

Risks associated with your anaesthetic

SECTION 1: FEELING SICK

This leaflet explains the causes of sickness following anaesthesia and surgery, what can be done to prevent it occurring, and treatments available if it does happen to you.

Some words explained

Nausea This is an unpleasant sensation, usually felt in the stomach area, which can also be described as 'feeling queasy' or 'feeling sick'. It is often felt with the urge to vomit.

Vomiting This means being sick. It is the act of forcefully emptying the stomach, or 'throwing up'.

PONV These letters are used to mean post-operative nausea and vomiting. 'Post-operative' means that it happens after the operation.

Anti-emetic drugs These are medicines that help to prevent or treat nausea and vomiting.

General anaesthesia This is a state of controlled unconsciousness during which you feel nothing and may be described as 'anaesthetised'.

Regional anaesthesia This involves an injection of local anaesthetic which makes part of your body numb. You stay conscious, but free from pain in that part of your body.

You can find out more about general and regional anaesthesia in the booklet 'Anaesthesia Explained', which is on the Royal College of Anaesthetists' website (www.rcoa.ac.uk).

Will I feel sick after my operation?

Not everyone feels sick after an operation or anaesthetic, although it is a very common problem. Overall, about one third of people (1 in 3) will experience a feeling of sickness after

having an operation, but it depends on what operation you are having, what anaesthetic and other drugs you receive, and on who you are (see below).

Why do some people feel sick after operations?

There are a number of factors that we know affect how likely you are to feel sick after an operation.^{1,2}

The operation you are having

Some operations cause more sickness than others, for example:

- ▶ operations in the abdomen or genital area
- ▶ gynaecological procedures
- ▶ ear, nose or throat operations (e.g. removal of tonsils)
- ▶ surgery to correct a squint of the eye
- ▶ very long operations.²

Your anaesthetist will be able to tell you if your operation is likely to cause post-operative nausea and vomiting.

Drugs that are used

Some drugs are known to cause sickness including:

- ▶ anaesthetic drugs, including some anaesthetic gases
- ▶ pain relief drugs (especially the morphine-like pain-relieving medicines, including codeine).^{1,2}

Who you are

Some people are more likely to suffer from post-operative sickness:

- ▶ children
- ▶ women
- ▶ non-smokers
- ▶ those who suffer from 'travel sickness'
- ▶ anyone who has suffered from post-operative sickness before.^{2,4,5}

Other reasons

- ▶ Being without food or drink before the operation contributes to feeling sick afterwards. It is essential to avoid eating for six hours and drinking water for two hours before a planned operation. The reason for this is that if there is any food or liquid in your stomach during your anaesthetic, it could come up into the back of your throat and then go into your lungs. This would cause choking or serious damage to your lungs. You should stop eating and drinking for the amount of time advised, but not for any longer.
- ▶ Being without food after the operation. This also contributes to feeling sick. The time to start eating and drinking again varies depending on your operation – some general guidance is given later in this article. Otherwise your nurses, surgeon and anaesthetist will advise you.
- ▶ Being very anxious about what is happening can make you more likely to feel sick. You can tell your anaesthetist that you are feeling anxious. He/she will talk to you about your worries and you can ask for a medicine to help you with this.²
- ▶ Travelling shortly after receiving a general anaesthetic. If you are going home the same day, you may find that you feel sick or vomit during the journey. You are more sensitive to travel sickness during this time.

I felt sick after my last operation. Will I feel sick after this operation?

Not necessarily.

- ▶ Your operation may be different and less likely to cause sickness.
- ▶ Your anaesthetic can be tailored to reduce the likelihood of a recurrence.
- ▶ You may now be less likely to suffer (for example, the possibility of experiencing sickness after surgery lessens as you grow older).²

But if you have had sickness after surgery previously, you are more likely to have it again than if you have had an anaesthetic previously without any sickness.

How long does the feeling of sickness last?

Usually the sensation of sickness lasts an hour or two, or stops following treatment. Uncommonly, it can be prolonged and last for more than a day.

Can feeling sick after an operation harm me?

Feeling sick or vomiting after an operation is distressing and unpleasant. It can make the pain of your operation feel worse, particularly if you are vomiting or retching (trying to be sick, but nothing coming up). It can delay when you start eating and drinking after your operation. This may keep you in hospital longer.

Rarely, if vomiting is severe and lasts a long time, it can result in other more serious problems, such as damage to your operation site, tears to your oesophagus (gullet), or damage to your lungs.¹

Can anything be done to prevent me from feeling sick after my operation?

Yes, although the risk of sickness can never totally be removed. Your anaesthetist will assess your risk of experiencing sickness when they visit you before your operation.

There are various ways in which your anaesthetist can change your anaesthetic in order to reduce your chance of suffering sickness.

- ▶ You may be able to have your operation performed under a regional anaesthetic rather than general anaesthetic, as this may reduce the sickness that you feel.²⁻⁵
- ▶ You may be given one or several 'anti-sickness' medicines, called anti-emetics, as part of your anaesthetic.¹⁻⁵
- ▶ Some anaesthetic drugs are less likely to cause sickness than others. Your anaesthetist may decide that you are suitable to receive them.^{1,2,4,5}
- ▶ Acupuncture or acupressure can be used to prevent or treat sickness after surgery, but not all hospitals are able to provide this treatment.⁶
- ▶ You may receive intravenous fluids via a cannula (fluid goes into a thin plastic tube placed in a vein – often called a 'drip'). Fluid may be given for a variety of reasons, but studies have shown that in certain groups of patients, giving fluid can help to prevent sickness.

If you are worried about sickness, or have experienced it following a previous operation, it helps if your anaesthetist knows about it.

Is there any treatment available if I feel sick after my operation?

Yes. If you feel sick after your operation, the methods used to prevent you feeling sick can also be used to treat it. For example you could

be given anti-emetic (anti-sickness) drugs and intravenous fluids.³⁻⁵ Aromatherapy can also help: smelling rubbing alcohol (isopropyl alcohol) may help you feel better.⁷

It is much easier to relieve the feeling of sickness if it is dealt with before it gets too bad. So, you should ask for help as soon as you feel sick.

What drugs may I be given and do they have side effects?

Anti-emetic drugs can be given as a tablet or as an injection. Injections can be given intravenously into your cannula or into your leg or buttock muscle. Intravenous injections work more quickly and reliably and avoid the need for another needle.

The same drugs are used to prevent and treat sickness after surgery. There are several different types. A combination of anti-emetic drugs may be given, as this is more effective than one drug given on its own.³⁻⁵

All medicines have some side effects, although with anti-emetics these are generally minor and temporary, or rare. The following are commonly used anti-emetic drugs with their side effects. How likely you are to get the side effect is given in brackets.

- ▶ **Cyclizine** (Valoid) May cause drowsiness and a dry mouth (common).
- ▶ **Ondansetron** (Zofran) or **granisetron** (Kytril) Can cause headaches (uncommon).
- ▶ **Dexamethasone** Although a steroid drug, the single dose given to prevent nausea and vomiting does not seem to be associated with the side effects seen with long-term steroid use.
- ▶ **Prochlorperazine** (Stemetil) or **Metoclopramide** (Maxolon) May cause tremors or uncontrolled body movements, known as an extrapyramidal reaction (rare).

- ▶ **Scopolamine** (Scopoderm) Can be given as a stick-on patch 5-6 hours before your operation, to give it time to work. It can cause blurred vision and a dry mouth (uncommon).

Can I do anything to avoid feeling sick?

Yes. After your surgery:

- ▶ avoid sitting up or getting out of bed too quickly
- ▶ avoid eating and drinking too soon after your operation, but do not delay too long. Once you are awake you should start drinking and eating within 10 to 20 minutes as this improves your recovery. Start with small sips of water and slowly build up to bigger drinks and light meals. However, if you have had a more complicated operation your surgeon may not allow drinking or eating at first. Your nurses will give you advice about this

- ▶ good pain relief is important. Although some pain-relieving medicines can make you feel sick, severe pain will too. You should ask for help if you are not sure
- ▶ taking slow deep breaths can help to reduce any feeling of sickness.

Where can I get further information?

If you want to ask any further questions about the type of anaesthetic planned for your operation please contact your local hospital or clinic before you come into hospital. Most hospitals provide an assessment clinic prior to your admission, staffed by experienced surgical nurses and anaesthetists. This is a good moment to ask any questions that you have.

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This leaflet will be reviewed three years from the date of publication.

Risks associated with your anaesthetic

SECTION 2: SORE THROAT

After a general anaesthetic you may develop a sore throat. This can range between a minor discomfort and a more severe continuous pain. You may also have a very dry throat, a hoarse voice or feel pain on swallowing. These symptoms may disappear within 24 hours but may take two days or more to settle down.

Why does a sore throat happen?

During any general anaesthetic your anaesthetist must make sure that you can breathe freely. He or she must also make sure that if any stomach contents come up into the back of your throat during the anaesthetic, they do not get into your trachea (windpipe) or your lungs.

Your anaesthetist will choose one of several methods to achieve these things after you are anaesthetised. The choice will depend on your medical condition and on what operation you are having. He or she may use the following.

- ▶ **A face mask:** This is held firmly onto your face by your anaesthetist. Sometimes a separate plastic tube (a Guedel airway), which sits over your tongue, is needed as well.
- ▶ **A laryngeal mask airway:** This is a different shaped tube, which sits in the back of the throat above the opening to the trachea. It may have a soft inflatable cuff. When in place it allows gases to move freely in and out of the lungs. It does not prevent the entry into the lungs of stomach contents that may have collected in your throat. It is therefore not suitable for all operations.
- ▶ **A tracheal tube:** This is positioned in your trachea (windpipe) and has a soft cuff, which is inflated. This tube protects the lungs from

the entry of any stomach contents that have collected. It is also likely to be required if a breathing machine is being used to replace your natural breathing. There are a number of reasons why this type of tube would be used, including: long operations; operations on the abdomen or in the chest; operations on the brain; operations on the back of the body, where you must lie face down for the operation; operations on people who are significantly overweight

- ▶ **A gastric tube:** During your anaesthetic it is occasionally necessary to place an additional tube through your nose or mouth to empty your stomach.

All of these tubes or masks are placed after you are anaesthetised and you are not usually aware of their use. However, any of them may contribute to a sore throat after the operation, because of the following:

- ▶ During insertion, any of the tubes or the equipment used to accurately place them, may cause irritation or damage to your throat.
- ▶ The tracheal tube and the laryngeal mask airway may have a cuff, which is inflated for the duration of your anaesthetic. This may press on parts of your throat causing swelling and pain afterwards.

- ▶ Anaesthetic gases and some drugs can dry your throat. This may contribute to a sore throat following your anaesthetic.

Uncommonly, placement of an airway tube is difficult. It is possible that more significant damage to the vocal cords and other structures can occur occasionally in these circumstances.

How likely is a sore throat to occur?

After a general anaesthetic with a tracheal tube the risk of developing a sore throat is estimated to be around 2 in 5.¹⁻³

After a general anaesthetic with a laryngeal mask airway the risk is estimated at about 1 in 5.¹

If any additional tubes are required in your nose or mouth, there is an increased chance of getting a sore throat.

Women are more likely to get a sore throat than men, and younger patients are more likely to have a sore throat than older people.^{1,3}

What can be done about it?

There is some evidence that a sore throat can be prevented or reduced by the use of local anaesthetic or steroid applied directly to the throat before the tube is placed. However, for long operations local anaesthetic is likely to have stopped working before the end of the operation.^{2,4}

If a sore throat occurs, symptoms usually disappear without any specific treatment over the course of a few days. If the pain is severe, pain relief medicines such as paracetamol and gargling with soluble aspirin may help to reduce inflammation and pain.

What happens if the symptoms do not disappear?

If your symptoms have not disappeared after two days or if you have a persisting hoarse voice you should contact your GP for further advice.

If, at any time, you are having any difficulty breathing or cough up blood, you should contact your GP urgently or your anaesthetist for further advice.

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Risks associated with your anaesthetic

SECTION 3: SHIVERING

At the end of your operation, you will be taken to the recovery room. Staff in the recovery room will be with you at all times and will continue to monitor your blood pressure, oxygen levels, pulse rate and temperature. Some people shiver during this period. This article gives you information about shivering after an operation, and how it can be prevented and treated.

Shivering after an operation is a very common problem. It can cause a great deal of discomfort.

'It was incredibly frightening, I felt so cold and I didn't know what to do or how to stop it. I thought something must be dreadfully wrong'

Although it can be extremely distressing, shivering is not usually dangerous¹ and should stop within 20 to 30 minutes. It can occur after a general anaesthetic and during or after a regional anaesthetic (for example, an epidural or spinal).

What causes it?

Most shivering after an operation is due to a fall in your core (central) body temperature.^{2,3} This occurs because parts of your body may be exposed to a cool environment during your operation. Anaesthetic drugs and gases can contribute to this fall by reducing your body's natural ability to regulate your own temperature. Epidural and spinal anaesthetics open up blood vessels to the skin. This increases blood flow to the skin and increases heat loss.

Shivering may also occur without a fall in core body temperature. It can be caused by anaesthetic drugs and gases, and is more likely if you have pain following your operation.⁴

What is done to prevent it?

Care is taken to keep you warm before, during and after your operation. If you are kept warm before your operation, you are less likely to be cold afterwards. There are some things that you can do to help you stay warm before your operation:⁵

- ▶ Remember that the hospital may be colder than your own home.
- ▶ Bring warm clothing, such as a dressing gown, to keep you comfortably warm before your operation.
- ▶ Tell the staff if you feel cold at any time during your hospital stay.

By keeping warm before your operation, you can help avoid shivering afterwards.

