ORTHOPEDIC ELECTRODES: METAL AND POLARITY EVALUATION IN SHORT TERM MARROW CELL CULTURE

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One aspect of orthopedic research has concerned itself with the study of metallic implants with regard to the effect of their corrosion products on tissue. Various metals have also been used in conjunction with current as electrodes for both bone stimulation and bicrobial inhibition (1,2). It is fundamental to localized current application in vivo to determine the response of nearby cells to the conducting electrode. We therefore examined the effect of direct current electrodes on the viability and morphological profile of bone marrow cells in short term culture. Such an approach should be beneficial in evaluating which metals and polarity to use as surface and implantable materials.

Femurs and tibiae of mature Swiss mice were aspirated and diluted in Dulbecco's culture medium (Flow 1-088D) with 20% fetal calf serum. The suspended cells were incubated at 37°C in special Plexiglas chambers for electrical stimulation (1). The cathode and anode chambers for each metal were separated by an agar-cotton bridge. Pairs of gold, graphite, platinum, silver, stainless steel and titanium electrodes were studied with 0.5, 1, 5, 10 and 20 microamperes constant current for four hours. After exposure, the cells were tested for viability by the Trypan blue exclusion method and stained with Wright-Giemsa for morphology. Differential counts were made of the major cell groups as well as lysed cells in treated cultures and controls without electrodes.

Fig. 1 shows a general view of results in terms of averages over all applied currents. The data show both cell and electrode specific effects with selective lysis occurring. Normal lysis, for example, was about 7% for all preparations, but increased to 34% in the stainless steel cathode chamber. In general, lymphocytes and neutrophils were decreased, eosinophils increased and normoblasts varied with respect to controls.

An index of reactivity (Table 1) was assigned to each electrode based on the above results. At the anode, the most reactive metals were silver, stainless steel and platinum. At the cathode, the most reactive were platinum, gold and titanium.

TABLE I : ELECTRODE REACTIVITY

	Ag	SS.	Pt	Gr.	Au	Ti
ANODE	3	2	2	1	0	1
CATHODE	0	1	3	1	3	3

- The number of cell types for which the measured population fell outside the normal range (ie. ±1 standard deviation).

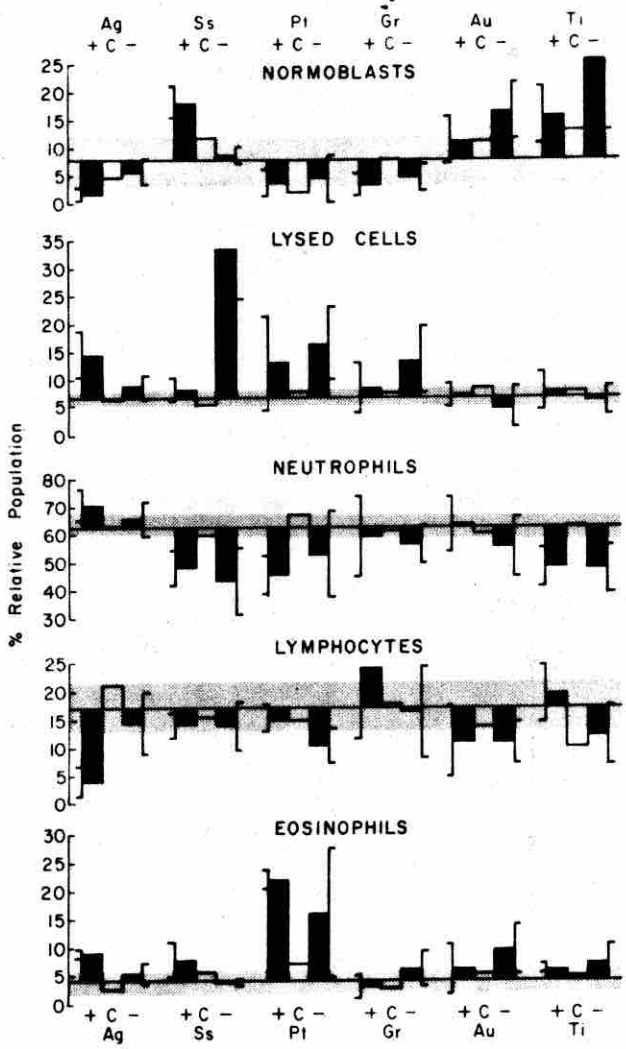

Figure 1. PERCENT RELATIVE POPULATION CHANGE IN MOUSE BONE MARROW CELLS AFTER 4 HOURS OF ELECTRICAL STIMULATION. The cell population at each electrode is the average over 5 current levels (0.5 - 20 μA, DC) relative to the average control (horizontal black line). Shaded area = 1 std. dev. for controls. Clear boxes = individual control for each electrode type. Brackets = 1 std. dev. for 5 measurements for each cell and electrode type.

1. J.A. Spadaro, et al, Antimicrob. Ag. and Chemother. 6, 637 (1974).
2. T.J. Berger, et al, Antimicrob. Ag. and Chemother. 9, 357 (1976).

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