NHS
Blood and Transplant

Irradiated Blood Components

Information for healthcare professionals

What are irradiated blood components?

Irradiated blood components are cellular blood components which have been exposed to irradiation in order to inactivate lymphocytes (a type of white blood cell).

Which blood components need to be irradiated?

Only cellular blood components (red cells, platelets, and granulocytes) need to be irradiated. Fresh Frozen Plasma (FFP), cryoprecipitate, frozen washed red cells and fractionated plasma products do not need to be irradiated as the lymphocytes are extremely unlikely to survive the freezing/fractionation processes.

How will I know if the components have been irradiated?

NHS Blood and Transplant (NHSBT) currently use both gamma and X-ray irradiators.

The rad-sure label is used for irradiated components:

The label is attached to the blood component prior to the irradiation process.

If you can see the **'NOT'** on the label **– do not use and return to the hospital transfusion laboratory.**

Why is irradiation used?

Irradiating blood components prevents the donor T lymphocytes surviving, replicating, and mounting an immune response against a vulnerable recipient. Otherwise, the lymphocytes can cause Transfusion-Associated-Graft-versus-Host Disease (TA-GvHD), which, although rare, has a significant mortality rate.

Leucodepletion reduces the number of lymphocytes in cellular blood components and has contributed to the reduction in cases of TA-GvHD.

Some components require irradiation regardless of the underlying diagnosis of the recipient, for example granulocytes. Alternatively, patients suffering from certain conditions require irradiated blood components; due to their immunocompromised status they are considered to be at risk of developing TA-GvHD.

Which components are always irradiated?

- All components from:
  - a first degree relative (parent, child, or sibling)
  - second degree relative (grandparent, grandchild, uncle, aunt, nephew, niece, or half sibling)
- All granulocyte/buffy coat components
- All Human Leucocyte Antigen (HLA) selected components

Who needs to receive irradiated blood components?

Paediatric practice

- Red cells and platelets for Intra-Uterine Transfusion (IUT)
- Red cells for neonatal Exchange Blood Transfusion (EBT)
- Preterm, or term, infants who received a previous IUT; irradiated cellular blood components should be administered until 6 months after the expected delivery date (40 weeks gestation).
- All patients with severe congenital T-lymphocyte immunodeficiency syndromes with significant qualitative or quantitative T-lymphocyte deficiency. Once a diagnosis of severe T-lymphocyte immunodeficiency has been suspected, irradiated components should be given while further diagnostic tests are being undertaken. A clinical immunologist should be consulted for advice in cases where there is uncertainty.
- Neonates and infants with suspected immunodeficiency syndromes should undergo T-lymphocyte enumeration prior to cardiac surgery wherever possible. If the T-lymphocyte count is >400 cells/µl, of which 30% are naive T lymphocytes, there is no need to irradiate red cells or platelets. If it is not possible to undertake T-cell investigations prior to surgery, irradiated cellular blood components should be given until immunological investigations have been undertaken.
- Adults, and children aged > 2 years referred for elective cardiac surgery for problems associated with DiGeorge syndrome need irradiated cellular blood components if there is a significant history consistent with severe T-lymphocyte-associated immunodeficiency.

Hodgkin Lymphoma (HL)

All adults and children with HL at any stage of the disease should have irradiated red cells and platelets indefinitely.

Allogeneic Haematopoietic Stem Cell Transplantation (HSCT)

All recipients (adult and paediatric) of allogeneic HSCT should receive irradiated blood components from the time of initiation of conditioning chemo/radiotherapy. The recommendation applies for all conditions where HSCT is indicated regardless of the underlying diagnosis.

Use of irradiated components should be continued until all the following criteria are met:

i. >6 months have elapsed since the transplant date
ii. The lymphocyte count is >1·0 × 10^9/L
iii. The patient is free of active chronic Graft-versus-Host Disease (GvHD)
iv. The patient is off all immunosuppression

If chronic GvHD is present or continued immunosuppressive treatment is required, irradiated blood components should be given indefinitely.

Use of irradiated blood components should continue indefinitely if this is required based on transplant conditioning, underlying disease, or previous treatment, e.g., previous diagnosis of HL or previous purine analogue treatment.

Allogeneic cellular blood components transfused to bone marrow and peripheral blood stem cell donors, of all ages, within 7 days prior to or during the harvest should also be irradiated.

Autologous Stem Cell Transplantation (ASCT)

Patients (adult and paediatric) undergoing bone marrow or peripheral blood stem cell collections for future autologous re-infusion should receive irradiated cellular blood components for 7 days prior to and during the bone marrow/stem cell harvest.

All patients undergoing ASCT irrespective of underlying diagnosis or indication for this treatment should receive irradiated cellular blood components from initiation of conditioning chemo/radiotherapy until 3 months post-transplant (6 months if total body irradiation was used in conditioning) unless conditioning, disease or previous treatment determine indefinite duration, for example previous diagnosis of HL or previous purine analogue treatment.

