

# Improving the Immune Response with Intraoperative Cell Salvage

Dr Michelle Roets

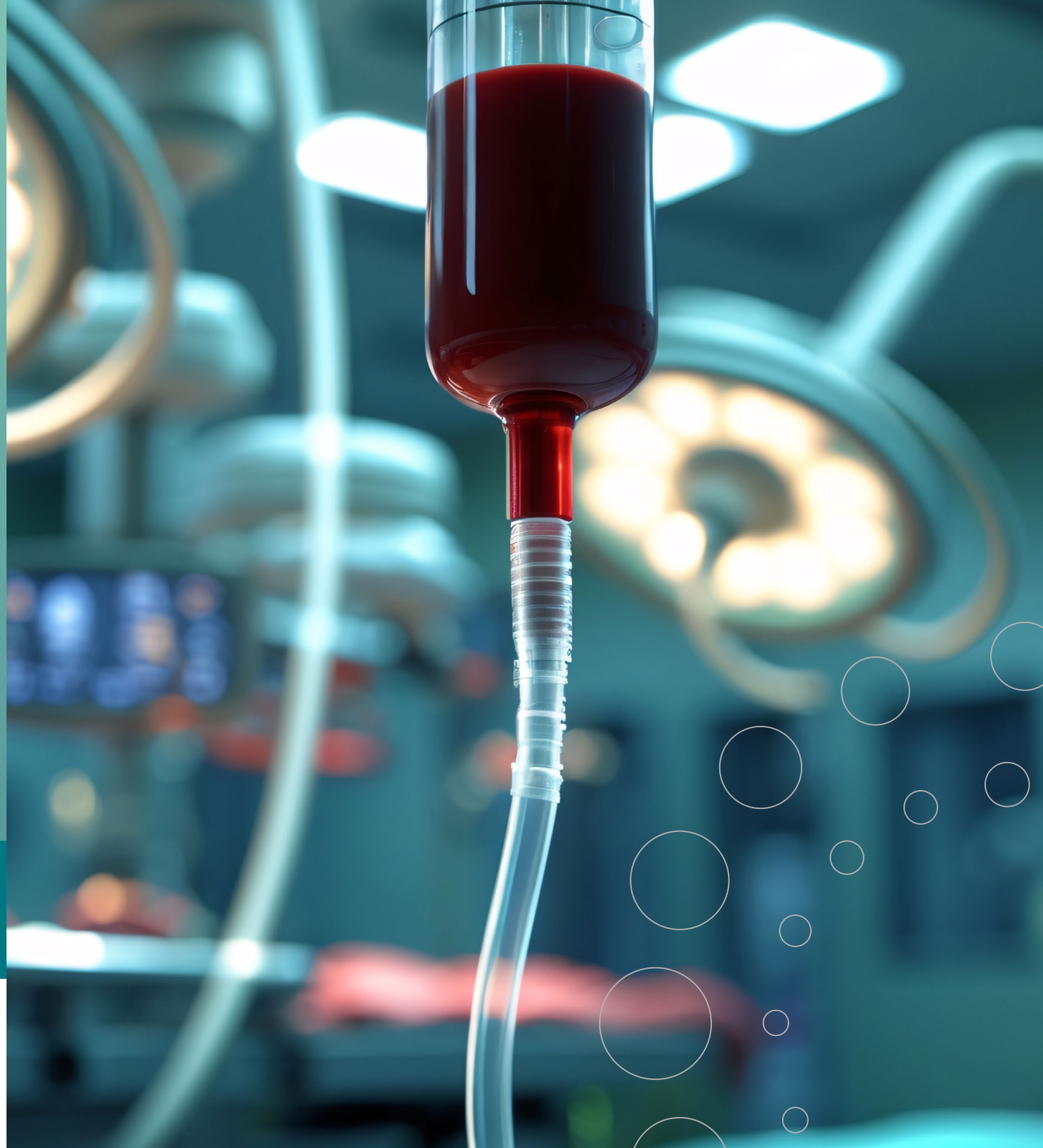
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Undergoing surgery comes with many risks. Numerous factors can influence the outcome, from the choice of anaesthesia to the type of operation. Long and complex procedures can require blood transfusions, which introduce yet another risk factor to the mix. Dr Michelle Roets from the Royal Brisbane and Women's Hospital in Queensland seeks to help mitigate these risks through intraoperative cell salvage, a different type of blood transfusion which could revolutionise surgical outcomes.

