without really thinking about it. Following ABI, it can be very difficult to retrieve stored information.

There are many different ways that information is remembered or recalled for different purposes. These can all be affected by ABI.

**Working memory** is the term used to describe the initial “holding point” for information as it is registered by the brain. There is only a limited capacity to hold information in this way; it needs to be deliberately and quickly sorted or organised to be of any use. Instructions given are held in working memory whilst they are sorted. Following ABI, it can be difficult to organise or sort information in working memory. This is often related to problems with attention and organisation skills. These problems can make it difficult to follow instructions.

**Episodic memory** comes from personal experiences or episodes in life, e.g. what you did on your summer holiday. These are not always consciously remembered, but they are retained. The ability to remember these experiences can be affected by ABI.

**Procedural memory** involves learning a procedure or set of actions, usually by practice and repetition, which then becomes automatic and doesn’t need to be thought about consciously. In young people with ABI, the ability to use this type of memory is not often affected.

**Semantic memory** involves learning information deliberately e.g. a list of facts or rules. Children with ABI can find this very difficult, especially if the information is out of context and doesn’t relate to other aspects of their life.

#### **Explicit and implicit memory**

**Explicit memory** involves consciously learning and remembering information, and being aware of how this was done, e.g. studying for an exam. This can be difficult following ABI

**Implicit memory** is used when skills or knowledge are acquired without consciously trying to learn e.g. a child “picks it up” through play and interaction with others

**Sensory factors** can affect the ability to encode information. Most people have a preference as to how they remember things;

Visual memory – remembering things that have been seen

Auditory memory – remembering things that have been heard

Motor memory – using physical actions to help remember things e.g. some people recall phone numbers by remembering the pattern of movement their fingers make on the keypad as the number is dialled.

The ability to encode information in a specific, preferred way can be affected by ABI. This may mean trying to develop and practice other ways to do this, which can be difficult.

**Recall** is an essential part of the memory process that allows the retrieval and use of information that has been stored. This ability can be impaired following ABI and may need prompting or given cues to help with recall.

Memory loss in the early recovery period after meningitis or septicaemia can sometimes be restored. However, in general, prolonged memory loss is unlikely to recover. This can have a significant impact on life; affecting their home, school, work and social life. As with other problems, it is important to report any concerns to your GP. A referral to a neuropsychologist, who will assess memory, may be needed.

There are many strategies that children with memory problems (and their families, friends or teachers) can use, which will make the most of the memory ability that has been retained. The Brain Injury Hub, written by The Children's Trust, contains an extensive amount of information on all aspects of brain injury, including memory loss and practical tips to help children at home and at school. <http://www.braininjuryhub.co.uk/information-library/memory>

### **Attention and concentration**

A child's ability to pay attention and concentrate is often reduced during the early recovery period following meningitis or septicaemia. This is usually a short-term problem, but in some children, these difficulties can continue as a result of ABI and have an impact on their ability to learn.

Attention is a term used to describe the skills needed to hold information consciously. It is closely related to memory and other cognitive skills, which can also be impaired following ABI. Concentration is the ability to maintain attention over a period of time.

Attention and concentration problems can mean that it is difficult to focus on a task or piece of work, and are easily distracted, particularly in a noisy or busy room where lots of things are happening at the same time. It can also be difficult to do more than one thing at a time; something that most people take for granted e.g. talking whilst riding a bike. These problems tend to get worse when tired, stressed or worried. As a child moves from primary to secondary school, there can also be problems coping with a varied timetable and finding the way around a larger building.

As with memory problems, there are strategies that can be used to help children make the most of the abilities they have and overcome some of their difficulties. It is really important to raise any concerns you have with your child's teacher so that support can be put in place.

### **Executive function**

The term executive function describes a set of abilities that control and regulate other abilities and behaviours. Executive functions include the ability to initiate and stop actions, to monitor and change behaviour as needed, and to plan future behaviour when faced with new tasks and situations. Executive functions allow us to anticipate outcomes and adapt to changing situations. The ability to form concepts and think abstractly is often considered a component of executive function. Cognitive skills, emotions and behaviour are all regulated by executive function.

