NOT A DRY EYE IN SPACE – THE MANAGEMENT OF DRY EYES IN MICROGRAVITY ENVIRONMENTS: A LITERATURE REVIEW

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INTRODUCTION

Dry eye disease (DED) causes gritty, painful eyes. It significantly affects quality of life, reduces high-stress performance and increases ophthalmic infection risk of keratitis (1-3). Spaceflight initiates macroscopic ophthalmic changes, which, with lunar dust and radiation, cause DED in 1-44% of astronauts (4-5). Treatments are limited by multifactorial microgravity constraints (6). Trehalose eye drops (TED) and intranasal neurostimulation (IN) are used. TED maintains tear homeostasis and prevents evaporation (7). IN utilises trigeminal nerve stimulation to promote tear formation (8).

This poster aims to review the research combating dry eyes in astronauts and compare treatment feasibility, cost and practicality.

METHODOLOGY

Literature search was conducted across PubMed and Embase utilising search terms involving “dry eye” and “microgravity”. Two multi-study reviews were compared, evaluating TED and IN by Schirmer I tests, quantifying tear volume production (9). Cost per mission was analysed.

RESULTS

TED treatment showed a mean increase in tears of 2.8mm/5 min. IN showed an increase in tear production of 19.8mm/5 min, a 607% increase between treatments as seen in Figure 1 (7-8).

For an average crew of 7 utilising TED 4 times daily and discarding contaminated bottles for a 3-year Mars mission costs £192,851.40 (6,10-14). IN costs £564.72, with monthly disposables costing £188.24 per person, costing £47,436.19 overall (15). A 75.4% cost decrease is seen using IN.

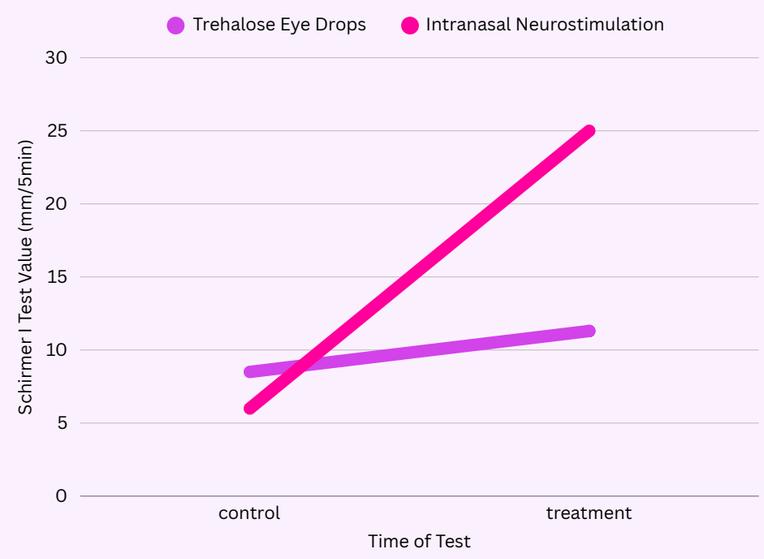

FIGURE 1: MEAN SCHIRMER I TEST VALUES ACROSS STUDIES FOR BOTH TREATMENT METHODS (6-7).

DISCUSSION

Gravity is required for TED mechanism of delivery or orbital contact in microgravity, risking contamination (16). One study reports 120g of monthly plastic waste utilising single-use eye drops, not mitigated by IN due to the required disposables. Studies are required to evaluate this (10,17). TED shelf-life is 3 months. IN has a battery life of 48 hours before requiring charging at 120-240V, promoting further energy use considerations (14,18).

Overall, IN seems most feasible for microgravity. Further research is required within microgravity environments and to review environmental impact.

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