## Life-Giving Blood

Surgical procedures all have associated risk factors which can influence patient outcomes. If a patient bleeds significantly during an operation, they may require a blood transfusion to replace the lost blood. Blood consists of a complex mixture of specialist cells, from red blood cells tasked with carrying vital oxygen around the body to white blood cells, which form part of the immune system. There are many different types of white blood cells, each with a specific role in the immune response. During and after surgery, the immune system is stimulated or suppressed, and changes in certain types of white blood cells occur.

Dr Michelle Roets works at the Royal Brisbane and Women's Hospital, and is an Associate Professor in the Faculty of Medicine at the University of Queensland. She explains that the immune response during and after surgery is very complex, adding that an impaired response can result in patients being more likely to experience adverse events like post-operative wound infections and pneumonia. One of the factors which can impact the actions of the immune system is a patient receiving a blood transfusion during surgery.

## Intraoperative Cell Salvage

Clinicians can select different blood transfusion techniques. Most will be familiar with allogeneic blood transfusion (ABT) where blood is provided by a donor, which is then given to the patient in need. ABT is an essential part of peri-operative care – the period of time just before, during, and after the surgery – and more than 118.5 million blood donations are collected around the globe each year.

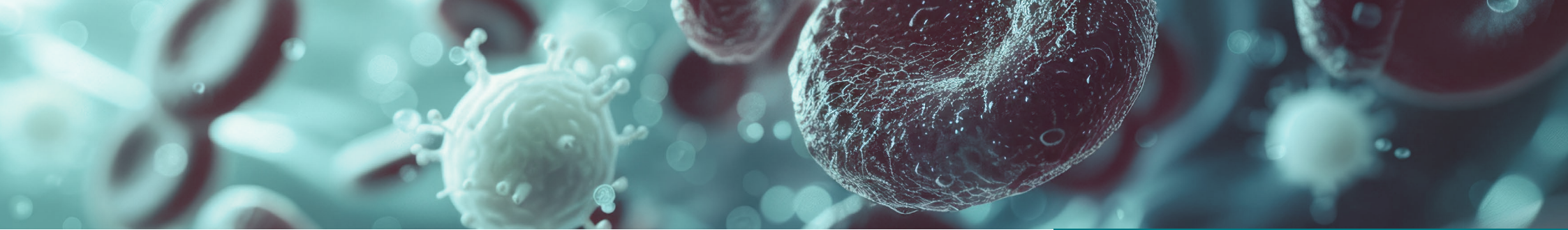
However, ABT is not without risk, and despite significant improvement in blood safety, there is still the possibility of incorrect blood components being transfused, lung complications, febrile reactions, and infection-related problems.

Dr Roets is an expert in the process of intraoperative cell salvage (ICS). This is another blood transfusion technique where, rather than using a blood donor, the patient's own blood is collected, processed, and reinfused during an operation using specialist equipment. In this autologous blood transfusion, the blood lost during the operation is cleaned from contaminants, debris and clots by the cell salvage equipment, and the red blood cells are then returned to the patient.

ICS is recommended for specific procedures and has been shown to reduce the need for ABT. A further advantage is that it seems to provide immunological benefits as well as result in improved patient outcomes. Transfusion-related immune modulation (TRIM) is a term used to describe adverse outcomes in patients after ABT. This is commonly known to occur, but why it happens and how to confirm the specific changes in the immune system when it happens, is largely a mystery.