Depending on the length and type of your operation, your anaesthetist and recovery nurses may use some other ways to keep you warm. These can include heating any intravenous fluids that you may receive and using a heated blanket filled with warm air.⁵

How often does shivering happen?

Shivering following an operation is a very common problem. Even using measures to

prevent a fall in body temperature, shivering may still occur in up to 1 in 4 patients following a general anaesthetic.⁶ The risk of shivering is increased in younger patients and during long operations and orthopaedic operations.⁷ Shivering may also be more common when epidural or spinal anaesthesia is used.³

What can be done if shivering occurs?

When you get to the recovery room, your temperature will be measured. If you are cold, the nurses will use warming blankets to help warm you up again. This is usually all that is required to stop shivering, although it may take some time for your temperature to return to normal.

There are also a number of drugs which can be used to treat shivering, although it is usually considered best to wait until the shivering stops on its own. None of the drugs is 100% effective and all may have side effects. The most effective drugs include pethidine, clonidine and doxapram.⁸ If you are in pain following your operation, treatment of your pain may also help to reduce your shivering.

Shivering will stop on its own and, although distressing, it is generally not dangerous. It does, however, increase your body's requirement for oxygen so you may be given additional oxygen via a mask.

A nurse will be with you at all times in the recovery room and they will make sure that you are warm and as comfortable as possible following your operation. When you are ready to drink, hot or warm drinks are a good idea, as they will help to warm you up.

If you have suffered from post-operative shivering in the past this does not indicate that you will shiver with surgery and anaesthesia in the future.

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SECTION 4: DAMAGE TO TEETH, LIPS AND TONGUE

During a general anaesthetic, it is possible for your teeth to be damaged. This happens in about 1 in 4,500 general anaesthetics. Minor damage to the lips or tongue is very common. More serious damage to the tongue is rare.

This article tells you more about why damage can happen, what type of damage may occur, and what you can do to help prevent it.

Why does damage happen?

General anaesthesia is a state of controlled unconsciousness. When you are anaesthetised, you become less able to breathe freely through your nose or mouth. Your anaesthetist will choose a way of making sure that you can breathe properly. This is essential for your safety, and usually requires an artificial airway or breathing tube to be placed in your mouth or throat. The devices used are described in more detail in 'Section 2: Sore Throat' in this series of leaflets. The placement and removal of these devices can sometimes cause damage to the teeth or soft tissues of the mouth.

What type of damage may occur?

Minor cuts or bruising to the lips and tongue are very common, probably occurring in about 1 in 20 general anaesthetics.¹ These injuries heal very quickly and can be treated with simple ointments. Sometimes teeth or dental work such as crowns, bridges, implants or veneers may be broken, chipped, loosened or completely removed by accident. The most frequently damaged teeth are the top front teeth.^{2,3,4} Damage to a tooth requiring subsequent removal or repair occurs in about 1 in 4,500 general anaesthetics.⁴

Occasionally, pressure from an airway device causes damage to nerves which control movement and feeling in the tongue. This can cause numbness and loss of normal movement of the tongue for a period of time. These changes usually recover over a period of weeks or months.

How does damage to teeth occur?

The placement of artificial airway devices to keep you breathing safely after you are anaesthetised is not always straightforward. Anaesthetists are trained in the use of airway devices, but, even in skilled hands, there may be some difficulty and a certain amount of force may be needed. This can sometimes lead to damage to teeth, lips or tongue. Damage to teeth, lips or tongue can also occur during the operation or at the end of the operation as the device is removed. This is due to unexpected biting or other jaw movement. This is more likely if your teeth are already loose.

The surgeon can also damage your teeth, lips or tongue during operations in the mouth or throat. This includes telescope examinations under anaesthetic of the throat, the lungs or the oesophagus (gullet).

What about false teeth?

You will usually be asked to remove false teeth before a general anaesthetic. This is because they may be dislodged or damaged as your anaesthetist places the artificial airway device. Sometimes, your anaesthetist may ask you to leave your false teeth in place. This is most likely if you have teeth of your own amongst the false teeth and your anaesthetist thinks that the false teeth will help protect your own teeth.

Who is at increased risk of damage to teeth?

Anyone undergoing a general anaesthetic is at some risk. Wherever possible, your anaesthetist will assess your airway before the anaesthetic starts. He/she may:

- ▶ look in your mouth
- ▶ ask you to move your neck
- ▶ ask you about your teeth and any crowns, bridges, veneers, implants or loose teeth that you may have.

The following factors mean that damage is more likely:

- ▶ reduced mouth opening
- ▶ reduced neck movement
- ▶ prominent upper teeth or small lower jaw
- ▶ certain medical conditions such as rheumatoid arthritis and ankylosing spondylitis
- ▶ people requiring an emergency general anaesthetic
- ▶ people who are very overweight.

The following have a higher risk of damage to teeth:

- ▶ people with one or more of the above factors³
- ▶ people with teeth and/or gums in poor condition³ (large amounts of decay, failing

dental work, loose teeth). Nearly two thirds of injuries to teeth happen to people with teeth in a poor condition

- ▶ people with crowns, bridges, veneers, or implants on their front teeth
- ▶ people having an operation or examination of the mouth, neck, jaw or oesophagus (gullet).
- ▶ people who need to have a tracheal tube inserted after the operation has started. This is occasionally necessary if the existing airway becomes unsatisfactory during the operation, and insertion of an alternative airway device may be more difficult.

Your anaesthetist will be able to tell you if you have any features described above which could make it more difficult to insert an artificial airway device. However, difficulties can also arise unexpectedly, without a specific risk factor being apparent in advance.

What about orthodontic appliances?

Increasingly, children and young adults are benefitting from orthodontic treatment. If you have removable type braces, your anaesthetist will probably ask you to remove them. Fixed orthodontic devices would be left in place, but are vulnerable to damage. Even in skilled hands it is possible that insertion and removal of airway devices, or the removal of secretions from the mouth with suction, may result in dislodgement of brackets, wires or bands. It is important that you talk to your anaesthetist about any orthodontic appliances that you have.

What steps are taken to prevent damage to my teeth?

All anaesthetists are trained to be aware of the potential for damage to teeth. Your anaesthetist will take care during the insertion of airway devices and force will be avoided as much as

possible. If you have any features that make it more difficult to have an artificial airway device, your anaesthetist will choose a suitable technique which will allow safe insertion. This should be discussed with you beforehand.

Is there anything I can do to prevent damage to my teeth?

If your teeth or gums are in poor condition or any teeth are loose, it is advisable to visit your dentist before a planned operation for a check-up and dental assessment. Please alert the anaesthetist to any loose teeth or dental work before your operation.

If you know there have been difficulties with placing a tube in your airway or you have had damage to your teeth during a previous anaesthetic, it is important to tell your anaesthetist. It may be necessary to find your previous anaesthetic records to find out exactly what happened. It is helpful if you tell the surgical and anaesthetic team caring for you as early as possible. Your GP could do this for you, or you can tell the surgeon or the nurses at the pre-assessment clinic.

If your anaesthetist tells you that there were difficulties, it is very helpful if you know what the difficulties were. If you are not sure, ask your anaesthetist to write them down so that you can show the letter to anaesthetists in the future.

What happens if my teeth are damaged during an operation?

Your operation should proceed as planned. If a tooth has become completely dislodged it must be secured or removed before you wake up. If a tooth is chipped or cracked, any fragments will be removed and the anaesthetist will record the damage. You will be informed when you have recovered.

Immediate treatment will involve pain relief, if required, and an explanation of what has happened. The tooth may require repair, re-implantation or extraction depending on the nature of the injury and pre-existing health of the tooth.⁵ Damage to veneers, crowns, implants, bridges or fixed orthodontic appliances may require repair.

If you are being treated in an NHS hospital with a dental department, it may sometimes be possible for you to be assessed by a dental surgeon. It may be possible for this dentist to repair the damage. However, it is more usual for the treatment to be done by your own dental practitioner, as he/she is in overall charge of your dental care.

How likely is damage to teeth, lips and tongue?

Minor injuries to the lips or tongue are very common and are usually unreported which means accurate figures do not exist. A small study of 404 patients suggests that minor injuries occur in about 1 in 20 patients.¹

Damage to a tooth which requires subsequent repair or extraction happens in about 1 in 4,500 general anaesthetics. This figure comes from a large study of just under 600,000 patients.⁴

Nerve damage to the tongue due to pressure from airway devices is reported, but accurate figures do not exist. It is likely to be rare or very rare.

Summary

Minor injuries to the lips or tongue are very common. Serious damage to the tongue is rare. The overall risk for serious damage to teeth is around 1 in 4,500 general anaesthetics. Damage can happen even if the anaesthetist uses an appropriate technique with care. If you have an increased risk for damage to teeth, this may be identified by your anaesthetist before the anaesthetic starts. Damage is more likely in people with teeth in poor condition. A visit to the dentist before a routine operation is advisable if your teeth are not in good condition.

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Risks associated with your anaesthetic

SECTION 5: DAMAGE TO THE EYE DURING GENERAL ANAESTHESIA

During a general anaesthetic it is possible for your eyes to be damaged. This is an uncommon or rare event. The types of damage that can occur, and its consequences and treatment are described in this article.

Damage caused during surgery to the eye itself or associated with anaesthesia for eye surgery is not described here. You can talk about this with the eye surgeon or specialist anaesthetist who is looking after you.

What is the most common type of damage?

The most common damage to the eye which can occur during or after general anaesthesia is a corneal abrasion.^{1,2}

What is a corneal abrasion?

The cornea is one of the outer clear layers of the eye. An abrasion is a tear or graze of this layer. The abrasion can cause pain, blurred vision and considerable irritation for a few days. Almost all corneal abrasions heal without long-term effects on vision.

How do corneal abrasions happen?

Most abrasions happen because the eye does not close fully during the anaesthetic. Approximately 6 out of 10 people (60%) do not close their eyes naturally when they have a general anaesthetic.¹ The cornea is then exposed to the air and becomes dry. Fewer tears are produced during an anaesthetic which also causes dryness in the eyes.^{2,3}

The dry cornea can then stick to the inside of the eyelid and the abrasion occurs when the eye opens again at the end of the anaesthetic.

Corneal abrasion can also occur because something rubs against the exposed cornea during the anaesthetic. This may be one of the sheets used during surgery to cover the patient and keep the operation area sterile, or other equipment. Anaesthetists take care to ensure the eyes are closed during a general anaesthetic and to protect the eyes.

What is done to prevent corneal abrasions?

Corneal abrasions can usually be prevented by careful protection of the eyes.

Small pieces of sticking tape are commonly used to keep the eyelids fully closed during the anaesthetic. This has been shown to reduce the chance of a corneal abrasion occurring.^{1,2} However, bruising of the eyelid can occur when the tape is removed, especially if you have thin skin and bruise easily.

Sometimes, the anaesthetist may use a gel, an ointment or eye drops to moisten the eyes during your anaesthetic. These may be helpful if tape cannot be used or for certain operations in which the eyes need to be opened briefly during the operation. Eye ointments can

sometimes cause temporary eye irritation or blurring of vision following an anaesthetic.

Anaesthetists are trained to take care that nothing rubs against the eyes. If your surgery requires you to be positioned lying on your front, your anaesthetist will use goggles, cushions and/or eyepads to protect your eyes.

How often do corneal abrasions occur?

Following a general anaesthetic, it is uncommon to suffer from a corneal abrasion that causes symptoms. A large study of over 60,000 patients having a general anaesthetic found that 1 in 2,800 patients suffered symptoms from a corneal abrasion.⁴

Studies have also been done using a microscope to examine the eyes following an anaesthetic. These show that small corneal abrasions occur commonly. Around 1 in 25 patients may have a small corneal abrasion, which the patient does not notice. This occurs even when protective eye tape or ointment is used.

You are more likely to suffer from a corneal abrasion if your surgery requires you to be positioned lying on your front or your side, if your operation lasts a long time, or if you are having surgery on your head or neck.⁴

What if I already have poor vision?

If you have poor vision, it is helpful if you tell your anaesthetist about it. This is because he/she can give you any extra information that you need to help you feel at ease if you cannot see well. However, this will not make any difference to the risk of getting a corneal abrasion, or to the ways in which your anaesthetist cares for your eyes while you are anaesthetised.

What happens if I have a corneal abrasion?

Corneal abrasions may be very painful. Healing usually takes a few days, after which the pain will stop completely. Treatment during this time can reduce pain and aims to prevent an eye infection developing. Eye drops, ointments and an eye patch may be used, as well as pain-relieving medicines. No surgical treatment is necessary.

Almost all corneal abrasions heal with no visible scar and no long-term effect on vision. An eye specialist may be able to see a scar through a microscope. Contact lens users should take advice before using contact lenses again.

Can I lose my sight during a general anaesthetic?

Serious eye injuries during a general anaesthetic are very rare, but can lead to loss of eyesight. Two structures can be damaged:

- ▶ the retina is the light-sensitive layer inside the eye
- ▶ the optic nerve carries visual information from the eye to the brain.

One or both of these can be damaged by one or more of the following:

- ▶ low blood pressure during the operation can mean that the optic nerve and/or the retina do not get enough oxygen
- ▶ tiny clots in the blood vessels to the eye can also cause lack of oxygen to the optic nerve or the retina
- ▶ too much pressure on the eyeball during the operation can damage the optic nerve or interrupt the blood supply to the nerve and the retina.

The operations with higher risk are:

- ▶ operations on the spine in the prone position (face down), especially if the operation lasts more than six hours and there is a lot of loss of blood⁵
- ▶ operations which require cardio-pulmonary bypass (open heart surgery with use of a heart/lung machine)
- ▶ neck dissection operations on both sides of the neck.

During these operations the anaesthetist will take particular care to keep the blood pressure at an appropriate level and prevent pressure on the eyeball.