Other patient groups who require irradiated blood components

- All patients treated with purine analogues (fludarabine, cladribine, bendamustine and pentostatin), regardless of the underlying condition, should receive irradiated blood components indefinitely.
- Haematology patients (e.g., those with Chronic Lymphocytic Leukaemia [CLL] and aplastic anaemia) treated with alemtuzumab (Campath 1H-anti-CD 52) or Anti-Thymocyte Globulin (ATG)
- Patients receiving ATG or other T-lymphocyte-depleting serotherapy for rare types of immune dysfunction conditions should receive irradiated blood components.

- Chimeric Antigen Receptor T-cell (CAR-T) therapy. Patients (adult and paediatric) undergoing peripheral blood lymphocyte collections for future CAR-T cell re-infusion should receive irradiated cellular blood components for 7 days prior to and during the harvest. Irradiated blood components should continue to be used until 3 months following CAR-T cell infusion unless conditioning, disease or previous treatment determine indefinite duration, e.g., previous diagnosis of HL or previous purine analogue treatment.

New immunosuppressive agents

Despite the development and wide usage of new potent immunosuppressive agents, no cases of TA-GvHD have been reported in the literature. The authors are unable to make any recommendation for those agents and advise that manufacturers' recommendations should be followed.

In the event of an emergency

In an emergency the provision of red cells or platelets must not be delayed by sourcing irradiated components for patients with the appropriate indication; leucodepleted blood or platelets must be sourced rapidly from the blood bank; where non-irradiated components are used because of urgency this should be recorded and clinical observation made for any evidence of TA-GvHD over the next 6 weeks.

In emergency situations where irradiated components are unavailable, blood banks should consider preferentially issuing older red cells where possible (>14 days). For neonates and infants, see BSH guidelines for transfusion of fetuses, neonates and older children for a suggested hierarchy of blood component characteristics to use in an emergency.

When are irradiated components not recommended?

- Infants or children with temporary defects of T-lymphocyte function as the result of a viral infection.
- Adults or children who are HIV-antibody positive or who have Acquired Immune Deficiency Syndrome (AIDS).
- For patients with aplastic anaemia, transfusion of irradiated cellular components is not routinely recommended, unless otherwise indicated.
- For adults or children treated for acute leukaemia or non-Hodgkin lymphoma (including CLL unless treated with alemtuzumab) except for HLA-selected platelets, transfusion of granulocytes, donations from first- or second-degree relatives, or due to current or previous treatment.
- Following treatment with alemtuzumab using the schedule currently recommended for Multiple Sclerosis (MS) or vasculitis.
- For patients undergoing solid organ transplantation who have received alemtuzumab or ATG as induction therapy or for treatment of graft rejection.

- Treatment of patients with rituximab is not an indication for use of irradiated cellular blood components unless this is indicated for a different reason (underlying diagnosis, type of component or previous treatment)
- Routine transfusion of red cells or platelets to preterm or term infants (other than for EBT for red cells) unless there has been a previous IUT, in which case irradiated components should be administered until 6 months after the expected delivery date (40 weeks gestation).
- Adults, and children aged > 2 years without a significant history of infection, referred for elective cardiac surgery for problems associated with DiGeorge syndrome, such as aortic arch anomalies and pulmonary artery stenosis, or in whom DiGeorge anomaly is suspected, unless there is a significant history consistent with severe T-lymphocyte-associated immunodeficiency.

Who should you inform if your patient requires irradiated blood components?

To prevent errors and/or delays in transfusion, if you diagnose or recognise a patient is at risk of TA-GvHD, please inform:

- the hospital transfusion laboratory
- any other hospital that might share the care of the patient (using shared care forms)
- nursing staff
- most importantly, the patient themselves of their need for irradiated blood components.

A patient information leaflet, 'Information for patients needing irradiated blood,' which includes an alert card for patients is available free of charge via https://hospital.nhsbtleaflets.co.uk and can be used in conjunction with this factsheet to inform the patient.

The need for irradiated blood components should also be clearly documented in the patient's notes during the authorisation processes and be part of the bed side administration checks.

Are there any other specific requirements for irradiated blood components?

- Red cells used in intrauterine, or exchange transfusion must be less than five days old when irradiated and transfused within 24 hours of irradiation to ensure optimal red cell function and minimise the risk from free potassium
- Red cells for other patient groups need to be less than 14 days old when irradiated and will expire 14 days after irradiation
- Where a patient is at risk from hyperkalaemia, red cells should be transfused within 24 hours of irradiation (or specialist washed cells can be provided) as irradiating units significantly raises the potassium level.
- Washed red cells that are irradiated will expire at 23:59 hrs on the day following irradiation and will have a maximum shelf-life of 48 hours

- Platelets can be irradiated at any stage and stored up to their normal shelf life
- Granulocytes should be irradiated as soon as possible after production and used with minimum delay.

References

Foukaneli, D. et al. on behalf of the British Society for Haematology. (2020), Guidelines on the use of irradiated blood components. Available at: https://b-s-h.org.uk/guidelines/guidelines/guidelines-on-the-use-of-irradiated-blood-components/

New, H.V. et al. on behalf of the British Committee for Standards in Haematology. (2016), Guidelines on transfusion for fetuses, neonates and older children. Available at: https://b-s-h.org.uk/guidelines/guidelines/transfusion-for-fetuses-neonates-and-older-children/