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# Acoustic citometry allows the diagnosis of pathologies related to red blood cells


The normal shape for a red blood cell is a bi-concave disc. However, a lot of pathologies are generated by a distortion in this shape due to different causes like a defects in the cell membrane skeletal architecture. Acoustic cytometry allows the study of the orientation of non-spherical particles. That is why the Citómica Funcional group in l'Institut de Recerca de Leucèmia Josep Carreras in collaboration with other groups has studied this advantage and has proven its utility to evaluate the different causes of the red blood cells distortions or to evaluate immediately the quality of erythrocytes following blood donation.

The acoustic focus of suspended particles or cells prior to injection is routinely used to achieve higher precision alignment at sample flow rates up to 10-fold greater than with conventional flow cytometers that use hydrodynamic focusing only. The Group of Functional Cytomics at the Josep Carreras Leukaemia Research Institute, in collaboration with Michael D. Ward and Jolene A. Bradford, co-inventors of the acoustic focusing cytometer, has studied the less commonly exploited advantage of acoustic focus on orientation of non-spherical particles, as a tool for analysis of red blood cell health and pathology, that requires no staining reagents.

Distortions of the normal bi-concave disc shape for red blood cells (RBCs) appear in a number of pathologies resulting from defects in cell membrane skeletal architecture, erythrocyte ageing, and mechanical damage. They have presented the potential of acoustic cytometry for developing new approaches to light-scattering based evaluation of RBC disorders and of the effects of storage and ageing on changes or damage to RBC membranes. These approaches could be used to immediately evaluate the quality of erythrocytes prior to blood donation and following transfusion. They could also be applied to studying RBC health in diseases and other pathologies, such as artificial heart valve hemolysis, thermal damage or osmotic fragility. Abnormal distributions of erythrocytes can typically be detected after just 30 to 45 seconds of acquisition time using 1–2 μL starting blood volumes.

This method was applied to study RBCs and learn more about the specific scatter patterns of RBCs using the acoustic flow cytometer. They observed consistent and reproducible forward scatter vs. side scatter dot plots displaying the RBCs in unusual arch-shaped patterns (Fig. 1). Thinking that these patterns could be related to shape, volume and hemoglobin content, the authors hypothesized that differences in these RBC distributions could be promising indicators of pathognomonic signs characteristic of different red blood cell disorders.

The authors also studied RBC disease with defects in cell membrane skeletal architecture and remodeling of the cell membrane as a consequence of erythrocyte ageing, which can result in alterations of cell deformability, elasticity or viscosity. Currently available methods to study such parameters on RBCs include rotational viscometers and ektacytometers. However, these techniques do not take into consideration the heterogeneity or size differences within the sample population of erythrocytes.

This work shows the potential of acoustic flow cytometers for developing new approaches using light-scattering to evaluate the effects of storage and ageing on changes or damage to RBCs membranes, or to immediately evaluate the quality of erythrocytes following blood donation. Such approaches may also be useful in other research areas, including the study of heart valve hemolysis as a consequence of mechanical trauma in patients with artificial valves.

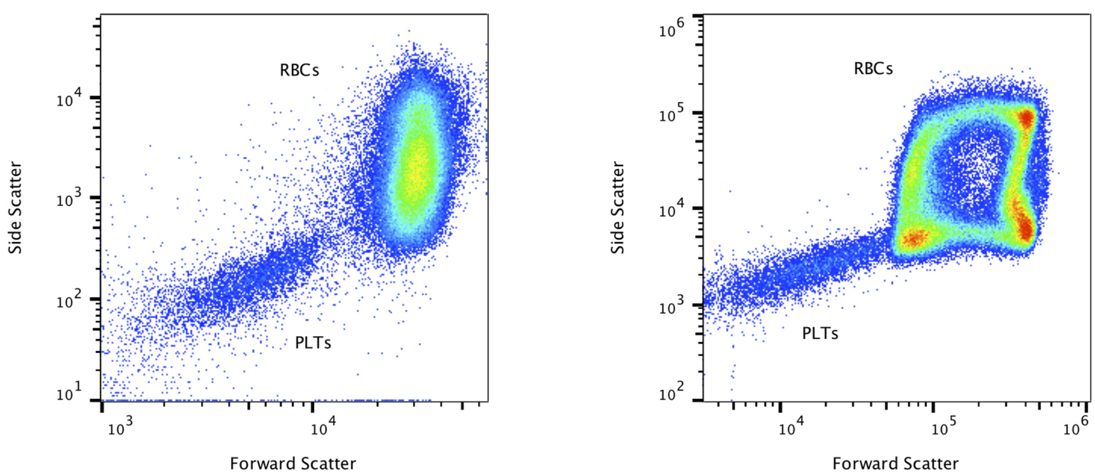


*Figure 1. Comparative data for a conventional hydrodynamic focused cytometer and the acoustic focusing using normal blood. Representative distribution of blood cells showing a vast majority of red blood cells (RBCs) and platelets (PTLs) obtained with hydrodynamic (left) and acoustic focusing (right). Populations are much better defined with the characteristic arch shape shown, when acoustic focusing is used (right). This suggests a deterministic acoustic orientation effect.*

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## References

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