The people with higher risk include those with other vascular diseases (high blood pressure, heart attack or stroke), diabetics and those with high red blood cell counts.

Overall, it is very rare to lose sight in an eye after a general anaesthetic. It is difficult to give an accurate figure for the risk because it is so rare. Studies suggest that the overall risk, for all operations under general anaesthetic is between 1 in 60,000 and 1 in 125,000 operations.^{2,3,6,7} However it is more likely (but still uncommon) in the high risk operations listed above. One study estimates that visual loss happens in 1 in 3,300 operations on the spine and 1 in 1,100 open heart operations.⁷

Are there any other eye injuries that can happen?

Other eye problems that can follow a general anaesthetic include:

- ▶ Pressure on nerves in the eyebrow area may cause a droopy eyelid. This is usually temporary and should recover.
- ▶ Protective tape or eye ointments used to protect your eyes from corneal abrasions may cause temporary bruising of the eyelids or irritation of the eyes. Redness of the eye, blurred vision and the feeling that there is something in the eye may last for up to eight hours.
- ▶ A few operations are performed in an extreme head down position. This includes prolonged laparoscopic (keyhole) surgery for major procedures such as removal of parts of the bowel. This can lead to swelling of your eyelids which should resolve within a short time.
- ▶ If you have glaucoma (which causes high pressure inside your eye) your anaesthetist will need to take extra care to protect your eyesight during surgery.

Summary

Corneal abrasion causing symptoms is an uncommon eye problem after general anaesthesia. Anaesthetists take care to prevent it by using tape or other forms of eye protection. It is more common in patients who need to lie face down for surgery.

Loss of sight after general anaesthesia is very rare, but should be considered a risk in certain operations.

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Risks associated with your anaesthetic

SECTION 6: POST-OPERATIVE CHEST INFECTION

After an anaesthetic and an operation there is a risk that you may develop a chest infection. This article tells you what a chest infection is, what it feels like and how it may affect your recovery. It includes information about what you can do to help prevent yourself from getting a chest infection.

What is a chest infection and why can it happen after surgery?

Chest infections are caused by bacteria or a virus. General anaesthetics affect the normal way that phlegm is moved out of the lungs. Pain from the operation can mean that taking a deep breath or coughing is difficult. As a result of these two things, phlegm can build up in the lungs. Within the phlegm an infection can develop. Pneumonia is a type of chest infection, and you may also hear the name 'lower respiratory tract infection', or 'LRTI'.

What does it feel like?

- ▶ You may feel very unwell and tired.
- ▶ You may have a high temperature.
- ▶ You may have a cough that brings up thick yellow or green sputum (phlegm).
- ▶ It will become harder to breathe, and your breathing may be quite fast.
- ▶ Chest pain can also be a sign of a chest infection.
- ▶ Some patients, especially older people, become confused. This is usually temporary and is likely to improve as the chest infection gets better.

Here are some ways that patients who developed a post-operative chest infection described it:

'I woke up all sweaty with a pain in my back, like a tight band across my back.'

'I thought I was going to cough my lungs up.'

'I was so flat out I didn't even have the energy to eat or wash myself.'

'The nurse said my temperature and heart rate was up, and I could feel the heart racing in my chest. My breathing wasn't right either.'

How do you know if you have a post-operative chest infection?

- ▶ Doctors and physiotherapists listen to your chest with a stethoscope. They can hear extra crackles and wheezes.
- ▶ If you have an X-ray of the chest, the infection can be seen on the X-ray.
- ▶ Blood tests can also show that you have an infection.

- ▶ A sample of your sputum (phlegm) can be sent to the lab to try to identify any bacteria which are causing the infection.
- ▶ Sometimes the heart rate becomes faster and the blood pressure can fall. These are signs of a serious chest infection.

Who is most likely to get a post-operative chest infection?

The following factors make a post-operative chest infection more likely:

- ▶ Increased age (over 50).
- ▶ Certain operations: you are more likely to get a chest infection if your operation is on the abdomen or the chest, or if you are having **major** surgery on the head or neck.¹
- ▶ Having a long-term medical condition – for example, diabetes, kidney disease, asthma or chronic obstructive pulmonary disease.^{2,3}
- ▶ Being very overweight.
- ▶ Being a smoker.⁴
- ▶ Having a weakened immune system. This makes a person less able to fight off bacteria or virus infections. This includes people who have a long-term disease of the immune system or who are on medications at home that suppress their immune system, such as steroids.
- ▶ Being immobile after surgery, and unable to get out of bed, either due to the surgery or due to a pre-existing problem with moving about.

There is a lot of debate about whether the type of anaesthetic makes any difference. There is some evidence that having a regional anaesthetic (for example, a spinal or epidural injection), either with or without a general anaesthetic reduces your risk of a chest infection compared to having a general anaesthetic alone.¹ You can find out

more about these alternatives and whether they may be suitable for you from the booklet 'Anaesthesia Explained' on the Royal College of Anaesthetists' website (www.rcoa.ac.uk).

How likely is it to get a chest infection?

The risk is very variable depending on all the factors listed above. One example is that around 1 in 5 people having major abdominal surgery are likely to get a chest infection, which may be mild or severe. However people with none of the risks above are quite unlikely to get an infection.

How serious is it if I get a chest infection?

If you were previously healthy, you are very likely to recover fully from a post-operative chest infection. But rarely, people who were well before their surgery die from pneumonia afterwards.

If you were not previously healthy and had longstanding lung disease or another long standing illness, then you are more likely to have a serious life threatening post-operative chest infection. However many people with previous lung disease recover after a post-operative chest infection. Your anaesthetist will be able to talk to you about the risks which apply to you.

What can I do to prevent a chest infection?

- ▶ If your General Practitioner has advised you that you have an increased risk of getting influenza (flu), then being immunised against the flu virus (having a flu jab) is a good idea. This may help prevent a chest infection after your surgery. However, this should be done well ahead of your operation, and avoided in the two weeks before your surgery.

- ▶ Smokers are more likely to get a chest infection after an operation. Giving up smoking, even a few days or weeks before coming into hospital, will allow the damaged linings of your airways to begin to repair. This reduces your risk of getting an infection.⁴ However you will gain the most if you can give up smoking at least two months before your operation.¹
- ▶ You are more likely to be successful in giving up smoking if you use a stop smoking support service. Your GP or hospital clinic can help you find your nearest provider of this service or the NHS Stop Smoking Service is available at <http://smokefree.nhs.uk>.
- ▶ Your anaesthetist will consider whether a certain anaesthetic technique will help prevent a chest infection. You may be offered a local or regional anaesthetic. These are injections which numb an area of the body, meaning that you do not need a full general anaesthetic for the surgery. This is only possible for certain types of operations. You can find out more about this in the booklet 'Anaesthesia Explained' on the Royal College of Anaesthetists' website (www.rcoa.ac.uk).
- ▶ Your doctors and nurses will be ready to help make your pain relief as good as possible by adjusting your pain relief medicines if necessary. This will enable you to breathe deeply and cough more easily, which will help prevent or clear any infection. The anaesthetist will talk to you about a plan for pain relief. Local or regional anaesthetics can be used together with a general anaesthetic, to give better pain relief after the operation.
- ▶ Reminding yourself to breathe deeply after your operation and to cough at regular intervals helps prevent a chest infection.

It also helps to clear an infection more quickly by getting rid of phlegm.

- ▶ A physiotherapist may work with you after your surgery to prevent or treat a chest infection. He/she is an important member of the healthcare team who will teach you how to breathe and cough more effectively to keep your chest clear.

What is the treatment for a post-operative chest infection?

You will require oxygen which is given through a facemask or through small plastic tubes that sit just inside your nostrils (sometimes called nasal prongs, or nasal specs). The flow of oxygen can be quite noisy and can make your mouth and nose dry.

You may be given intravenous fluids (a 'drip' into a vein) to prevent dehydration. This will help thin the phlegm in your lungs and make it easier to cough up. A cannula is inserted into a vein in your hand or arm. This is a thin plastic tube which is inserted using a needle, and the needle is then discarded. The cannula will be replaced every 48 hours or so. You will also be encouraged to drink plenty, if your recent operation allows this.

Antibiotics can also be given through the cannula into a vein. For mild infections, tablet antibiotics may be given. Antibiotics kill bacteria or slow down their growth. There are many types and doctors try to choose the one most likely to be effective in each type of infection. Antibiotics have a lot of side effects and your doctors should tell you what to expect when they are prescribed.

Pain from your operation, and other pains such as headache, will be treated with pain relief medicines. It is important that you tell your doctors and nurses about your pain, so they can help you.

Occasionally, the physiotherapist, nurse or doctor will ask you to use oxygen under pressure by breathing through a mouth piece (like a snorkel) or through a tight fitting mask which covers the mouth and/or nose. This helps to expand the lungs better.

If your chest infection is very severe, you may need help with your breathing. This is done in an intensive care unit. You are heavily sedated while a tube is inserted through your mouth or nose into the trachea (windpipe). A ventilator (breathing machine) is used until your condition improves. Admission to an intensive care unit with a post-operative chest infection is very serious and some people do not survive.

What does getting a chest infection mean for my recovery?

If you get a post-operative chest infection, your discharge from hospital will be delayed by days or weeks.⁵ Chest infections can have many complications. Fluid can build up in the lungs or infection can spread in the bloodstream to affect other organs in your body. Specific treatment is given for these on the ward or in the intensive care unit. If you are admitted to the intensive care unit, your recovery is likely to be very slow indeed.

Most people who get a post-operative chest infection go on to make a full recovery without long-term effects.

Some comments from patients:

'My breathing meant I had to stay in bed, I couldn't walk, I couldn't eat because when I took the mask off, my breathing got harder and the oxygen levels in my blood dropped very low.'

'My brother who had near enough the same type of surgery was out in a week but I was in just over a month.'

'I didn't expect it to be as bad as it was. I thought the antibiotics into my vein would clear me right up but I had to have three different types and the last one affected my kidneys which made me even sicker.'

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Risks associated with your anaesthetic

SECTION 7: BECOMING CONFUSED AFTER AN OPERATION

Anaesthesia and surgery are intended to give you relief from an illness or from pain and disability. However, these benefits are weighed against risks. Becoming confused is a common risk after an operation and an anaesthetic. Behaviour and memory can be affected and there may be some deterioration in more complex mental functions such as the ability to get dressed or do the crossword.

There are two types of confusion which can happen after surgery and an anaesthetic.

- ▶ Delirium, (or post-operative delirium) happens very soon after an operation. It has a number of causes which are usually treatable.
- ▶ Cognitive dysfunction (or post-operative cognitive dysfunction or POCD) can develop later. The cause of this is not well understood and there is evidence that in a few people its effects may be permanent.

Neither of these is the same as dementia. Dementia is a progressive disease of the brain, which has quite well understood causes. It is unrelated to having an operation and an anaesthetic. However people with previous dementia are more likely to get both delirium and POCD. Also, it may be that mild early dementia has not been noticed by the patient or by friends and family. It may seem to have been related to the operation and anaesthetic, whereas in fact the changes were there beforehand.

Post-operative delirium and POCD are described in more detail in this article. They are different, but some elements (for example poor memory) can happen in both and also happen in dementia.

DELIRIUM

What is post-operative delirium?

Delirium is a state of confusion. It can happen during an illness as well as after an operation. After an operation the person usually wakes up behaving normally. The confusion appears during the first few days after the operation. The severity of symptoms varies and tends to fluctuate over the course of the day, being better in the mornings and worsening in the evening and at night. It can be frightening – certainly for the person who is affected, but also for the patient’s relatives and friends.

What is it like to have delirium?

Symptoms vary a lot in different people. Some people become agitated and confused. Others become quiet and withdrawn. Here are some typical symptoms:

- ▶ Not knowing your own name or where you are.
- ▶ Not knowing what has happened to you or why you are in hospital.
- ▶ Loss of memory – being unable to recognise family members.

- ▶ Reversal of sleep patterns – sleeping during the day and being awake at night.
- ▶ Being incoherent, shouting and swearing.
- ▶ Emotional changes such as tearfulness, anxiety, anger or aggression.
- ▶ Trying to climb out of bed and pulling out drips and tubes.
- ▶ Appearing indifferent to whatever is going on.
- ▶ Becoming paranoid and thinking that people are trying to harm you – this can be particularly distressing for friends and relatives.
- ▶ Occasionally, there may be visual or auditory hallucinations (seeing and hearing things that do not exist).
- ▶ inadequate nutrition
- ▶ prolonged constipation
- ▶ sleep disturbance
- ▶ not taking the drugs that you were taking before the operation
- ▶ loss of vision and hearing makes the symptoms and behaviours of delirium worse – sometimes simply due to lack of glasses or hearing aids.

Why does post-operative delirium develop?

In the first few days and weeks after your operation, your body is repairing itself. The physical challenges associated with this process affect the way that the brain is working. Some specific causes, many of which can be effectively treated, are listed below.

Causes of post-operative delirium:

- ▶ infections, such as wound, urine and chest infections
- ▶ poor pain control
- ▶ side effects of the medicines for pain relief
- ▶ other medicines
- ▶ dehydration
- ▶ low oxygen levels due to:
 - effects of the anaesthetic
 - effects of medicines on breathing, especially medicines for pain relief
 - a chest infection
 - other lung problems

Nurses and doctors on wards where people have had an operation understand what causes delirium. Treatment will include oxygen therapy, antibiotics, adjusting any medicines being given, good nutrition and relief of constipation. They will also be keen to provide a quiet environment for good sleep at night although this can be difficult in a busy ward. Friends and relatives can help by making sure that glasses and hearing aids are available, and by quietly reassuring the person about who they are and what has been happening.

Who is at risk of developing delirium?

