Are Medications Involved in Vision and Intracranial Pressure Changes Seen in Spaceflight?

V. E. Wotring, Ph.D.

NASA Johnson Space Center

Division of Space Life Science, Universities Space Research Association, Houston TX

INTRODUCTION

Some crewmembers have experienced changes in their vision after long-duration spaceflight on the ISS. These impairments include visual performance decrements, development of cotton-wool spots or choroidal folds, optic-disc edema, optic nerve sheath distention, and/or posterior globe flattening with varying degrees of severity and permanence. These changes are now used to define the visual impairment/intracranial pressure (VIIP) syndrome. It is known that many medications can have side effects that are similar to VIIP symptoms. Some medications raise blood pressure, which can affect intracranial pressure. Many medications that act in the central nervous system can affect intracranial pressures and/or vision. About 40% of the medications in the ISS kit are known to cause side effects involving changes in blood pressure, intracranial pressure and/or vision. For this reason, we have begun an investigation of the potential relationship between ISS medications and their risk of causing or exacerbating VIIP-like symptoms.

METHODS

The medical literature indicates that pain relievers, especially non-steroidal anti-inflammatory (NSAID) medication (like ibuprofen) and glucocorticoids (like dexamethasone) were among the most likely candidate medications, and have the focus of initial queries for this study. Two different data sources were examined.

Data from the general population: The Food and Drug Administration (FDA) maintains a system for collecting suspected medication adverse events in their Adverse Event Reporting System (AER). Patients and medical professionals may enter data regarding suspected events and these unconfirmed raw data are available for public download. In this study, we downloaded 3 years of data representing over 1 million suspected medication-related adverse events from January 2009 – December 2011. To better model the astronaut corps, cases involving individuals younger than 25 or older than 65 were removed from our analysis. Similarly, cases involving cancer, multiple sclerosis or other serious and chronic conditions were removed. Medications used in cases associated with VIIP-like symptoms were examined.

PRELIMINARY RESULTS

Figure 1. Occurrence of VIIP-like Symptoms With Suspected Link to Medication Use in the General Population

A. Ibuprofen

B. Hydrocortisone

C. Dexamethasone

Figure 2. Occurrence of VIIP-like Symptoms With Suspected Link to Prednisone Use Among Different Age Groups in the General Population

Table 1. Total occurrences of VIIP-like symptoms associated with use of each listed medication in the general population from 2009 - 2012. Data are from the FDA AERs and thus, indicate occurrence of symptoms correlated with use of each medication; causality has not been confirmed. Furthermore, these data do not permit an estimate of occurrence rate, because there is no measure of total medication use or medication use without adverse events.

<table>
<thead>
<tr>
<th>Medication</th>
<th># AE Reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ibuprofen</td>
<td>137</td>
</tr>
<tr>
<td>Aspirin</td>
<td>180</td>
</tr>
<tr>
<td>Acetaminophen</td>
<td>110</td>
</tr>
<tr>
<td>Hydrocortisone</td>
<td>6</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>39</td>
</tr>
<tr>
<td>Prednisone</td>
<td>192</td>
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<tr>
<td>Pseudoephedrine</td>
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<td>Promethazine</td>
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<tr>
<td>Benadryl</td>
<td>31</td>
</tr>
<tr>
<td>Desferoxime</td>
<td>4</td>
</tr>
</tbody>
</table>

Figure 3. VIIP-like Symptom Reports Are Reported by both Males and Females in their Middle Years

Figure 4. Reports of VIIP-like symptoms are associated with ibuprofen use in the general population. Results show that most females report VIIP-like adverse events more than males, but for females in the 46-55 age group.

REFERENCES


ACKNOWLEDGEMENTS

NSBRI intern Joy C. Eckert developed the Microsoft Access database from FDA AERs and performed initial data analysis. Chris Miller (Wyle) provided software expertise and Kami Faust (Wyle) performed much of the data analysis. The author thanks NASA JSC Lifetime Surveillance of Astronaut Health and Occupational Health Board for access to crew data and the NASA JSC Human Research Program for funding.

Further detailed examination of both data sets (general population and crew data) may permit more substantive correlations as this study progresses.

INTERIM CONCLUSIONS

The preliminary nature of this report must be taken into consideration when interpreting results. Crew cases are limited in number, and medication usage records lack details that would be helpful. For this reason, we are using the FDA AERs as an additional source of data. This is an extremely large data set, and while it includes persons who may not model the astronaut population, the sheer volume of data may highlight trends to examine in the crew data. FDA results are compromised by several factors, chiefly the lack of causal information regarding each report, but issues of incomplete data reporting and polypharmacy also play confounding roles.

However, certain trends may be noted:

- In the general population, use of several medications is associated with VIIP-like symptoms, with changes in visual acuity being the most common.
- In the general population, there may be gender trends with males over 46 years of age more likely to experience or report VIIP-like symptoms associated with prednisone use.
- In the general population, there may be a trend toward increased occurrences of VIIP-like symptoms with ibuprofen use by males from 36-65 years old; reports are higher for females from 26-55. For purposes of comparison, the average age of crewmembers at their first ISS mission is 46.6 years (range 37 – 54 years).

Further detailed examination of both data sets (general population and crew data) may permit more substantive correlations as this study progresses.