



## **Biocompatibility of dialysis membranes**

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### **INTRODUCTION**

The interaction between biological tissues and artificial materials is becoming increasingly important in the field of biomedicine. Synthetic grafts are implanted in the body and different cells will be exposed to these foreign materials. The interactions between such synthetic vascular grafts and blood components (granulocytes and platelets) have successfully been investigated by using microcalorimetry [ 1 ]. Another biocompatibility problem exists for hemodialysis membranes and blood. This application note deals with the microcalorimetric evaluation of the interactions between human granulocytes and different materials used for dialysis reported in detail by Monti, Ljunggren and co-workers [2]. Granulocytes are characterised by a low basal metabolism and a large metabolic burst when exposed to foreign particles. The basal metabolism as well as the metabolism associated with phagocytosis was measured for granulocytes in contact with different materials. As shown here, the efficacy of different materials for use with living cells is easily monitored by using TAM.

### **EXPERIMENTAL**

Granulocytes derived from healthy donors were used in all the experiments. For calorimetry, ordinary 4 ml stainless steel ampoules were used. Each ampoule was first lined with the desired membrane and then loaded with  $10^6$  cells suspended in 0.1 ml of plasma. The sample ampoule together with the reference (water) were lowered to the measuring position of the TAM set at 37 °C and the heat flow was recorded. In order to measure the metabolism associated with phagocytosis, zymosan particles at a final concentration of 0.1 mg/ $\mu$ l were added after the cells had been monitored for 2 hours in the calorimeter. The membrane materials tested were polyacrylonitrile (AN), polyetherpolycarbonate (PC) and regenerated cellulose (Cu). Fluorinated ethylene propylene, (FEP), served as the reference material.

### **RESULTS**

The results from the measurements on granulocytes in contact with regenerated cellulose Cu and the reference substance FEP are shown in Fig. 1. The first part of the figure shows the difference in basal metabolism and the second part shows the difference in metabolism upon addition of zymosan particles. The basal metabolism of the cells in contact

with Cu exhibits a burst in contrast to the cells in contact with the reference material FEP which have a low basal metabolism without any initial burst. The heat burst (second part) associated with phagocytosis is, however, much larger for the cells in contact with FEP compared to those in contact with Cu. The explanation for this is simple; granulocytes should give as large heat burst as possible when particles, here zymosan, are present, whereas the basal metabolism in absence of stimulus should be low and without any burst. The compatibility between granulocytes and the different materials as judged from the heat flow values determined after 2 hours in the calorimeter is shown in Table 1. From these data, it is clear that the biocompatibility is on the order AN > PC > Cu.

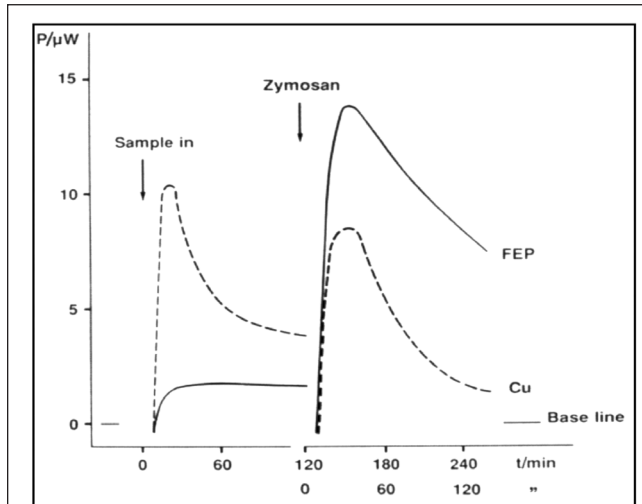


Figure 1. Results from measurements on granulocytes in contact with two polymers, regenerated cellulose (Cu) and fluorinated ethylene propylene (FEP). The first part of the graph shows the basal metabolism, whereas the second part shows the activation (phagocytosis) upon addition of zymosan particles. From Ikomi-Kumm et al. [2].

## CONCLUSIONS

Granulocytes are characterized by a low basal metabolism and a large metabolic burst when exposed to foreign particles. By using TAM, it is clear that granulocytes exhibit this behaviour when they are in contact with an inert reference material (FEP). When other materials were used, the basal metabolism increased and the metabolic burst associated with phagocytosis of foreign particles decreased. In addition, the results described here could be used to differentiate between different membrane materials with respect to biocompatibility.

FEP	AN	PC	Cu
1.47	3.15	5.48	8.87

**Table 1.** Basal metabolism for granulocytes in contact with AN, PC and Cu expressed in pW/cell. FEP serves as the reference having optimal biocompatibility. A low value corresponds to good biocompatibility. Adapted from Ikomi-Kumm et al. [2].

## REFERENCES

1. Parsson, H., Nassberger, L., Thorne, J., and Norgren, L. J. Biomed. Mater. Res. 21, (1995) 379-397.
2. Ikomi-Kumm, J., Ljunggren, L., Lund, U., Monti, M., and Thy sell, H. Blood Purif. 9, (1991) 177-181.