Some people are more likely to develop delirium. This includes people with:

- ▶ previous dementia or brain disorders
- ▶ advanced age
- ▶ high alcohol intake
- ▶ poor mobility (unable to walk about easily)
- ▶ previous surgery, especially hip or heart surgery
- ▶ depression
- ▶ poor eyesight or hearing
- ▶ heart failure
- ▶ a medical condition requiring surgery to be done as an emergency.

Does delirium improve and go away?

Most people who develop delirium are treated for any identified causes and improve greatly. However they are more likely to stay in hospital days or weeks longer than people who do not become confused. There is a slightly increased risk that people who have had severe delirium will end up living in a more supported environment, less independently, than before.

POST-OPERATIVE COGNITIVE DYSFUNCTION (POCD)

What is POCD?

POCD involves experiencing difficulty with the higher mental tasks that people use every day. For example, concentrating on a story or film, recalling what was recently heard or said, completing several tasks at the same time, doing a crossword, or making a shopping list. At first, recovery from the operation may seem to be going well, and symptoms either do not exist or are not noticed. Then, during the weeks or months after the operation, the person or their families and carers may gradually notice that tasks which were easy before the operation, are increasingly difficult. For example, people may find they cannot make decisions or complete difficult calculations at work, or play chess as well as before.

Does POCD ever recover?

POCD tends to fade away as healing from the operation continues, but the process may take months or years to happen. It is difficult to measure the symptoms of POCD, which is why doctors are not certain how often it happens. One study suggests that 10% of people have POCD three months after the operation, but only 1% have it after one year.

What is it like to have POCD?

Most people with POCD feel quite normal when they first come out of hospital. However, as they return to normal life, they start to notice what is wrong. Problems with the memory is one of the first things they notice. For example, they go to the shops and then cannot remember what they wanted to buy. Items are misplaced around the house, and it may be difficult to remember the names of people they do not see very often. There can be difficulty learning to use a new gadget and the ability to calculate and problem-solve can be affected. This can be a frightening period and independence and confidence generally may be reduced. However, with support, people with POCD can develop strategies to cope – for example using calendars and lists to help with everyday activities.

Why does POCD develop?

The cause of POCD is unclear. Problems with the blood vessels of the brain, reduced blood pressure during and after surgery, stress levels whilst in hospital, genetic susceptibility, and increased inflammation in the body and brain have all been suggested as causes. Some medicines given in hospital seem to be more likely to be associated with POCD, but it is unclear whether these medicines actually cause POCD.

The anaesthetic technique used does not appear to be an important cause of POCD. Studies have compared regional anaesthesia (for example spinal or epidural injections) with general anaesthesia. They do not show a significant difference in the number of people who get POCD afterwards. Regional anaesthesia may reduce the chance of getting delirium, but probably not POCD.

The type of pain relief medicines used also does not seem to affect the chance of getting POCD.

It might seem that having an epidural for pain relief would reduce the chance of getting POCD, as people who have an epidural receive less strong pain relief medicine. However this has not been proved.

Who is at risk of developing POCD?

The problem with studies on POCD is that it is difficult to measure with certainty the types of mental function that are affected. This list shows who is probably more likely to be affected, although many people with these risk factors go through surgery without developing POCD.

- ▶ People having major surgery, or who need to have a second operation before they leave hospital.
- ▶ People over the age of 60, although some studies show it can happen to younger people as well.
- ▶ People having longer operations.
- ▶ People who have a serious infection or breathing difficulty after surgery.
- ▶ People with a lower level of education – the reason for this is not known.
- ▶ People having open heart surgery – this increases the chance of POCD more than other types of major surgery.

Confusion after an operation: can I do anything to help?

If you have decided to have an operation, then you are accepting the risk that you may develop delirium and/or POCD, or both. The risk of both is low, however, and in general should perhaps not put you off having important life-saving or life altering surgery.

Here are some things that you can do which may help prevent becoming confused, and also may help you deal with it if it happens to you.

- ▶ Before the operation, try and be as healthy as possible. Eat a good diet and take a sensible amount of exercise. It is a good idea to give up smoking and to lose weight if you are overweight.
- ▶ Ask your anaesthetist if there are any alternatives to a general anaesthetic – such as a spinal anaesthetic or a nerve block. These will not guarantee that you will not suffer from delirium, but they may help. You can find out more about these on www.rcoa.ac.uk/patientinfo.
- ▶ If you are having a minor or moderate operation and you have someone at home to look after you, you may be able to go home on the same day. This reduces the risk of becoming confused.
- ▶ Make sure that you have your glasses and hearing aids with you, and that spare batteries are available if needed.
- ▶ Make sure that you bring all your medications into hospital with you so that your doctors know what you are taking and so that these medications can be continued.
- ▶ If you drink a lot of alcohol you should take advice about how to cut down safely. Your GP or practice nurse will be able to help you with this. You should also tell your doctors in hospital how much you drink.
- ▶ It can help if friends and family understand that you may become confused afterwards. Some ideas on how they can help are given below.
- ▶ Motivation is important. Your nurses and physiotherapists will tell you when you can start exercises and looking after yourself. You should aim to be increasingly independent.

- ▶ As you recover, you may feel upset and sad about what has happened to you and worry that you may never get back to normal. Remember that some degree of confusion is very common and most people make a good recovery.

How can friends and family help while I am confused?

- ▶ They should speak softly and use simple words or phrases.
- ▶ They can remind you of the day and date.
- ▶ They can tell you what has been happening day by day.
- ▶ They can talk about family and friends.
- ▶ They can make sure you have your glasses and hearing aids.
- ▶ When you are back at home, they can help with lists, calendars, pictures of family and helping you get out and about if you lack confidence.
- ▶ They can remind you when your favourite TV or radio show is on.

What will the hospital do to help me?

The team caring for you on the ward are trained to consider how to help people with all kinds of confusion. They will be keen to provide a regular routine, a visible clock, and natural daylight. They will try to look after glasses and

hearing aids, and allow as much visiting as seems appropriate. They will try to have the same staff caring for you, whenever possible, and that you know who is who on the staff. They will try to keep the ward quiet at night, although this cannot always be achieved.

Who can I talk to before my operation about the possibility of being confused afterwards?

Most patients are called to a pre-assessment clinic before surgery. At this clinic, you will be able to talk to an experienced surgical nurse, and perhaps to your anaesthetist. They will be able to tell you if you have a high risk of confusion after surgery, and what you can do to help.

It can also help to talk to family and friends about the possibility of becoming confused after the operation. They will be important in helping you make a full recovery.

Who can help me after my operation?

The nurses and doctors on the ward will be keen to help you. People with delirium are likely to stay in hospital longer than normal after an operation. When you are well enough to be at home, they can arrange extra help at home – usually temporarily, for a fixed period of time. A social worker may need to help set this up. Some people need to go to a convalescent home for a little while, or stay with family or friends as the confusion resolves.

Summary

Delirium happens commonly after surgery. It is caused by treatable factors such as infections or low oxygen levels. Once these are treated it usually gets better completely, although the hospital stay will be longer.

POCD is much less common but has longer term effects on higher mental functions. It is difficult to study as these functions are difficult to measure reliably. Therefore it is not well understood. Most people who develop POCD get better but it may take a year or more.

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Risks associated with your anaesthetic

SECTION 8: AWARENESS DURING GENERAL ANAESTHESIA

When you have a general anaesthetic, you become unconscious. The anaesthetist decides how much anaesthetic you need to keep you unconscious during your operation. Awareness is when a patient becomes conscious or partly conscious during a general anaesthetic and can remember things that happened. This is uncommon, but it can be very distressing. This article tells you more about how it can occasionally happen, what steps are taken to prevent it and what to do if you think it has happened to you.

What is awareness?

Awareness is becoming conscious during some part of your operation under general anaesthetic. The majority of patients who are aware do not feel any pain, but may have memories of events in the operating theatre. Dreaming around the time of an operation is very common (6 in 100) but this is not awareness¹. Some patients recall events from the recovery room after their operation and mistakenly believe them to be memories of the surgery.

How and why does it happen?

Your anaesthetist is present throughout the whole operation and he/she uses clinical judgement and experience to ensure that you are receiving enough anaesthetic to keep you unconscious, but not so much that you suffer serious side effects.

Anaesthetics have side effects that increase as more anaesthetic is given. These include falling blood pressure and reduced breathing. Anaesthetists sometimes use a muscle relaxing drug as part of the anaesthetic. These drugs stop your breathing and your anaesthetist will use a ventilator (breathing machine) to do the breathing for you. For some operations these drugs are essential as they allow the surgeon

access to parts of your body that he/she could not reach without muscle relaxants. These drugs also allow lighter levels of anaesthetic to be used, and this reduces dangerous side effects. Muscle relaxants also prevent movement, and your anaesthetist uses information coming from monitors (heart rate, blood pressure, anaesthetic gas levels etc) to judge whether you are unconscious or not.

Awareness occurs if you are not receiving enough anaesthetic to keep you unconscious. It can also happen if the equipment that delivers the anaesthetic to your body is malfunctioning, or there may be a combination of these.

How likely is it?

Careful studies have been done, mainly in the USA and Scandinavia, which include interviews with many thousands of patients. Several studies^{1,2} suggest that around one or two people per 1,000 patients under anaesthetic experience some kind of awareness. Only one third of these people feel pain, although the experience can still be very distressing. Awareness with on-going psychological effects afterwards is more likely (but still uncommon) if you receive a muscle relaxant.

Another study,³ of over 80,000 patients given an

anaesthetic according to a strict protocol, found that only 1 in 14,000 people having a general anaesthetic experience awareness. Most of the cases they found happened to people who had certain risk factors. If no risk factor is present, the risk was 1 in 42,000 anaesthetics. The risk factors they recorded were having open heart surgery, Caesarean section (delivering a baby), or surgery after a major accident. Awareness remained uncommon even for these procedures.

A recent survey of anaesthetists in the UK estimates that around 1 person per 15,000 patients reports awareness to their anaesthetist.⁴

What does it feel like if it happens to me?

Over half of aware patients recollect sounds and conversations within the operating theatre.^{1,2,4} They are unable to move and have feelings of anxiety and panic.^{1,4} Approximately a quarter of aware patients are aware of the insertion or presence of the breathing tube in their throats^{1,5,6} and about a third experience pain.^{1,2,5,6}

Are there any long-term effects?

Some people who have been aware during a general anaesthetic suffer long term effects.^{2,5} These include anxiety, sleep disturbances, flashbacks and nightmares. A post-traumatic stress disorder can develop. There is also likely to be fear of anaesthesia should another anaesthetic be needed.

If I think I have been aware, what should I do?

You will benefit from talking to an anaesthetist about it and understanding how it might have happened. You can contact your original anaesthetist or any anaesthetist through the anaesthetic department at your hospital. If you are still in hospital you can ask your nurses to make contact. If you are already at home,

you or your GP can contact the anaesthetic department at the hospital.

Studies have shown that some people do not realise that they have been aware until several days later. You can report the fact that you think you have been aware, days or months later.

The anaesthetist who conducted the anaesthetic, or another anaesthetist, will talk to you. He/she will ask you to explain exactly what you remember. He/she will talk to you about your memories and try to work out if you have been aware or if your memories are dreams or relate to things that happened while you were waking up after your operation. If you have been aware when you should not have been aware, the anaesthetist will explain to you how this might have happened.

It can be helpful to see a Psychologist who has experience of working with people with who have had awareness during a general anaesthetic. The anaesthetic team can set this up for you. You will also be offered details of how to contact the psychology services in the future, if you do not think that you need help right away. Help is also available on the internet.^{7,8}

Can awareness be avoided?

Awareness happens when a general anaesthetic is used and an insufficient amount of anaesthetic is given. Not all operations require general anaesthetic. Some operations can be carried out using a local or regional anaesthetic to numb part of the body. If you have this kind of anaesthetic, you will be awake. You will not be able to feel anything, and if you are anxious, some light sedation may be used to keep you calm and relaxed. You can find out more about these anaesthetics in the booklet [Anaesthesia Explained](#) on the Royal College of Anaesthetists website. Your anaesthetist will be able to tell you if these anaesthetics are suitable for you.

How is awareness prevented during a general anaesthetic?

At the start of the day, your anaesthetist will check all equipment to ensure it is functioning properly. Misconnections and disconnections of the breathing tubes can cause awareness. All anaesthetists are trained to spot these problems, hopefully before awareness occurs. Before the start of your anaesthetic you will be connected to a monitor that tells the anaesthetist how you are responding during the operation. Another monitor will usually be used which shows the amount of anaesthetic in your body. This monitoring equipment helps the anaesthetist judge whether you are having the right amount of anaesthetic.

Monitors, which try to detect awareness by analysing brain activity, have been developed. These have been studied in a number of trials of varying size and quality.^{9,10} These monitors may reduce the possibility of awareness, particularly in patients who are at higher risk, but they cannot prevent awareness completely. At the present time these monitors are not in routine use in British hospitals nor are they generally recommended for routine use in America.¹¹ NICE, the National Institute for Health and Clinical Effectiveness, published guidance in 2012 for their use in the UK.¹²

If I have had an episode of awareness, is it more likely to happen during my next anaesthetic?

Yes, you are at a slightly increased risk during your next anaesthetic. It is very important you tell your anaesthetist about your previous episode of awareness. He/she will try to ensure that you receive adequate doses of anaesthetic throughout surgery.

Are there any circumstances in which awareness is more or less likely?

If you are very ill, awareness is more common¹. Very ill patients have a low blood pressure and anaesthetics can decrease the blood pressure further which may cause harm (e.g. heart attack or stroke). The anaesthetist may use a lighter general anaesthetic to reduce the risks to you. However, the risk of you being aware of what is going on is increased.

