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Automated patch-clamp recordings of ion channels in human erythrocytes

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Erythrocytes (Red Blood Cells, RBCs) are commonly used in the study of membrane transport. Despite the recent advances in the knowledge of pumps and specific solute transporters, the physiology of these cells and their maintenance of homeostasis are still poorly understood. Among the different techniques used to investigate cell membrane transport, the patch clamp technique has proven to be a very useful tool to characterize and better understand ion channels in both physiological and pathophysiological situations (Bouyer et al., 2012). Nevertheless, the small size (2.1-9.4 µM for mammals) and the high membrane deformability of RBCs as well as the large heterogeneity of native RBC conductance represents a hurdle when attempting to perform manual patch clamp technique on these cells (Bouyer et al., 2012; Minetti et al., 2013).

In the present study we utilized the automated patch clamp (APC) technology as a powerful method to characterize ion channels in human erythrocytes. This approach requires minimal manual dexterity and allows probing an increased number of cells (up to 48 cells in a run with Nanion's Patchliner) under the same conditions and experimental procedure (Farre et al., 2007). Thus, it permits testing for the heterogeneity among RBCs of a donor as well as the variability between different donors.

We show results from electrophysiological recordings on RBCs carried out using two Nanion devices (Port-a-patch and Patchliner) in comparison with manual patch clamp technology. Both Nanions' platforms generated high-quality data in good agreement with those determined here with conventional patch clamp and those reported in the literature from previous studies.

A big advantage of the APC technology is its scalability in terms of throughput. An established assay on RBCs would be also transferable to Nanion's high-throughput platform SyncroPatch 384PE. It will allow recordings from up to 786 cells in one run and might overcome the problem of variability among RBCs and permit a more detailed characterization of their electrophysiological properties in the future.

References

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