Although different areas of the brain are involved in executive function processes, it is the frontal lobes that are most significant. If these are injured as a result of meningitis or septicaemia, then a patient can be left with some of the following difficulties:

**Planning and organising:** if thinking is disorganised, it can be difficult to plan the sequence of events needed to complete a task.

**Initiating and sustaining:** may be unable to get started with a task even if they have the knowledge or skills to carry it out

**Goal setting:** may start a task, but not have a clear goal in mind. This can lead to them seeming unmotivated or disorganised

**Inhibiting and self-monitoring:** language or behaviour may be inappropriate because they aren't able to stop and think about the implications of what is being said or done. This can lead to difficulties with friends when children are young, but can also put older children at risk if their behaviour is inappropriate in certain situations.

**Problem solving:** these skills are often needed to overcome daily obstacles or changes in routine. ABI can make it very difficult to think of different ways to solve problems

**Flexible thinking:** they may find it difficult to cope with changes to routine or meeting new people.

As with most aspects of brain development, executive function skills mature throughout childhood and early adulthood. Difficulties may not therefore be evident immediately after the child has been ill. The move from primary to secondary school is often a time that problems are noticed, and as with other cognitive skills, it is very important to raise any concerns with your child's teacher.

### How to get help for your child

It is really important that you report any concerns about your child's development to your GP as soon as possible.

There is growing evidence to show that having bacterial meningitis and septicaemia in childhood can have an impact on children's learning<sup>1-5</sup>. If you are not happy after speaking to your child's GP do not be afraid to be persistent. You can ask to be referred for a neuropsychological assessment and you may find it helpful to take a copy of this fact sheet along with you to help explain your concerns.

Additionally, if you are not happy that your child's teacher is acting on your concerns you can ask to see the head teacher and request that they make a referral to have your child assessed by an educational psychologist.

An educational psychologist or neuropsychologist can help to identify the special educational needs of children with ABI. The underlying cause of a child's difficulties following ABI may often be unclear until an appropriate assessment has been done.

Once the causes of a child's problems have been identified, an individual education plan (IEP) is often needed to ensure that the child's specific needs are met and strategies are put in place to help your child's learning. It is also possible to seek help from a psychologist privately.

### Further sources of information and support

Brain Injury NZ provides information and gives support to people affected by brain injury.

[www.brain-injury.nz](http://www.brain-injury.nz)

The Brain Injury Hub, produced by the Children's Trust UK provides excellent information and practical advice about acquired brain injury.

[www.braininjuryhub.co.uk](http://www.braininjuryhub.co.uk)

### Further reading

Walker S & Wicks B, 2005, Educating children with acquired brain injury, David Fulton Publishers, Abingdon, UK

### References

1. Anderson, V., et al., Cognitive and executive function 12 years after childhood bacterial meningitis: effect of acute neurologic complications and age of onset. *J Pediatr Psychol*, 2004. 29(2): p. 67-81.
2. Bedford, H., et al., Meningitis in infancy in England and Wales: follow up at age 5 years. *BMJ*, 2001. 323(7312): p. 533-6.
3. de Louvois, J., S. Halket, and D. Harvey, Effect of meningitis in infancy on school-leaving examination results. *Arch Dis Child*, 2007. 92(11): p. 959-62.
4. Stevens, J.P., et al., Long term outcome of neonatal meningitis. *Arch Dis Child Fetal Neonatal Ed*, 2003. 88(3): p. F179-84.
5. Viner, R.M., et al., Outcomes of invasive meningococcal serogroup B disease in children and adolescents (MOSAIC): a case-control study. *Lancet Neurol*, 2012. 11(9): p. 774-83.

### Resources

Information provided by Meningitis Now and Meningitis Research Foundation April 2017

More information can be found at [meningitisnow.org](http://meningitisnow.org) and [meningitis.org](http://meningitis.org)