In some types of surgery the side effects of anaesthetic drugs may be particularly dangerous to you (or, if you are pregnant, to your unborn child). The risk of awareness is increased because your anaesthetist may need to use less anaesthetic. For example:

- ▶ cardiac surgery (the risk may be 1 in 100)
- ▶ emergency caesarean section under a general anaesthetic (4 in 1,000).⁶

If you take certain medications you will require more anaesthetic. These include alcohol (prolonged, heavy use), some types of sleeping tablets and morphine-like drugs. It is very important that you inform the anaesthetist of all your regular medications.

Most cases of awareness leading to serious psychological upset occur in people who have received muscle relaxants. People who have not had muscle relaxants, and are breathing for themselves, very rarely become aware during anaesthesia,² and if they do become aware, serious psychological upset does not generally follow. Anaesthetists will avoid muscle relaxants and allow patients to breathe for themselves whenever it is possible and safe to do so. However for many types of surgery, muscle relaxants are essential.

Is there anything I can do to prevent it from happening?

You could ask your anaesthetist if it is possible to avoid having a general anaesthetic and have your operation performed with a local anaesthetic. You can have sedation as well to help you feel drowsy and mentally relaxed.

Tell the anaesthetist about all your regular medications or drugs, especially those mentioned above, and about your alcohol intake. Also tell him/her if you think you may have been aware during any previous anaesthetic.

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Risks associated with your anaesthetic

SECTION 9: SERIOUS ALLERGY DURING AN ANAESTHETIC (ANAPHYLAXIS)

When you have an anaesthetic you will receive a number of medicines, drugs or injections. During the anaesthetic you may receive injections into a vein or a muscle as well as anaesthetic gases. Before or after the anaesthetic, you may receive pills, tablets or liquids to swallow, injections or suppositories. You may also be given fluids into a vein to prevent dehydration and you will be in contact with antiseptics and equipment in the operating theatre.

All these things, except the anaesthetic gases, can occasionally cause allergic reactions of varying severity. This article gives information about these reactions.

What is anaphylaxis?

Anaphylaxis is a severe, life-threatening allergic reaction. Allergic reactions can happen in response to many things – pollen, dust, bee stings, nuts and antibiotics are common causes. These things are called antigens. Rarely, anaphylaxis can happen during an anaesthetic, either caused by one of the anaesthetic drugs or by other substances used during surgery.

We meet thousands of antigens in everyday life and they usually do us no harm whatsoever. Sometimes, for reasons we don't fully understand, the body makes substances called antibodies. The purpose of antibody production is to help eliminate antigens, which may be harmful, from the body. Each antibody is a unique match for its own antigen, and will be produced rapidly if the antigen appears in the body in the future. This is known as sensitisation. If they meet the same antigen or a very similar antigen again at

a later date, the antibody-antigen combination may cause the release of histamine and other chemicals. These chemical substances released are called mediators and they can cause the symptoms of allergy¹.

If only small amounts of mediators are released the symptoms are minor – for example, hay fever or skin rashes. If very large amounts are released very rapidly there may be severe difficulty with breathing (wheezing), low blood pressure or swelling inside the throat, and this is called anaphylaxis. Severe anaphylaxis is life threatening but, with prompt treatment, death from anaphylaxis is very rare.

Other similar types of reaction

There are some reactions that cause similar symptoms, but are not due to antibody production. It can be more difficult to identify the exact cause of these reactions.

How is anaphylaxis treated?

- ▶ Any medicine that might have caused the reaction should be stopped immediately.
- ▶ If the pulse is weak, the affected person should be laid flat on their back and their legs should be raised. This is the quickest way to improve the blood pressure.
- ▶ Adrenaline is the most effective drug treatment and is given as a series of injections.
- ▶ In hospitals, oxygen and an intravenous drip are also used.
- ▶ Antihistamines, steroids and asthma treatments might be needed.

Usually the symptoms will settle down quite quickly, but continued observation will be required, often necessitating an overnight stay in hospital. Very serious reactions will require treatment in the Intensive Care Unit (ICU). If the operation has not already started, surgery will almost certainly be postponed unless it is very urgent.

All anaesthetists are trained in how to treat anaphylaxis. Adrenaline is immediately available in every operating theatre.

It is extremely important that any episode of anaphylaxis is investigated in detail, so that the drug or other substance responsible can be identified and avoided in the future. Investigations include blood tests taken at the time of the reaction and then skin testing at a later date.

How frequently do anaesthetics cause anaphylaxis?

Nobody knows this exactly. At the moment, the best estimate is that a life-threatening allergic reaction (anaphylaxis) happens during 1 in 10,000 to 1 in 20,000 anaesthetics.²

Most people make a full recovery from anaphylaxis. We do not know how many anaphylactic reactions during anaesthesia lead to death or permanent disability. One review article suggests that 1 in 20 serious reactions can lead to death, but this is only one person's estimate.³ This would mean that the chance of dying as a result of an anaphylactic reaction during anaesthesia is extremely rare, lying between 1 in 200,000 and 1 in 400,000 anaesthetics.

What can cause anaphylaxis during an anaesthetic?

During any operation and anaesthetic, it is normal to have contact with a wide range of antigens (unfamiliar substances). Many of these could potentially cause an allergic reaction, but some are more likely to do so than others. Anaphylaxis is more likely when drugs are given intravenously.

The four most common causes of anaphylaxis during anaesthesia are:⁴

- ▶ drugs used to prevent movement during surgery (called muscle relaxants or neuromuscular blocking agents). These drugs are only given to patients who are already anaesthetised
- ▶ antibiotics – these are often needed during surgery
- ▶ chlorhexidine, a skin antiseptic often used before surgery
- ▶ latex (a type of rubber). For many years latex has been used in the manufacture of surgical rubber gloves and other equipment used in operating theatres. Most hospitals are taking steps to reduce the number of latex-containing products they use. The Health and Safety Executive has developed guidelines about the use of latex in operating theatres.⁵

Your anaesthetist will choose drugs for your anaesthetic taking into account many different factors, in particular the type of operation, your physical condition and whether you are allergic to anything. All drugs, including anaesthetic drugs, are carefully tested before they are licensed for general use. In the UK every serious reaction should be reported to the Medicines Control Agency and the Association of Anaesthetists of Great Britain and Ireland National Anaesthetic Anaphylaxis Database. Your anaesthetist should make sure that this is done.

What factors could make anaphylaxis more likely?

Anaphylactic reactions during anaesthesia seem to occur more in women than in men.

Allergy to certain fruits and nuts, particularly bananas, avocados and chestnuts is seen more commonly in patients who are allergic to latex. Latex allergy is also seen more often in people who have frequent exposure to latex, e.g. hospital workers and those who have had several surgical operations.

Some people who have multiple allergies or allergic asthma may be more likely to experience anaphylaxis than people who have no known allergies. Most severe reactions are unpredictable.

Is allergy to anaesthetics hereditary?

No. If you are allergic to an anaesthetic drug, your children are no more likely to have the same allergy than any other person. Some very rare non-allergic problems with anaesthetic drugs can occur in families, for example 'suxamethonium apnoea' where some muscle relaxant drugs can last longer than usual, and "malignant hyperthermia" where the body can become very hot. These are NOT allergic conditions.

Is there anything I can do to help avoid serious allergy?

You may already know that you are allergic to certain medicines or substances. When you come into hospital, you will be asked several times if you are allergic to anything. It is very important that you pass on this information to the health professionals looking after you. If your allergy is serious, you may be advised to wear a Hazard Warning bracelet.

Can I be tested for anaphylaxis before I have my anaesthetic?

Routine skin testing is not currently recommended,⁶ except for some people who have had a serious allergic reaction during an anaesthetic in the past.^{7,8}

There are two reasons why routine skin testing is not currently recommended before surgery.

The most important reason is that a negative skin test to a particular drug does not guarantee that you will not experience an anaphylactic reaction to the same drug in the future. Skin tests are only a guide because the response of the skin to a tiny amount of the drug is not necessarily the same as giving a much larger dose of the drug directly into a vein during the anaesthetic.

A second reason is that it is possible to become sensitised to some anaesthetic drugs without ever having received the drug previously. Some common chemicals are similar to certain anaesthetic drugs. It is possible to become sensitised to these anaesthetic drugs in everyday life after the skin test has been done.

An important exception is latex allergy. If you have any symptoms of latex allergy – for example, itching or a rash after exposure to latex rubber in children's balloons, rubber gloves or

condoms – then you should be tested for latex allergy before your surgical operation. There are two types of test: a skin test and a blood test. Which of the tests you have will depend on their availability in your locality. If you believe you may be allergic to latex you should tell your GP well in advance of going into hospital for surgery; it is possible for the GP to send a blood sample for latex testing. It usually takes a week or two for the result to come back.

Skin testing is done by putting a tiny drop of the drug on the skin and pricking the skin lightly with a small piece of plastic shaped like a toothpick. This is not painful. A positive test produces an itchy lump on the skin. Skin testing has to be done by someone who has been trained in diagnosing allergy.

If I am allergic to an anaesthetic drug, are alternative drugs available?

Yes, there are many different anaesthetic drugs and alternative drugs can almost always be given. Just occasionally a person is allergic to several muscle relaxant drugs and we advise the avoidance of all drugs of this type. If a person is allergic to an antibiotic or a skin antiseptic, suitable alternatives are available.

What should I do if I think I have had an allergic reaction during an operation in the past?

If you think you might have had an allergic reaction during or after previous surgery, it is important to try to find out whether it was an allergic reaction and what caused it. It may be possible for your GP to find out from your hospital consultant what was the cause of the problem. If your GP thinks it is appropriate, you may be referred to an allergy clinic to help to find the cause.

Where can I get more information about anaphylaxis?

- ▶ Your GP or your anaesthetist.
- ▶ Suspected Anaphylactic Reactions associated with Anaesthesia, published by the Association of Anaesthetists of Great Britain and Ireland and the British Society of Allergy and Clinical Immunology.⁷
- ▶ Allergy UK (www.allergyuk.org).

Where can I get more information about other unwanted effects of anaesthetic drugs?

- ▶ British Malignant Hyperthermia Association (www.bmha.co.uk).
- ▶ Other pages in this series.

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Risks associated with your anaesthetic

SECTION 10: NERVE DAMAGE ASSOCIATED WITH AN OPERATION UNDER GENERAL ANAESTHETIC

Significant nerve damage can be associated with a general anaesthetic. Peripheral nerve damage occurs uncommonly (less than 1 in 1,000).¹ Spinal cord damage is exceptionally rare. This article gives information as follows:

- ▶ How can nerves can be damaged during an operation under general anaesthesia?
- ▶ What kinds of nerve damage can happen?
- ▶ How likely is this?
- ▶ What recovery can be expected?

What is the nervous system?

The nervous system consists of:

- ▶ **Peripheral nerves** run between the spinal cord and the rest of the body.
 - **Sensory nerves** bring information into the brain about touch, pain, position and hot or cold.
 - **Motor nerves** carry messages from the brain to control muscles.
 - **Mixed nerves** are partly motor and partly sensory.
- ▶ **The central nervous system**
 - The brain acts as the 'central processor' of the system.
 - The spinal cord carries electrical signals to and from the brain. It links the brain to the peripheral nerves.

What symptoms can be caused by nerve damage?

Peripheral nerve damage

- ▶ If sensory nerves are damaged, you may feel numbness, tingling or pain. The pain can be a continuous aching pain or a sharp shooting pain. You may also get inappropriate warm or cold sensations. Symptoms can start immediately after an injury to a nerve, or can sometimes not appear until several weeks after the initial injury.
- ▶ If motor nerves are damaged, there may be weakness or paralysis (loss of movement) of muscles in the area supplied by that nerve.
- ▶ If mixed nerves are damaged, there will be a mixture of symptoms.
- ▶ The area affected varies according to which nerves have been damaged. There could be anything between a very small patch of numbness and most of a limb being affected.

Spinal cord damage

Damage to the spinal cord usually affects both muscle power and sensation, depending on where the damage has happened. Unfortunately, spinal cord damage is often extensive, with pain being a frequent feature. Control of the bowels and the bladder can also be affected.

What are the most common peripheral nerve injuries?

The ulnar nerve runs in the arm down to the fourth and fifth fingers. Ulnar nerve damage is by far the most commonly reported nerve injury.²⁻⁴ Pressure can easily damage the nerve around the elbow, where it is very close to the skin. Ulnar nerve damage causes numbness in the fourth and fifth fingers and/or weakness of the hand muscles.

The common peroneal nerve runs in the leg supplying muscles and skin of the foot. It can be damaged on the outside of the leg, just below the knee. This can cause numbness on the top of the foot and/or foot drop (an inability to bend the foot upwards at the ankle joint).⁶⁻⁸

How long do these effects last?

Peripheral nerves

- ▶ This is variable.
- ▶ If the changes you notice are slight, recovery may occur within a few days, but it may take several weeks. Most symptoms resolve within three months.
- ▶ Full recovery can sometimes take up to a year or even longer.
- ▶ Uncommonly, (around 1 in 1,000 anaesthetics)⁵ nerve damage occurs that is permanent.

Spinal cord

- ▶ Unfortunately, damage caused by an injury to the spinal cord is usually permanent. This is very rare, occurring in less than 1 in 50,000 anaesthetics.

What can be done if there is nerve damage?

Your anaesthetist or surgeon may arrange for you to see a neurologist (a doctor specialising in nerve diseases). Tests may be done to try and find out exactly where and how the damage has occurred. This might involve:

- ▶ nerve conduction studies. Very small electric currents are applied to the skin or muscles and recordings are made further up the nerve. This shows whether the nerve is working or not
- ▶ Magnetic Resonance Imaging (MRI)
- ▶ Computed Tomography (CT) scanning.

