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Optimum Mannitol Dosage for Raised ICP in Severe Head Injury

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Abstract

In a study of 15 patients with closed severe head injury to correlate the changes in serum osmolality in relation to reduction of ICP and mannitol dosage, it was found that mannitol given at a dose of 0.4g/kg body weight was as effective as 0.8g/kg body weight in maintaining the desired ICP and serum osmolality upto 5h.

Key words -
Mannitol,
Head injury,
Intracranial pressure

Mannitol is one of the most effective therapeutic agent [5] used for control of cerebral edema. The dose ranges from 0.5g to 4g per kg of body weight in 24h [1]. It is often seen that in management of head injury, mannitol is given at a dose of 150 to 200cc every 6 or 8 hourly or even twice daily to adult patients. Occasionally mannitol administration may lead to high serum osmolality resulting in deleterious effects on the heart and kidney. The present study is aimed to correlate the changes in serum osmolality in relation to reduction of intracranial pressure (ICP) and amount of mannitol administration.

Material and Methods

Fiteen adult male patients, with severe closed head injury treated at NIMHANS were considered for this study. A surgically treatable mass lesion was excluded with CT scan in each case. All of them were treated with mannitol alone for control of raised ICP. The ICP was monitored continuously in each case using Goud P-50 miniature transducer placed epidurally. These patients were distributed in three groups-I, II and III. In each case the initial ICP and corresponding serum osmolality was recorded. Immediately thereafter 20% mannitol was infused intravenously over a span of 10 min. The dosage schedule was 4ml, 3ml and 2ml per kg body weight to patients of groups I, II and III respectively.

The second reading of ICP and corresponding serum osmolality were recorded when the ICP was steadily lowest following mannitol infusion. The time interval between the end point of mannitol

infusion and the point of lowest recorded ICP was noted. In other words this was the time interval required by the mannitol to reduce ICP to the lowest recorded point.

A third reading of ICP and corresponding serum osmolality was recorded after the fifth hour following mannitol infusion. The observations are tabulated in Table-1. Mean and standard deviations were calculated from the data (Table-II). The data was computed for the study of correlation.

Observations (Table-I)

The onset of lowering of ICP began within 1 to 5 min and was greatest between 14-19 min after infusion of mannitol.

Table I - ICP and osmolality dose responses for mannitol in patients with raised ICP

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Table II - Means and Standard deviations calculated from table I

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An osmotic gradient of about 10 osmol, yielded a satisfactory reduction of ICP which lasted for as long as 5 h. About 60% of the raised ICP was reduced within 14 to 19 min.

It is also apparent that smaller doses of mannitol (group III) lead to smaller increase in serum osmolality and larger doses lead to greater increase in serum osmolality (groups I and II). Again with smaller doses the osmotic gradient is abolished significantly by the 5th hour (group III) as compared to the initial record. On the other hand with higher dosage (groups I and II) the osmotic gradient is still maintained at a higher level at the 5th hour following the therapy.

When the ICP values at the three different occasions (initial, lowest and after the 5th hour) are considered, it is apparent that there is earlier and greater degree of reduction of ICP with lower dosage (group III) as compared to higher dosage (groups I and II). Five hours after mannitol infusion the ICP still remains at a lower range in groups I and II as compared to that in group III. But statistically there has been no significant difference as far as reduction of ICP is concerned with different doses.

The correlation between the serum osmolality and ICP was computed for the three groups combined together. As expected the correlations were high and the largest correlation was seen on second occasion when ICP values were lowest and osmolality values were highest i.e., following infusion of mannitol. In the final occasion though the correlation was significant, it was less than the initial correlation (Rank correlation between osmolality and ICP-initial-0.8540, lowest-0.9103, final-0.7993).

The correlations were also computed separately for each of the three groups. As seen from table III, the correlation though highest initially for lowest dosage, on the final occasion it was least, in that group even though statistically significant.

Table III - Rank correlation between osmolality and ICP of the individual groups

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The means and standard deviations of ICP measurements, osmolality on initial occasion and final

occasion, the lowest ICP occasion and time duration of lowest occasion for the three groups are shown in table II. An analysis of the variants to compare the mean values of the three groups indicates that except for the final ICP values the groups differ significantly.

Discussion

The maximum reduction of ICP following mannitol infusion occurred between 14-19 min. At five hours following infusion, the osmolality was till higher than the initial reading in the first and second group and it was lower or same as the initial reading in the third group. The corresponding ICP after 5 hours remained consistently low in all groups. Statistically there was no significant difference as far as reduction of ICP was concerned with different doses. These findings suggest that lower dosage (0.4g/kg) of mannitol is as effective as higher dosage (0.6g/kg-0.8g/kg) in maintaining desired ICP and serum osmolality.

These observations further establish the concept formulated earlier, that low doses of mannitol at regular intervals was superior to high doses. Our findings are similar to those of Kuhner et al [1], Mc Graw and Howard [2] and Marshall et al [3] who concluded that in the treatment of raised ICP small frequent doses of mannitol was more effective than larger dosage.

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