Extramitochondrial energy production in platelets.

Ravera S[1], Signorello MG[1], Bartolucci M[1], Ferrando S[2], Manni L[3], Caicci F[3], Calzia D[1], Panfoli I[1], Morelli A[1], Leoncini G[1].

https://www.ncbi.nlm.nih.gov/pubmed/29537672

Abstract

BACKGROUND INFORMATION:

Energy demand in human platelets is very high, to carry out their functions. As for most human cells, the aerobic metabolism represents the primary energy source in platelets, even though mitochondria are negligibly represented. Following the hypothesis that other structures could be involved in chemical energy production, in this work, we have investigated the functional expression of an extramitochondrial aerobic metabolism in platelets.

RESULTS:

Oximetric and luminometric analyses showed that platelets consume large amounts of oxygen and produce ATP in the presence of common respiring substrates, such as pyruvate + malate or succinate, although morphological electron microscopy analysis showed that these contain few mitochondria. However, evaluation of the anaerobic glycolytic metabolism showed that only 13% of consumed glucose was converted to lactate. Interestingly, the highest OXPHOS activity was observed in the presence of NADH, not a readily permeant respiring substrate for mitochondria. Also, oxygen consumption and ATP synthesis fuelled by NADH were not affected by atractyloside, an inhibitor of the adenine nucleotide translocase, suggesting that these processes may not be ascribed to mitochondria. Functional data were confirmed by immunofluorescence microscopy and Western blot analyses, showing a consistent expression of the β subunit of F_1 F_o -ATP synthase and COXII, a subunit of Complex IV, but a low signal of translocase of the inner mitochondrial membrane (a protein not involved in OXPHOS metabolism). Interestingly, the NADH-stimulated oxygen consumption and ATP synthesis increased in the presence of the physiological platelets agonists, thrombin or collagen.

CONCLUSIONS:

Data suggest that in platelets, aerobic energy production is mainly driven by an extramitochondrial OXPHOS machinery, originated inside the megakaryocyte, and that this metabolism plays a pivotal role in platelet activation.

SIGNIFICANCE:

This work represents a further example of the existence of an extramitochondrial aerobic metabolism, which can contribute to the cellular energy balance.