The neurologist will suggest a treatment plan, which might include:

- ▶ physiotherapy
- ▶ exercise
- ▶ drugs that relieve pain. Drugs may be given which are normally used for treating epilepsy or depression. They help because they change electrical activity in nerves. Drug treatment is not always successful in relieving pain
- ▶ Occasionally an operation may be recommended, either to repair a nerve or to relieve pressure on a stretched nerve.

Peripheral nerve damage

How does peripheral nerve damage happen?

Mechanism	Cause
Compression/stretch	<p>Related to positioning</p> <p>During the operation, you will be placed in a certain position to allow the operation to be done. For example, you may need to lie on your front to allow surgery on your back. If a nerve is stretched or compressed (pressed on or squashed), there can be nerve damage. If you were awake, you would feel this and move to relieve the discomfort. During an anaesthetic, you cannot do this.</p> <p>Tourniquets</p> <p>If a tourniquet (a tight bandage) is used to reduce surgical bleeding there can be nerve damage due to pressure on the nerve. Your anaesthetist and surgeon will take care to limit the pressure and the length of time the tourniquet is used to reduce the chance of this happening.</p> <p>Airway tubes</p> <p>Very rarely, the nerves to your tongue can be compressed by the tube used in your throat during a general anaesthetic. These tubes are essential for a safe anaesthetic, to ensure that your airway is clear. You can find out more about this in Section 4 in this series.</p> <p>Surgical equipment</p> <p>Retractors are surgical instruments that may be used to hold structures in the body out of the way so that the surgeon can see more deeply into the body. They are used with care, aiming to avoid pressure on nerves.</p>
Direct injury	<p>The surgeon might damage a nerve as he/she operates. Surgical instruments can also compress and/or stretch a nerve. During some operations, this may be difficult or impossible to avoid. If this is a significant possibility, the surgeon should discuss it with you beforehand.</p>
Inadequate blood supply	<p>Every nerve is supplied by blood vessels which keep it healthy. If these blood vessels are damaged during the operation, or if the blood supply is reduced due to pressure or stretching, the nerve can be starved of oxygen. This type of damage is slightly more likely if you have narrowing of your blood vessels generally. The surgeon will know about this and take as much care as possible.</p>
Pre-existing	<p>Nerves already compromised by co-existing diseases such as rheumatoid arthritis and diabetes are more likely to be injured. Your surgeon will know about these conditions and will take as much care as possible.</p>
Insertion of a cannula	<p>Nerves can be damaged by needles used to place a cannula ('a drip') into a vein or artery.</p>

What is done to prevent peripheral nerve damage?

Your anaesthetist, surgeon and theatre staff take care to try and prevent nerve damage. They share the responsibility of minimising the risks by:

- ▶ careful padding of vulnerable areas
- ▶ positioning you in a way which avoids stretching nerves as much as possible

- ▶ the surgeon being aware of the risk of damaging nerves
- ▶ avoiding prolonged bed rest.

Sometimes nerve damage can happen even if the team looking after you have taken the best possible care of you.

What increases the risk of peripheral nerve damage?

Patient factors

- ▶ Medical conditions – diabetes, smoking, vascular disease
- ▶ Being male
- ▶ Increasing age
- ▶ Being very overweight or extremely thin.

Surgical factors

- ▶ More complicated operations which involve more instruments are more likely to damage nerves than simpler operations.
- ▶ Certain operations, including:
 - operations on the spine or brain
 - cardiac or vascular operations (on the heart or major blood vessels)
 - operations on the neck or parotid (a gland in the face)
 - some kinds of breast operation
 - operations where a tourniquet (a tight band around a limb) is used to reduce bleeding.

Positioning

- ▶ You are more likely to get nerve damage if you have been placed in certain positions:
 - lying on your front
 - lying on your side for some operations on the chest or kidney
 - lying on your back with your legs raised and separated – for operations in the genital area (this is called the lithotomy position)
 - your arm being placed in position for some shoulder operations.

Spinal cord damage

Spinal cord damage is very rare. Unfortunately, compared to peripheral nerve injury, it is more likely to result in permanent serious disability. This is because the spinal cord cannot repair itself.

Compared to peripheral nerve injury, spinal cord damage is:

- ▶ much more rare
- ▶ more likely to be disabling
- ▶ more likely to be permanent
- ▶ more often associated with pre-existing disease.

How does it happen?

Inadequate blood supply to the spinal cord

This is the main cause of spinal cord damage associated with a general anaesthetic. The following factors may cause oxygen starvation of the spinal cord:

- ▶ low blood pressure
- ▶ a clot blocking the blood vessels
- ▶ compression or stretch of blood vessels, making them narrower.

The 'anterior spinal artery syndrome' is caused by reduced blood flow in this artery. Part of the spinal cord becomes starved of oxygen and may be damaged. This can result in permanent lower limb paralysis.

If you have disease of your blood vessels elsewhere (for example coronary heart disease) the risk of this happening is slightly higher, but the risk remains very rare (see later for estimated figures). Your anaesthetist will adjust your anaesthetic to keep your blood pressure at a level that he/she considers safe.

How likely is peripheral nerve and spinal cord damage?

The exact risk of nerve damage is not known. The following figures are the best information available.

- ▶ The risk of a significant peripheral nerve injury lasting more than three months, is estimated to be less than 1 in 2,000 patients having a general anaesthetic.⁹ Permanent damage, lasting more than a year, is estimated to be less than 1.2 in 5,000.⁵
- ▶ Spinal cord damage occurs in less than 1 in 50,000 patients having a general anaesthetic.¹⁰
- ▶ More minor symptoms occur much more frequently, perhaps as high as 1 in 100 people having a general anaesthetic. Most of these recover completely.

Who should I go to for help if I think I may have nerve damage and I have left hospital?

- ▶ Your GP
- ▶ Your surgeon
- ▶ Your anaesthetist

You should go to your GP initially, who may refer you back to your surgeon or to your anaesthetist.

More detailed information about the risk of nerve and spinal cord damage

The precise risk of significant and disabling peripheral nerve damage occurring after surgery and anaesthesia in the United Kingdom is unknown. Many cases of nerve damage have been reported, but we do not know how many anaesthetics there were during the same time without problems. Therefore we cannot work out how frequently the damage is occurring.

From the USA, two surveys of cases which have been settled in a court of law (called closed claim studies) were conducted a decade apart. They showed that nerve injury was the third most common cause of anaesthetic-related litigation, making 16% of total claims. These cases include all types of anaesthetic – general anaesthetic, peripheral nerve blocks, spinal and epidural injections.

In these closed claim studies from the USA:

- ▶ 48% of the injuries were to nerves in the arm. Most of these involved only a general anaesthetic, without any kind of peripheral nerve block. Some were thought to be associated with the position of the arm during the anaesthetic, but the exact cause of many injuries was not known.
- ▶ 13% of the injuries were spinal cord injuries. Over half of these had a spinal or epidural injection as well as a general anaesthetic. Of those having a general anaesthetic alone, approximately half were having operations on their spine.

It is helpful to remember that:

- ▶ Many millions of anaesthetics were given in the 30 years covered by these closed claim studies.
- ▶ This information only includes cases reported and settled in a court of law.
- ▶ Considerable improvements have been made in the care given during and after operations since then.
- ▶ Most UK anaesthetists and surgeons would consider the risks now to be less than those quoted here, but this view remains to be proven.

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This leaflet will be reviewed three years from the date of publication.

Risks associated with your anaesthetic

SECTION 11: NERVE DAMAGE ASSOCIATED WITH A SPINAL OR EPIDURAL INJECTION

Your anaesthetist will talk to you about the balance between the benefits and the risks of having an epidural or a spinal injection. These injections are usually carried out without any problems, but can rarely be associated with nerve damage. This section gives you information as follows:

- What are spinal and epidural injections?
- What types of nerve damage can happen and what are the symptoms?
- How does nerve damage happen?
- What can be done to prevent nerve damage? If I think I have nerve damage, what can be done about it?
- How likely is permanent nerve damage?
- How frequent is this type of nerve damage?

What is a spinal injection?

A very thin needle is inserted between the bones of your back, through ligaments and then into the fluid surrounding the spinal cord. Spinal injections are usually performed in the lower part of the spine. At this level, the spinal cord itself has ended and a bundle of nerves is present which supplies the legs and genital area. Nerves in this area are surrounded by a liquid called cerebrospinal fluid (CSF). A single injection of local anaesthetic (sometimes with other painkillers) is given and the needle is removed. This injection should make you feel numb in the lower part of the body for between about two and four hours.

You can find out more about having a spinal injection in the leaflets *Anaesthesia Explained* and *Your spinal anaesthetic* on the Royal College of Anaesthetists' website (www.rcoa.ac.uk).

What is an epidural injection?

A larger needle is used to introduce a thin catheter (tube) into your back. The needle is passed between the bones, through ligaments and into a space outside the linings of the spinal cord. The catheter is passed through the hollow needle into this space and the needle is then removed. The catheter is taped securely to your skin. You can lie on your back with this catheter in place. Local anaesthetic and other drugs can be given through this catheter for a period of time – perhaps several days.

An epidural is used for operations which are longer than two hours or when pain relief is needed for several days.

You can find out more about having an epidural in the leaflets *Anaesthesia Explained* and *Your epidural for pain relief* at www.rcoa.ac.uk.

Risks and benefits

You can find general information about the risks and benefits of spinal and epidural injections in the leaflets named above. Your anaesthetist will be able to tell you more about your individual risks and benefits. He/she will also be able to describe alternative treatments, which will also have benefits and risks.

This article describes nerve damage associated with spinal and epidural injections. It is aimed at patients having all kinds of operations. If you are planning to have an epidural or a spinal for childbirth you can find additional information at www.oaa-anaes.ac.uk – Information for Mothers section.

How do we know about these risks?

We know about the risks of epidurals and spinals from medical research. A few years ago all the anaesthetists in the country contributed to a project that examined this topic in detail.

The project collected reports from anaesthetists of any major problem that had occurred with an epidural or a spinal performed in an NHS hospital in the UK for a period of 1 year. During this time over 700,000 epidurals and spinals were inserted, and the project aimed to collect reports of every major complication that occurred. It gave us a lot of information about risks. The project was called the 3rd National Audit Project (NAP3). For those interested in the details of this big project, all the results are available at www.rcoa.ac.uk/nap3.

What types of nerve damage can happen?

Nerve damage is a rare complication of spinal or epidural injections. Nerve damage is usually temporary. Permanent nerve damage resulting in paralysis (loss of the use of one or more limbs)

is very rare. More figures are given at the end of this section.

- ▶ A single nerve or a group of nerves may be damaged. Therefore the area affected may be small or large.
- ▶ In its mildest form you can get a small numb area or an area of 'pins and needles' on your skin.
- ▶ There may be areas of your body that feel strange and painful.
- ▶ Weakness may occur in one or more muscles.
- ▶ The most severe (and very rare) cases give permanent paralysis of one or both legs (paraplegia) and/or loss of control of the bowel or bladder.

The majority of people make a full recovery over a period of time between a few days and a few weeks. Permanent damage is very rare.

How does nerve damage happen?

The ways in which nerve damage can be caused by a spinal or epidural injection are listed here and explained below.

- ▶ Direct injury caused by the needle or the catheter
- ▶ Haematoma (a blood clot)
- ▶ Infection
- ▶ Inadequate blood supply
- ▶ Other causes

Direct injury

This can occur if the epidural or spinal needle or the epidural catheter damages a single nerve, a group of nerves or the spinal cord.

Contact with a nerve may cause 'pins and needles' or a brief shooting pain. This does not mean that the nerve is damaged, but if the

needle is not repositioned, damage can occur. If this happens you should try to remain still and tell your anaesthetist about it. The anaesthetist will change the position of the needle and the sensations will usually improve immediately.

Most cases of direct damage are to a single nerve and are temporary. Injecting drugs right into the nerve rather than into the area surrounding it can also cause direct damage.

Haematoma (blood clot)

This is a collection of blood near the nerve, which collects due to damage to a blood vessel by the needle or the catheter. Small amounts of bleeding or bruising are common, and do not cause damage to the nerve. A large haematoma may press on a nerve or on the spinal cord and cause damage. This is a very rare problem, but may require an urgent operation to remove the haematoma and relieve the pressure.

If your blood does not clot normally or you take a blood-thinning medicine such as warfarin, heparin or clopidogrel, you are more likely to get a haematoma. In most circumstances you will be asked to stop these medicines, before you have an epidural or spinal injection. If your blood does not clot for other reasons (e.g. haemophilia) you are also at increased risk of this complication. It is important that you tell your anaesthetist about any problems with blood clotting that you have had in the past as you may not be able to have an epidural or spinal injection. See below for more details about blood thinning medicines.⁵

Infection

Most infections related to a spinal injection or an epidural are local skin infections and do not cause nerve damage. Very rarely, an infection can develop close to the spinal cord and major nerves. There may be an abscess (a collection of pus) or meningitis. These infections are

very serious and require urgent treatment with antibiotics and/or surgery to prevent permanent nerve damage.

If you already have a significant infection elsewhere, or if you have a weak immune system, you have a higher risk of these serious infections. You may not be offered an epidural or spinal injection.

Inadequate blood supply

Low blood pressure is very common when you have an epidural or spinal injection. This can reduce the blood flow to nerves and, rarely, this can cause nerve damage. Anaesthetists are aware of this risk and use drugs and intravenous fluid to prevent large drops in blood pressure.

Other causes

There have been cases of the wrong drug being given in an epidural or spinal injection. This is an exceptionally rare event and all anaesthetists take precautions to eliminate this type of error.

What else can cause nerve damage?

