Severe Combined Immunodeficiency (SCID)

Severe combined immunodeficiency (SCID) is the most serious form of primary immunodeficiency (PID). Most infants with SCID are diagnosed within the first year of life, and require a haematopoietic stem cell transplant (HSCT) to survive. Early diagnosis by newborn screening for SCID allows for a HSCT transplant to be undertaken before infections cause complications, that may be life threatening.

SCID is usually an inherited disorder

SCID and other PIDs are caused by defects in cells of the immune system, and are usually inherited. PIDs are different to AIDs (acquired immunodeficiency syndrome), that is due to human immunodeficiency virus (HIV).

Children usually inherit SCID from their parents, by one of the following ways:

- **X-linked** means that it only affects boys, and is transmitted by their mothers, who are called carriers. A daughter of a carrier mother has a 50% chance of being a carrier herself. Each son of a carrier mother has a 50% chance of being affected by SCID.
- **Autosomal recessive disorders** means that both parents are carriers and each child, whether a girl or a boy, has a 25% chance of being affected. Sometimes the autosomal recessive form of SCID is caused by a deficiency of an enzyme called adenosine deaminase (ADA SCID).

What is SCID?

The main role of the immune system is to defend against infections and other invaders (such as cancer cells) whilst protecting the body's own cells. Around half the white blood cells in healthy people are T cells (T lymphocytes), which are the most important cells in the immune system.

One of the roles of T cells is to help another type of white blood cell called B cells (B lymphocytes), to produce antibodies, also known as immunoglobulins. In SCID neither the T cells nor the B cells work properly.

Blood from infants with SCID does not usually have any T cells. Even if the blood of infants with SCID contains B cells, the B cells cannot make antibodies without T cells.

Infants are usually protected at birth against infections like tetanus, diphtheria, chickenpox, polio and most types of meningitis. After birth, antibodies start to gradually disappear from the infant's blood, and by six months of age they are practically gone. The amount of antibodies in the blood is shown by the Immunoglobulin G (IgG) level. Infants with SCID can't produce IgG, so once the IgG from the mother has gone, they easily get infections that antibodies prevent.

Infants with SCID tend to at risk of severe infections of the lungs, especially by Pneumocystis carinii or by cytomegalovirus (CMV). Symptoms include poor growth rate and chronic (ongoing) diarrhoea.

How is SCID diagnosed?

The diagnosis of SCID in infants is based on several signs, including:

- Very low numbers of T cells in the blood.
- T cells that do not work properly.
- An inability to make immunoglobulins
- Very low levels of immunoglobulins in the blood once the mother's antibodies have disappeared (around a few months of age).

Newborn screening for SCID is routinely performed in New Zealand, the United States and in some European countries. Early diagnosis by newborn screening for SCID allows for a HSCT transplant to be undertaken before infections cause complications, that may be life threatening.

Treatment options depend on the cause of SCID

Depending on the cause of SCID, there are three main treatment options, in addition to specific treatment of infections with appropriate antibiotics.

Deficiency of adenosine deaminase enzyme (ADA SCID)

- Can sometimes be treated by replacing the missing enzyme with injections of purified enzyme, which has been specially treated to make the enzyme last long enough in the blood for it to work.

Missing antibodies or immunoglobulins

- Can be replaced by immunoglobulin replacement therapy (IRT).

T cell disorders

- Require a haematopoietic stem cell transplant (HSCT) to survive.
- HSCT provides a new source of stem cells for infants with SCID. Stem cells are obtained from donated bone marrow or blood and are able to develop into all types of blood cells, including T cells and B cells, which produce antibodies.
- HSCT usually cures SCID, but has risks, and must be performed in specialist centres.
- After a successful HSCT, immune function is gradually restored, taking about a year to be considered cured and no longer in danger of serious infections. During that time it is important to minimise exposure to possible sources of infections. After a year, childhood immunisations can be given.

Patient support organisations

The following organisations provide support for people with SCID and their families:

- AusPIPS www.auspips.org.au
- Immune Deficiencies Foundation of Australia (IDFA) www.idfa.org.au
- Immune Deficiencies Foundation of New Zealand (IDFNZ) www.idfnz.org.nz

For more information go to www.allergy.org.au

To donate to immunology research go to www.allergyimmunology.org.au