Effect of electrolyte disturbance on the cell kinetics and chromosomal structure

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The present study was concerned with testing theeffect of hypercalcaemia on the cell kinetics andchromosomal structure. The blood leukocytes - grownin vitro - were utilized as an experimental model inthis respect. The blood samples were obtained fromtwo groups of donors, namely; a male group comprising8 donors and a female group comprising 7 ones. Theleukocytes were separated and the initial cell densitywas adjusted to fit 200 x 103 lymphocytes per millilitreof culture medium utilizing the cetrimidepronasetechnique. The lymphocytes were enhanced toundergo proliferation either by the plant lectinphytohaemagglutinin (PHA) or by mixing the bloods oftwo separate donors (histocompatibility antigenicactivation). The calcium ion level was adjusted tofit the ascending tested concentrations throughtitrating the tested solution against 1/50 N EDTAbufferedsolution and the end point was the change ofcolour from purple to blue.In experiment I, the leukocyte suspension of eachdonor was divided -into 21 aliquots, one representing acontrol standard culture and five experimentalquadruplets. The calcium ion level was adjusted to 50j.lg/ml. in the control culture and to 70, 90, 110, 130and 150)lg/ml. in the first, second, third, fourth andfifth quadruplets respectively. Four experimentalmodels were employed in each group of quadrupletsdepending on the time of advent of calcium ion intothe culture, namely; simultaneous addition of calciumion and the mitogen (model A) and five minu tes, onehour and six hours after the addition of the mitogen(models B, C and D respectively). In experiment II ,five culture series were prepared from 10 donors andthe same models were utilized according to the timelapse between blood mixing and the adjustment ofartificial hypercalcaemia.The index of the proliferative response was estimatedby the cell density of the cultures; quantitated at24, 48, 72 and 96 hours from the inoculation time(Time 0). After 96 hours of incubation, the smearswere prepared from each culture tube and were used toestimate the transformation score as well as thechromosomal structure. In chromosomal study, 10slides were chosen at random - for each culture tube -and 50 metaphases (Exper iment I) or 100 metaphases(Experiment II) were examined under the oil-immersionobjective, photographed and karyotyped according tothe standard human chromosome nomenclature.The results of the present investigation revealed thefollowing:-1- In control cultures, the proliferative response wassignificantly higher in the female donors than inthe male ones.2- Elevation of the calcium ion concentration to 70)-lg/ml. (equivalent to 14 mg% in the blood) resultedin an increased response in

the male cultureswhereas the female proliferative response wassuppressed.The suppressive effect of the 90concentration (equivalent to blood level ofwas more evidenced in the female cultures)-Ig/ml.18 mg%)than inthose of the male group.4- Higher calcium ion concentrations (110 and 130)-Ig/m~.) which are equivalent to blood levels of 22and 26 mg% were irreversibly toxic to the cells ofboth groups of donors although the latterconcentration was nearly completely lethal to thefemale cultures.5- Still higher calcium ion concentration (150~g/ml.)which is equivalent to a blood level of 30 mg% wascompletely lethal to both groups of cultures asshortly as 24 hours of incubation.6- The maximum yield of abnormal karyotypes wasrecorded with the 90 ~g/ml. concentration in bothgroups of donors in all experimental models. Theprevailing anomalies met with in this concentrationwere tetraploidy and endoreduplication.7- Chromosomal breaks, however, were highly frequentwith higher calcium ion concentrations (110 and 130yg/ml.).In conclusion, the data obtained by the presentinvestigation may provide an evidence that the femaleimmunocompetent cells are more susceptible to thedrastic effect of high calcium ion concentrations. Inaddition, chromosomal abnormalities are much moreexpected in the females when subjected tohypercalcaemia. As an inhibitor of allergicreactions, the ionic calcium is preferably used duringthe triggering event of the immunocompetent cells; arecommendation which is pract ically impossible. Inaddition, the level at which this ion actsmeaningfully (18 mg%), is not advised to achieve dueto its mutagenic effect on the concerned cells.