

**THE EFFECT OF SPACE FLIGHTS ON LIVING HUMAN CELLS
ABOARD DISCOVERER XVIII**

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The purpose of this study is to attempt to determine the effect of space flight on a suspension of living human cells in sealed glass ampuls. In a previous flight, on Discoverer XVII,¹ cultures were prepared using Rose chambers. The weight of the chambers greatly limited the payload that could be sent aloft and also limited the volume of nutriment as well as the possible longevity of the cells. In this flight, information was sought on the survival of the cells, possible changes in their morphology, rate of growth, and any other characteristic differences that could possibly evolve as a result of the stresses encountered during flight.

MATERIALS AND METHODS

Defects of methodology encountered in the Discoverer XVII flight¹ were corrected for the Discoverer XVIII flight. A smaller population of 50,000 cells was suspended in 3 cc. medium and sealed in glass ampuls which also contained a small glass coverslip (fig. 1).

Seven human cell lines were employed. Five of these were normal, definitive representatives of the three embryonic germ layers, and two were of neoplastic origin.

Human cell lines

Ectodermal:

- Amnion
- Conjunctiva
- Sternal marrow
- Synovia

Mesodermal (neoplastic cell lines):

- Monocytic leukemia
- Hela

Entodermal:

- Embryonic lung

¹Katzberg, A. A. Biologic experiments with space probes: The effect of space flights on living human cells aboard Discoverer XVII. (Unpublished material)

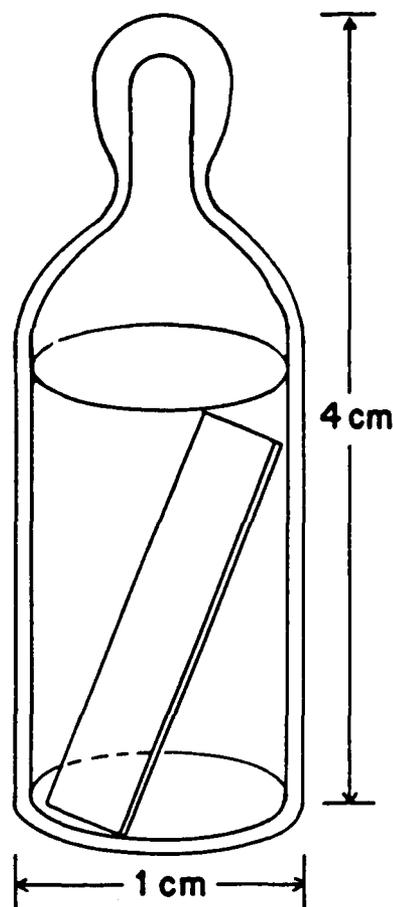


FIGURE 1

Ampul for cells.

OBSERVATIONS

All cultures were returned in good condition on the twelfth day after preparation. Preliminary observations indicated a high level of viability.

No latent lag period was noted in this series of human cells on subculturing. The smaller

initial population, the larger volume of medium, and the shorter interval that lapsed before their return were the principal factors contributing to this good survival and immediate resumption of growth.

The following figures show the appearance of the various cells immediately after their return to the laboratory.

Conjunctiva:
Control (fig. 2)
Flight (fig. 3)

Sternal marrow:
Control (fig. 4)
Flight (fig. 5)

Synovial cells:
Control (fig. 6)
Flight (fig. 7)

The observed effects such as giant-cell formation were well below the minimum observed with alpha bombardment at 435 or 910 Mev or with protons at 730 Mev.



FIGURE 3

Flight conjunctival cells 12 days after preparation. Note the formation of epithelial sheets.



FIGURE 2

Control conjunctival cells 12 days after preparation. Note the formation of epithelial sheets.



FIGURE 4

Control sternal marrow cells 12 days after preparation. Note the numerous bipolar mesenchymal cells.



FIGURE 5

Flight sternal marrow cells 12 days after preparation. Note the numerous bipolar mesenchymal cells.



FIGURE 7

Flight synovial cells 12 days after preparation. Note granular cytoplasm of these ameboid cells.

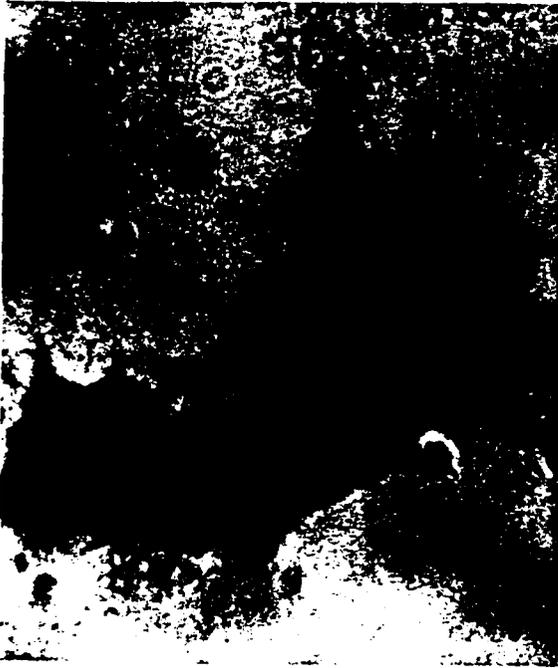


FIGURE 6

Control synovial cells 12 days after preparation. Note granular cytoplasm of these ameboid cells.

DISCUSSION

The smaller cell population and the larger volume of medium may be considered to be important factors in maintaining the cells in a viable state for an extended period of time away from the laboratory and in an environment which lacks optimum conditions for survival and growth. Also, most of the cells remained in a suspended condition and this may have allowed greater exchange of metabolites between the cytoplasm and the medium which would account for greater survival of the cells.

Comparison of flight and ground-control cultures showed no evidence of morphologic alterations. Conjunctival cells shown in figures 2 and 3 of flight and ground-control cultures reveal that the epithelial nature of the cells was not altered. Similarly, figures 4 and 5 of sternal marrow show no morphologic differences. There is a tendency toward the formation of isolated mesenchymal-type cells predominantly fusiform in shape. Lastly, figures 6 and 7 show synovial cells; both flight

and control cultures exhibit a granular cytoplasm and an ameboid outline.

All this evidence accumulated up to this point indicates that living human cells, maintained in a suspension of tissue-culture methods, can tolerate orbital flights such as was made by Discoverer XVIII for the period of time involved and survive the stresses to which they were exposed during this flight.

Additional studies are under way in the preparation of ideograms from chromosome spreads to determine the existence of mutations as revealed by the possible presence of chromosomal aberrations.

SUMMARY

Human cells, maintained by tissue-culture methods in a suspension, display a higher survival rate than cells attached to coverslips in a Rose chamber.

No gross morphologic changes have been noted which could be attributed to stresses encountered in space flight. Growth patterns of control as well as flight cultures were alike.

Additional studies using ideograms need to be made to obtain data on the possible existence of chromosomal aberrations and the implications that mutations have or have not been produced.