If you have nerve damage, you should not assume that it is caused by the epidural or spinal injection. The following list shows other causes of nerve damage related to having an operation. You can find more about these causes in Section 10 in this series.

- ▶ Your nerves can be damaged by the surgery. During some operations, this may be difficult or impossible to avoid. If this is the case, your surgeon should discuss it with you beforehand.
- ▶ The position that you are placed in for the operation can stretch a nerve and damage it.
- ▶ The use of a tourniquet to reduce blood loss during the operation will press on the nerve and may damage it. Tourniquets are used for many orthopaedic arm and leg operations.

- ▶ Swelling in the area after the operation can damage nerves.
- ▶ Pre-existing medical conditions that interfere with blood supply (e.g. diabetes or atherosclerosis – narrowing of your blood vessels) or with nerve function (e.g. multiple sclerosis) can make damage more likely or make it more difficult to determine the cause of complications.

What is done to prevent nerve damage?

Anaesthetists are trained to be aware of nerve damage. Steps taken to prevent each kind of damage are described here.

Direct injury

- ▶ All anaesthetists performing epidural and spinal injections are trained in these techniques.
- ▶ Spinal injections are placed below the expected lower end of the spinal cord. This should prevent damage to the spinal cord itself.
- ▶ Spinal injections are usually performed while you are awake or lightly sedated. If there is pain or tingling due to contact with a nerve, you will be able to warn the anaesthetist who will then be able to adjust.
- ▶ Your anaesthetist may wish to do your epidural injection while you are awake. Direct nerve injury after an epidural injection is rare, and there is no clear evidence about whether it is safer to do the epidural while you are awake or after a general anaesthetic has been given. Anaesthetists vary in their views on this matter and you should discuss your preference about this with your anaesthetist.

Haematoma (blood clot)

- ▶ If you take an anti-coagulant (a drug which thins the blood, such as warfarin), you will be asked to stop it several days before surgery if your doctors think it is safe to do so. The anaesthetist and surgeon together will decide if and when the drug should be stopped.⁵ A blood test will allow your anaesthetist to decide if it is safe to have a spinal or epidural injection. If your anti-coagulation cannot be safely stopped, then you will not be able to have an epidural or spinal injection.
- ▶ If you take clopidogrel (another drug which thins the blood by its effect on platelets), you will usually be asked to stop it several days before planned surgery. For urgent surgery, your doctors will think about whether it is safer for you to have or to avoid a spinal or epidural injection.
- ▶ If you take aspirin, you can have an epidural or spinal injection.

Infection

All epidural and spinal injections are performed under 'aseptic conditions' (i.e. using special precautions to make the procedure as clean as is possible), similar to those used during the operation. Your back should be kept clean and regularly checked over the next few days

General care

If you have an epidural or spinal injection, the nurses will make regular checks until everything returns to normal. This should help spot possible nerve damage very early and if treatment is needed it can be started immediately.

If I think I have nerve damage, what can be done about it?

If you are concerned you may have nerve damage from an epidural or spinal injection it is important your anaesthetist knows about it. Your anaesthetist will be able to assess you. Your anaesthetist may arrange for you to see a neurologist (a doctor specialising in nerve diseases). Tests may be done to try and find out exactly where and how the damage has occurred. This might involve:

- ▶ nerve conduction studies (very small electrical currents are applied to the skin or muscles and recordings made further up the nerve. This shows whether the nerve is working or not)
- ▶ Magnetic Resonance Imaging (MRI): a form of body scan
- ▶ Computed Tomography (CT): a form of body scan.

If necessary, the neurologist will suggest a treatment plan, which might include physiotherapy and exercise. If you have pain, drugs that relieve pain will be used. This may include drugs that are normally used for treating epilepsy or depression because of the way that they change electrical activity in nerves. Drug treatment is not always successful in relieving pain.

Occasionally an operation is necessary, either to repair a nerve or to relieve pressure on a stretched nerve.

How likely is permanent nerve damage?

The best data available in the UK comes from the NAP3 project described above. The risk of damage to nerves is rare. In many of these people the symptoms improve or resolve within

a few weeks or months. The risk of longer lasting problems for all types of spinal and epidural injection is:

- ▶ permanent harm 1 in 23,500 to 50,500 spinal or epidural injections
- ▶ paraplegia or death 1 in 54,500 to 1 in 141,500 spinal or epidural injections.

These figures are only broad guidelines. The risk may be higher or lower depending on your general health and the circumstances in which you are having the spinal or epidural. Your anaesthetist can give you more specific information.

If you want to read more detailed, technical information you can visit the College website at www.rcoa.ac.uk/nap3 or if you have an iPhone you can download an iPhone app 'iNAP3' from the apple app store.

Summary

Nerve damage is a rare complication of spinal or epidural injection.

In the majority of cases, a single nerve is affected, giving a numb area on the skin or limited muscle weakness. These effects are usually temporary with full recovery occurring within days or a few weeks.

Significant permanent nerve damage resulting in the loss of the use of your legs is very rare.

Some people have a higher risk of permanent damage. Your anaesthetist will balance this against the benefits of an epidural or spinal injection.

Your anaesthetist will be able to tell you about the benefits and risks of an epidural or spinal injection for you as an individual. He/she will also be able to describe the alternatives.

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Risks associated with your anaesthetic

SECTION 12: NERVE DAMAGE ASSOCIATED WITH PERIPHERAL NERVE BLOCK

Your anaesthetist may suggest that you have a peripheral nerve block. This is an injection placed near to a nerve or group of nerves. Rarely, this injection can damage nerves. This article gives you information as follows:

- ▶ What is a peripheral nerve block?
- ▶ How can nerve damage happen?
- ▶ How does it feel to have nerve damage?
- ▶ What recovery can I expect?
- ▶ How does nerve damage happen?
- ▶ If I think I have nerve damage, what can be done about it?
- ▶ How likely is permanent nerve damage?

What is a peripheral nerve block?

This is an injection of local anaesthetic near to the nerves which go to the area of your operation. It makes the area feel numb. The injection is used with or without a general anaesthetic.

- ▶ If a general anaesthetic is given, the nerve block is intended to help with pain relief afterwards.
- ▶ If there is no general anaesthetic, the nerve block is intended to make you numb enough to have the operation without feeling anything. It can only be done like this if there is a nerve block suitable for your operation. It is useful if you wish to avoid a general anaesthetic. Sedation medicines may be given to keep you calm and relaxed.

You can find out more about these choices in the booklet *Anaesthesia Explained* which you will find on the Royal College of Anaesthetists' website (www.rcoa.ac.uk).

Types of nerve block

There are many types of nerve block, each one aimed at a different group of nerves.

Your anaesthetist will tell you if there is a block suitable for your operation. He or she will discuss the benefits, the risks and your preferences. Then you can decide whether you would like a nerve block.

How long does the block last?

A nerve block can give pain relief for between two and 18 hours depending on the site and on the drugs used. Sometimes a catheter (a very thin tube) can be passed through the needle and left in place, near the nerve. Local anaesthetic can then be injected through the catheter for a longer period – perhaps up to a few days.

Risks and benefits

A nerve block is intended to reduce the need for other anaesthetic drugs or to avoid a general anaesthetic altogether. It should also give you better pain relief after your operation. This allows you to be mobile more quickly after your operation. You may not need as much strong pain-relieving medicine, such as morphine. This will help reduce the side effects associated with these medicines, which include nausea (feeling sick) and drowsiness. These benefits may lead to a reduced stay in hospital.

The risks of having a nerve block include damage to the nerves. This is the subject of this leaflet. You can find out about the other risks by asking your anaesthetist.

How can nerve damage happen?

Nerve damage after peripheral nerve block is usually temporary and most patients make a full recovery within a few days or weeks.^{1,2} However, rarely, nerve damage is permanent.

How does it feel to have nerve damage?

Some people have mild changes in sensation (feeling). There may be an area of numbness or 'pins and needles'. Some patients describe strange sensations or pain in the area affected. Uncommonly, there may be weakness in one or more muscles.

What recovery can I expect?

Most nerve injuries are temporary, and will recover over a period of about three months. Permanent injury occurs on rare occasions. However if serious nerve damage happens, there can be severe pain or permanent paralysis of the area involved.

How does nerve damage happen? What is done to prevent nerve damage?

The ways in which a nerve can be damaged are listed here, and explained below. Anaesthetists who perform nerve blocks are trained in the technique and will take steps to prevent these types of nerve damage:

- ▶ direct injury caused by the needle or the catheter
- ▶ toxic effects on the nerves caused by the drugs injected
- ▶ haematoma (a blood clot)
- ▶ inadequate blood supply
- ▶ infection
- ▶ other causes.

Direct injury

This happens if the needle or catheter damages the nerve. During some nerve blocks, the needle or catheter may touch a nerve, causing 'pins and needles' or a brief shooting pain. This does not mean the nerve is necessarily damaged, although your anaesthetist should reposition the needle or catheter with care, so that damage does not occur.

If you are having a peripheral nerve block and a general anaesthetic, your anaesthetist may wish to do the nerve block while you are awake, before giving the general anaesthetic. This allows you to report any tingling or shooting pains that you feel. If you notice these, you should tell the anaesthetist immediately. The anaesthetist will reposition the needle and the feelings should disappear.

If you have the nerve block after you are anaesthetised, the anaesthetist will take other precautions to avoid nerve damage.

To help position the needle correctly, the anaesthetist may use an ultrasound machine which gives a picture of the nerve, the needle and the surrounding structures. This helps find the correct place for the injection. It may improve the success rate of the nerve block and may reduce the risk of nerve damage from the injection.

Toxic effects

The drugs injected can very rarely cause a chemical irritation that damages the nerves. The drugs used are chosen for their very low risk of causing this problem.

Haematoma (a blood clot)

This happens when there is bleeding near the nerve due to damage to a blood vessel by the needle or catheter. Small amounts of bleeding or bruising are common, and do not cause damage to nerves. A large collection of blood is called a haematoma, and this may press on a nerve and cause damage. Rarely, an urgent operation is required to remove the haematoma and stop it pressing on the nerve.

If you take blood-thinning medicines such as warfarin or clopidogrel, you are more likely to get a haematoma. Your anaesthetist will take this into account before he/she offers you a nerve block. You will be asked about which drugs you take at the pre-assessment clinic. It helps if you take all your medicines when you attend that clinic, to make sure the list is correct.

Inadequate blood supply

Every nerve is supplied by blood vessels, which keep it healthy. If the blood supply to a nerve is damaged by the needle or catheter, the nerve suffers a lack of oxygen, which can damage the nerve.

Infections

Infection after peripheral nerve block is very rare. This is because anaesthetists take care to work in very clean or sterile conditions. Infection is slightly more likely if a catheter is left in place but the risk is still very small. Catheter entry points should be kept clean and checked regularly. If you have infection elsewhere or a weak immune system, you are more likely to get an infection. The anaesthetist will take this into account before he/she offers you a nerve block.

Other causes of nerve damage

If you have nerve damage, you should not assume that it is caused by the nerve block. The following list shows other causes of nerve damage during an operation. You can find out more about these causes in Section 10 in this series of articles.

- ▶ The surgeon may damage your nerves. During some operations, this may be difficult or impossible to avoid. If this is the case, your surgeon should discuss it with you beforehand.
- ▶ The position that you are placed in for the operation can stretch a nerve and damage it.
- ▶ The use of a tourniquet (a tight bandage) to reduce bleeding during the operation will press on the nerve and may damage it.
- ▶ Swelling in the area after the operation can damage nerves. If it is a limb, elevation of the limb will help reduce any swelling.
- ▶ Pre-existing medical conditions, such as diabetes or atherosclerosis (narrowing of your blood vessels), can make damage more likely.

If I think I have nerve damage, what can be done about it?

If you experience numbness lasting longer than 48 hours or any of the symptoms mentioned above, you should contact the hospital where you had the procedure. Your anaesthetist or surgeon may arrange for you to see a neurologist (a doctor specialising in nerve diseases). Tests may be done to try and find out exactly where and how the damage has occurred. These tests may be:

- ▶ Nerve conduction studies. Very small electrical currents are applied to the skin and recordings are made further up the nerve. This shows whether the nerve is working or not.
- ▶ Magnetic Resonance Imaging (MRI).
- ▶ Computed Tomography (CT) scanning.

The neurologist or the surgeon and/or the anaesthetist will suggest a treatment plan, which might include physiotherapy and exercise. If you have pain, drugs that relieve pain will be used. Drugs which are normally used for treating epilepsy or depression are used because of the way that they change electrical activity in nerves. Drug treatment is not always successful in relieving pain. Occasionally an operation may be recommended, either to repair a nerve or to relieve pressure on a stretched nerve.

How likely is permanent nerve damage?

There have been many studies looking at how often nerve damage happens in various peripheral nerve blocks.¹⁻⁷

Short-term nerve damage (longer than 48 hours) occurs in less than 1 in 10 nerve blocks.⁵ The risk varies between the different blocks. The vast majority of those affected (92–97%), recover within four to six weeks. 99% of these people have recovered within a year.

Permanent nerve damage is rare and precise numbers are not available. An estimate from the information that we have suggests it happens in between 1 in 2,000 and 1 in 5,000 nerve blocks.^{5,6}

Summary

Permanent nerve damage after a peripheral nerve block is very rare. Temporary nerve damage is common and it recovers within a few days or weeks.

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This leaflet will be reviewed three years from the date of publication.

Risks associated with your anaesthetic

SECTION 13: EQUIPMENT FAILURE

This article describes the equipment used by anaesthetists. It gives information about the ways in which equipment is made as safe as possible and it describes what is done to protect you if equipment failure occurs. There is also a final section that deals with the possibility of equipment transmitting an infection from patient to patient.

What equipment will be used when I have an anaesthetic?

