# Universal Blood Donations

Richard Béliveau

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*Canadian researchers have identified enzymes from bacteria that are able to convert group A blood into group O (universal donor), which could greatly increase the availability of blood necessary for transfusion to patients.*

## BLOOD GROUPS

Many diseases (hemophilia, leukemias) and medical interventions (operations, accidents, traumas) require one or more blood transfusions.

According to Héma-Québec, every 80 seconds someone must receive blood in Quebec and at least 1000 donors per day are required to respond to this need in hospital centres across the province.

To be transfused, the donor blood must however be compatible with that of the recipient. In humans, there are four major types of blood groups (A, B, O and AB) which differ according to the type of sugar molecules present on the surface of the red blood cells (which we call surface antigens). In group A, this sugar is N-acetylgalactosamine, whereas in group B it is instead galactose (the two sugars are simultaneously present in the AB group). Group O, on the other hand, does not contain one or the other of these sugars. In Quebec, groups O and A are the most common, themselves comprising 88% of all individuals (46% O and 42% A).

These differences have enormous consequences in terms of blood transfusions: if a person of group A receives a blood donation from group B (or vice versa), their immune system will immediately detect the presence of the surface antigen and destroy the newly transfused red blood cells. It is thus necessary to use blood from the same blood group for transfusion to be possible.

One other option is to use type O blood: because this blood group has no surface antigen, it is possible to transfuse it to anyone, whatever their blood group, and it is for this reason that people of type O blood are commonly referred to as “universal donors”. This property of group O is particularly important in emergency situations where medical personnel do not have the time to determine a patient’s blood group, or when the stocks of one blood group’s donations become limited.

## FROM A TO O

Over the past 40 years, much effort has been devoted to discovering the enzymes capable of “cutting” the surface antigens from the red blood cells of groups A and B, converting them to the universal group O and thus increasing the quantity of blood available for transfusion. Up to now, this strategy has not provided conclusive results, either due to a lack of specificity amongst the enzymes or else because the quantities of enzymes required for the transformation are much higher than could be routinely used.

Work performed by a group of researchers at the University of British Columbia in Vancouver could however revolutionize this approach. Because certain bacteria present within the intestines feed on sugars similar to those present on the red blood cells, the authors postulated that these bacteria could be good sources for enzymes capable of cutting these sugars.

By using all of the microbial DNA contained within a sample of human stool, they succeeded in purifying these enzymes and showing that the combination of two of them (an N-acetylgalactosamine deacetylase and a galactosaminidase) produced by the bacterium *Flavonifractor plautii* actually succeeded in cutting the antigen present on the red blood cells of group A. This reaction only needed tiny quantities of the two enzymes (5 micrograms per millilitre), which shows that it should be technically feasible to convert several units of blood. Because group A blood represents about 40% of blood stocks, this conversion to the universal group O indicates that it will be possible to almost double the blood reserves available for transfusions with the aid of this enzymatic reaction.

While it remains to be shown that the reaction succeeded in totally eliminating all of the group A antigens without compromising the integrity of the red blood cells, these results are very promising and allow us to foresee a moderately near future where there is an important increase in the availability of the blood which is indispensable for so many medical interventions.

(1) Rahfeld P et al. An enzymatic pathway in the human gut microbiome that converts A to universal O type blood. Nature Microbiol. 2019; 4: 1475-1485.

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