## Limited Understanding of the Immune Changes

Many transfusion-related adverse outcomes after surgery are linked to the immune response and TRIM. Post-operative infections are a potential consequence of TRIM, with some patients developing this complication which can lead to sepsis, a leading cause of death in intensive care patients.



We have only a limited understanding of the changes that occur within the immune system, the mechanisms of suppression during transfusion and the exact risks of developing infections over the peri-operative period. The immune system has many different methods of defence against pathogens. Some white blood cells engulf pathogens, destroying them; others produce antibodies which attach to pathogens, highlighting them for destruction. Some types of white blood cells retain a memory of pathogens they find, allowing for a swift immune response if it is ever encountered again. Dr Roets and her team sought to understand the changes in the immune cell numbers and functions associated with traditional ABT and ICS.

### The TRIMICS Cell Study

Dr Roets and her colleagues conducted a 'transfusion related immune modulation and intraoperative cell salvage cell numbers' (TRIMICS) study. The team analysed the peri-operative changes in the numbers and proportions of different immune cell populations, white blood cells such as monocytes, T cells, and neutrophils. They had three study groups: patients who received no transfusion, patients who received only ICS, and patients who received both ICS and red blood cells (pRBC/ABT), all during major orthopaedic surgery.

Significant changes in immune cell populations occurred immediately after surgery and at 48 hours post-surgery. Specifically, neutrophils increased and lymphocytes reduced post-operatively, and both returned to their pre-operative levels by 48 hours post-surgery. When the before- and after-surgery samples of the three different transfusion groups were compared, changes were not significant for the patients who did not have a transfusion.

However, significant changes were found in the numbers of leucocytes, neutrophils and lymphocytes in both transfusion groups (i.e., ICS alone and ICS plus pRBC). The numbers and functions of one type of immune cell – dendritic cells (DC) – changed in a different way following ICS compared to ICS plus pRBC, and a sub-type (called pDC) were relatively well preserved post-operatively after ICS.

### The Future of Transfusion Research

The data collection in Dr Roets's study included methods never used before in TRIM research, accounting for how their findings showed some significant changes in immune cell subpopulations and functional characteristics in patients receiving ICS. As such, potential future avenues of investigation have now been opened. The post-operative increase in monocyte numbers in the ICS plus pRBC groups, and changes in subpopulations of dendritic cells, whilst considering post-operative adverse outcomes, should be explored further.

Further investigation of changes in immune cell subpopulations during the peri-operative period in association with different blood transfusion techniques may provide valuable insights into the evaluation and prediction of infection-related adverse events. Being armed with more information about the links between the immune system, transfusions, and outcomes, could help clinicians to minimise risks and optimise the care of patients undergoing complex surgery.



Article written by Luisa Postlethwaite, MPharm.



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## MEET THE RESEARCHER



### Dr Michelle Roets

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Dr Michelle Roets obtained her Bachelor of Medicine and Surgery from the University of Pretoria in South Africa, and her Master's degree in Clinical Research Administration from Walden University in the USA. In 2024, she completed her PhD at the University of Queensland in Australia. She is currently a consultant anaesthetist at the Royal Brisbane and Women's Hospital, and an intraoperative cell salvage (ICS) and equipment expert within the Metro North Hospital and Health Services. She is also the co-author of the National Australian Guidance documents for the Provision of ICS with the National Blood Authority in Australia. Additionally, she holds the position of Associate Professor at the University of Queensland, where she supports research and education for medical students in ICS, blood transfusion, and the development and implementation of equipment in anaesthesia. Dr Roets works to provide scientific evidence for and to encourage the development of ICS to protect national and international blood product supplies, as well as to reduce adverse patient outcomes and related costs.

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#### FURTHER READING

M Roets, D Sturgess, T Tran, *et al.*, Intraoperative cell salvage: The impact on immune cell numbers. *PLoS ONE*, 2023, 18(8), e0289177. DOI: <https://doi.org/10.1371/journal.pone.0289177>



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