Pipes bring oxygen, compressed air and anaesthetic gas (nitrous oxide) to the operating theatre. More pipes run from the wall of the theatre to the anaesthetic machine. If you are having a general anaesthetic, an anaesthetic machine is used to mix these gases with a volatile anaesthetic agent (a vapour).

This gas mixture is delivered to you through a breathing system made of light plastic tubing. A bacterial and viral filter is placed at your end of the breathing system and this is connected to a face mask or to a tube placed in your throat. (You can find out more about tubes which may be placed in your throat in Section 2 in this series.)

The breathing system may include a chemical absorber to remove carbon dioxide from the gas you breathe out, allowing the remaining gas to be used again.

During some general anaesthetics, you will be breathing for yourself. However, in others a machine is used to take over your breathing. This machine is called a ventilator. Your anaesthetist will be able to tell you if he/she plans to use a ventilator during your anaesthetic.

Monitors are electronic devices which measure your heart rate, blood pressure, blood oxygen level and the amount of anaesthetic gases,

oxygen and carbon dioxide in your breath. These measurements will inform your anaesthetist of any change in your general condition.

How am I protected from equipment failure?

An anaesthetist and a trained technician/assistant are present and pay constant attention to you and all the equipment being used throughout your anaesthetic. In this they are assisted by audible and visual alarms which the anaesthetist should set appropriately. If a problem occurs, the anaesthetist will be in a position to identify the cause immediately, and either correct it or change to an alternative anaesthetic technique and/or alternative equipment.

Equipment is designed to prevent misuse or mistakes. Gas pipe connections are colour coded and are non-interchangeable, thus preventing accidental administration of the wrong gas. Other connections are of standard sizes to prevent misconnections. Anaesthetic gases cannot be administered without oxygen because anaesthetic machines are equipped with a device that prevents low oxygen levels in the gas mixture that you breathe.

Other design features prevent injury from certain kinds of equipment failure. For example, pressure relief valves are built into anaesthetic machines to prevent high pressure gas reaching your lungs.

Regular checks of equipment are performed and documented as follows:

- ▶ Servicing of the anaesthetic machine should be performed at regular intervals, according to the manufacturer's instructions, and a service record is kept.
- ▶ It is the responsibility of the anaesthetist to check anaesthetic equipment at the beginning of each operating session and before each new patient. The Association of Anaesthetists has published guidelines on checking anaesthetic machines¹ and these form an important part of anaesthetic training and practice. The guidelines cover all aspects of the anaesthetic delivery system including the gas supply pipelines, the anaesthetic machine and breathing systems, the ventilator and the monitoring equipment. A summary of the guideline is attached to every anaesthetic machine and the anaesthetist must be satisfied that this has been carried out correctly. A record is kept, with the anaesthetic machine, that this check has been done.

All equipment failures that cause harm or could have caused harm should be reported as a 'critical incident'. Critical incidents include any unwanted event that happens during hospital care which may or could potentially cause harm to a patient. All hospitals have important processes which monitor and investigate critical incidents, looking for ways to improve patient safety.

Anaesthetic machines and monitors are fitted with comprehensive alarm systems. These emit both visual and audible signals, which are appropriate in terms of urgency, loudness and specificity. An alarm will go off when there has been a specific machine failure, or if a quantity being measured deviates from an expected normal value (e.g. a falling blood pressure).

If equipment fails, is alternative equipment available?

- ▶ A back-up oxygen cylinder is attached to every anaesthetic machine and can be used immediately in the event of an oxygen supply failure.
- ▶ If the anaesthetic gas supply fails, drugs may be given into a vein to maintain anaesthesia until the problem is resolved or the operation is over.
- ▶ If the ventilator (the breathing machine) fails, a self inflating bag and valve system can be used by the anaesthetist to supply oxygen and air by hand to the patient. Replacement equipment and technical assistance are also available in the theatre area.
- ▶ If there is an electric power failure, a generator should take over immediately without any loss of power supply to the equipment. This is tested regularly. However, as already stated, oxygen and anaesthetic agents can be given using equipment that is operated manually and which is not dependent on an electricity supply.

What type of failures can occur?

Unexpected equipment failure is uncommon. In an analysis of 195,812 patient safety incidents from the National Reporting and Learning System for England and Wales between 2006 and 2008, 1,029 incidents related to anaesthetic equipment (0.52%).

A detailed analysis of the 1,029 incidents revealed that:

- ▶ 272 (0.14%) incidents related to problems with the monitors (electronic devices which measure vital signs such as pulse, blood pressure, oxygen levels etc)

- ▶ 185 (0.09%) incidents related to ventilator problems
- ▶ 138 (0.07%) incidents related to gas monitoring
- ▶ 99 (0.05%) incidents related to leak in circuit
- ▶ 54 (0.03%) incidents related to anaesthetic machines failing 'cockpit check' or condition of machine/equipment unacceptable
- ▶ 53 (0.03%) incidents related to intravenous infusion pumps
- ▶ 52 (0.03%) incidents related to vapouriser problems
- ▶ 20 (0.01%) incidents related to problems with gas supply to machine.²

Most of the incidents caused no patient harm. Only 30 (0.015%) were judged to have led to moderate or severe harm. These findings agree with other published studies, that it is very rare for equipment failure to have serious consequences for the patient.^{3,4}

In 2002 there was a series of reports of problems with breathing systems. The Chief Medical Officer set up a group to investigate 11 cases in NHS hospitals where the breathing system had become blocked, obstructing the flow of oxygen to the patient. Two patients had died. This investigation led to important changes in practice relating to manufacture, supply and storage of breathing systems. Guidelines for checking anaesthetic equipment were rewritten and all anaesthetists were required to change their practice. This was an example of how national reporting systems can help to make things even safer for patients.⁵

Is there a risk of infection from the equipment?

Anaesthetic equipment can transmit disease but following correct practice, as set out in infection control guidelines, should prevent this.

Some items are used for only one patient and are then thrown away. Other items are cleaned in one of three ways. They may be:

- ▶ washed
- ▶ disinfected
- ▶ fully sterilised.

The method used will be determined by hospital or national policy and depends on what the contamination is and what disease could possibly be transmitted. MRSA is a well known hospital infection, but it is removed by standard hospital disinfectants and/or sterilisation.

The breathing system attached to the anaesthetic machine is changed at least every week. The bacterial and viral filter is disposable and a new one is used for each patient. Filters have been shown to prevent bacterial and viral contamination of the breathing system. MRSA is removed by these filters. However, if the patient is known to have a serious lung infection (such as TB), the complete breathing system is discarded after the anaesthetic.^{6,7}

New variant Creutzfeldt-Jakob disease is resistant to the methods of sterilisation currently used. No cases of infection with this very rare disease via anaesthetic equipment have been published so far. However, if you are having your tonsils removed, the Department of Health currently recommends that all non-disposable equipment placed in your mouth is covered with a disposable protective sheath.⁷ This is because the tonsils can be contaminated with this very rare disease and, in theory, the disease could be passed on in this way.

Summary

Anaesthetic equipment can fail however sophisticated it may be. Human error may play a part in equipment problems. The number of equipment problems is low, and they very rarely cause serious harm to patients.

The continued presence of a vigilant anaesthetist combined with equipment checks, appropriate monitoring and activated alarms, is the most important factor in keeping patients safe when equipment fails.

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Risks associated with your anaesthetic

SECTION 14: DEATH OR BRAIN DAMAGE

This article provides information about the risk of dying or getting significant brain damage during an anaesthetic.

It can be difficult to separate the risks of surgery and the risks of the anaesthetic when considering what happens during an operation. This article therefore includes some information about surgical risks too. However, your surgeon will be able to tell you more about the specific risks of your operation.

Why do deaths occur during general anaesthesia?

Most of the deaths that occur around the time of surgery are not directly caused by the anaesthetic.^{1,2} There are four main reasons.

1. There may be things about your health or the type of operation you are having that increase the risk of dying during a general anaesthetic. For example, death is more likely if:
 - you are older
 - you need major surgery on your heart or lungs, your brain, your major blood vessels, or your bowels
 - you need emergency surgery, including surgery for major trauma
 - you are very unwell before your operation.
2. There may be an unexpected allergic reaction to the anaesthetic drugs that are given. Life-threatening allergic reactions are rare. They occur in less than 1 in 10,000 general anaesthetics, and many are followed by a full recovery. More information can be found about serious allergies during an anaesthetic in Section 9 in this series.

3. The surgeon may find that the surgery is very difficult to achieve without damage or he/she may make an error during the operation. Specific risks of your operation should be explained to you before you sign your consent form. After the risks have been explained to you, you can decide whether you want to go ahead with the operation.
4. The anaesthetist may make a misjudgement or an error, perhaps by giving too much of a drug or giving the wrong drug. However, modern anaesthetic techniques, training, monitoring and equipment mean that deaths caused by anaesthetic errors are very rare, occurring in about 1 in 185,000 general anaesthetics given in the United Kingdom.³

What is the risk of dying during a general anaesthetic?

Exact figures are not available. Some facts and figures are given below.

- ▶ If you are a healthy patient, who is having non-emergency surgery, the short answer is that death is very rare. An exact figure is not known, but it is around 1 death per 100,000 general anaesthetics.⁴

- ▶ If you are having surgery and it is planned that you go home the same day, (day case surgery), the risk of death from general anaesthesia is even lower. This is because if you have been accepted for day-case surgery you will be reasonably healthy and you will not be having major surgery.
- ▶ As already stated, the risk increases:
 - if you are older
 - if you are having major or emergency surgery
 - if you have previous problems with your health, especially severe liver disease, heart disease, lung disease, diabetes requiring insulin, or cancer which has spread beyond the primary tumor
 - if you were ill or injured before the operation.

However, the risk of dying is still usually low.¹ An exact figure is difficult to quote, but your anaesthetist will be able to talk to you about it.

- ▶ For every 100,000 caesarean sections, one death happens which is said to be due to the anaesthetic alone. The rate is higher for emergency caesarean section with a general anaesthetic compared to planned caesarean section with a spinal or epidural anaesthetic. The overall death rate from all causes associated with caesarean section in England and Wales is approximately 17 in 100,000 caesarean sections.⁵
- ▶ The risk of a child dying from a general anaesthetic is around 1 in 40,000.⁶ However if the child is healthy and having non-emergency surgery, the risk is much less, probably less than 1 in 100,000,⁷ and the risks may be even lower in children over the age of one year.

What is the risk of getting brain damage due to a general anaesthetic?

Dizziness, drowsiness, headache and confusion are relatively common shortly after general anaesthesia, and in a small number of patients may persist for days, weeks or even months. However, this does not mean that brain damage has occurred. More information about these symptoms can be found in the leaflet entitled 'Section 7: Becoming confused after an operation' in this series.

If you are a healthy patient having non-emergency surgery, severe brain damage is very rare. But on the very rare occasions when it does occur, the brain damage may be permanent and cause inability to think, feel or move normally. Exact figures for this risk do not exist.

Such permanent brain damage may be caused by a stroke that occurs during an anaesthetic. The risk of having a stroke that causes brain damage during general anaesthesia increases:

- ▶ for the elderly
- ▶ for anyone who has had a previous stroke
- ▶ for people having surgery to the brain or head and neck, surgery on the carotid artery (a major blood vessel which supplies the brain), or heart surgery.⁴

Strokes occurring around the time of surgery are not often directly related to the general anaesthetic. Most strokes occur between two and ten days after surgery and are due to the combined after-effects of the surgery and the anaesthetic, together with the condition of the patient before the operation.

Very rarely, brain damage can happen because a complication or error has resulted in inadequate oxygen delivery to the brain for some time during the operation.

What precautions are used to prevent death and brain damage from occurring?

Drugs used by anaesthetists have effects on the brain (causing unconsciousness) but also on other body organs. They affect the heart, the blood pressure, breathing and lung function and other organs such as the kidney. It is usually these other effects that increase the risk of death or brain damage during the anaesthetic.

Anaesthetists are trained to use anaesthetic drugs with care, taking into account all relevant factors. Your anaesthetist will assess your condition before the operation to make sure that the drugs and techniques used are as safe as possible for you. He/she stays beside you throughout the whole anaesthetic and can adjust the anaesthetic and other treatments to keep you safe and healthy.

To help the anaesthetist, a number of monitors are used to measure heart and lung function, and the amount of anaesthetic given. Your physical state is monitored before the anaesthetic starts, during the anaesthetic,

and afterwards into the recovery period. The anaesthetist chooses the appropriate doses of drugs according to the information obtained from the monitors and his/her experience and clinical judgement.

There is continuing research aimed at making the drugs and techniques used by anaesthetists ever more safe for patients.

Is there anything I can do to prevent the risk of death or brain damage?

If you require emergency surgery, the short answer is: not much.

However, if you are having non-emergency surgery, then anything that you can do to improve your physical condition will reduce the risks associated with anaesthesia. This includes losing weight (if you are overweight), giving up smoking, eating well to improve your nutritional state, taking regular exercise and getting any long-term medical condition (such as asthma or diabetes) well controlled before the operation. Further information can be found in the booklet 'Anaesthesia Explained' on the Royal College of Anaesthetists' website (www.rcoa.ac.uk).

Summary

Most of the deaths that occur around the time of surgery are not directly caused by the anaesthetic.^{3,5}

For healthy patients undergoing surgery which is not major and not an emergency, dying or getting brain damage from a general anaesthetic is very rare.

The risk of dying or brain damage from a general anaesthetic increases if you are older, if you are having major or emergency surgery, or if you were ill or injured before the operation, but it usually remains low.

These risks vary greatly depending on your individual circumstances. Your surgeon and anaesthetist will be able to tell you more about your individual risks and then you can decide whether you want to go ahead with the operation.

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