DMSO Lowers ICP After Closed Head Trauma

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Short communication

Dimethly sulphoxide lowers ICP after closed head trauma

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Summary. Ten patients with closed head trauma and elevated intracranial pressure (ICP) ranging from 40–127 mm Hg were treated with intravenous dimethyl sulphoxide (DMSO) every 6 h for 1–10 days. Four patients received DMSO and intermittent oxygen.

All patients showed a reduction of ICP after 24 h and 7 had normal ICP after 6 days of treatment. Two patients died of their injuries.

Neurological assessment at the time of discharge showed 2 patients with *severe* neurological deficits and 6 patients with *mild* to *no* deficit. After a 3 month follow-up, 1 patient remained severely impaired and 7 patients showed mild to no deficit.

It appears that intravenous DMSO can rapidly reduce elevated ICP in severe closed-head injury and that it improves neurological outcome.

Key words: Intracranial hypertension, dimethyl sulphoxide (DMSO); head injury treatment

Intravenous administration of dimethyl sulphoxide (DMSO) has been shown to be clinically useful in lowering intractably raised intracranial pressure [1, 2] and increasing cerebral blood flow in brain-damaged patients [3], or after experimental brain injury [4, 5]. DMSO has a number of biological actions that may be useful in the clinical treatment of CNS trauma: for example, it can function in experiments as a free radical scavenger, powerful diuretic, calcium ion flux antagonist, platelet deaggregator and cell membrane stabilizer [6]. In addition, DMSO can reduce brain oedema [7] and increase cerebral perfusion pressure [8] following experimental trauma.

Subjects and methods

10 head injury patients were studied. Their Glasgow coma scale score at time of admission ranged from 3–9 (average 6) and rose to 15 in 8 of the 10 patients following treatment (Fig. 1). All patients had severe closed-head trauma and had an ICP monitor installed epidurally through a burr hole shortly after admission. The mean ICP on admission was 73 mm Hg (range 40–127 mm Hg; normal 5–13 mm Hg). CT scans were made before and after treatment and at the time of discharge. DMSO (RIMSO-100; Research Industries, Salt Lake City, UT) was administered every 6 h. The 28% solution was diluted with physiological saline (56:200 ml) to give a final dose of 1.12 $g \cdot kg^{-1}$ delivered intravenously at a fast drip rate. Blood pressure was not affected in patients receiving DMSO. All patients were ventilated and in four of them oxygen 2 $l \cdot min^{-1}$ was administered intermittently for the first 24 h after admission. The dose of DMSO was reduced by half when the ICP reached 20 mm Hg or lower and was continued until ICP stabilized or full recovery was observed.

Results

The effect of DMSO ($n = 6$) or DMSO + oxygen ($n = 4$) on intracranial pressure in 10 head injury patients is shown in Fig. 1 at 24 h and 6 days after treatment. All patients responded to treatment, with a *mean* reduction in ICP at 24 h of 28 mm Hg (DMSO alone) and 39 mm Hg (DMSO + oxygen). After 6 days, the *mean* ICP reduction was 58 mm Hg (DMSO alone) and 49 mm Hg (DMSO + oxygen) compared to pre-treatment values.

Although lowering ICP was dramatic, being seen in most cases within the first 30 min of DMSO administration, the effect was not sustained and most patients required maintenance doses for 2–10 days to minimize fluctuation in ICP. Increasing the dose of DMSO above that used initially was not associated with a greater reduction in ICP. Unlike mannitol, which was used in another group of patients, sudden rebound phenomena were not seen in patients treated with DMSO. In a further group, dexamethasone was ineffective in lowering ICP.

All patients received 15% dextrose in water 1 l/d as fluid replacement. Mean urine output was 1430 ml per day and averaged a brisk 238 $ml \cdot 2\,h^{-1}$ period during DMSO treatment. The haematocrit and haemoglobin levels remained normal. Renal function tests and serum electrolytes were normal during treatment and at discharge in all patients. CT scans confirmed the reduction in brain swelling following DMSO administration.

Neurological assessment of the treated patiens 6 days after DMSO administration was as follows: 2 patients showed *severe* CNS deficits (hemiparesis and cognitive impairment), 2 patients had *moderate* CNS impairment and 6 patients had *mild or no* deficit. Two patients even-

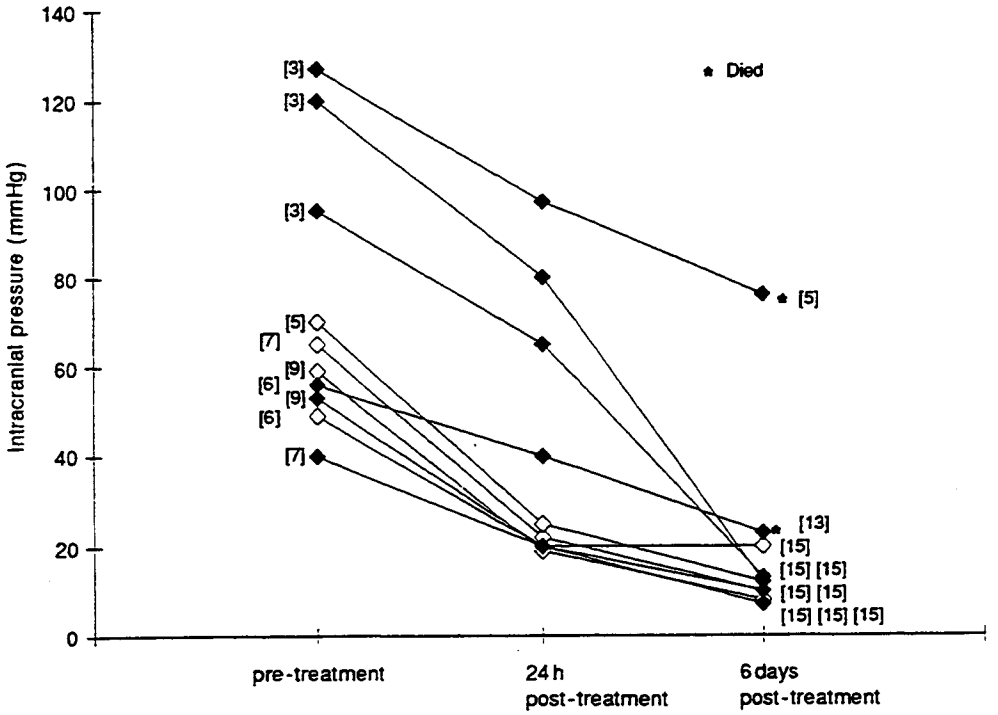

Fig. 1. Comparison of intracranial pressure (ICP) in 10 patients following closed head injury pre-treatment. 24 h after treatment with DMSO and 6 days after treatment. Numbers in parenthesis are Glasgow Coma Scale at admission (*left of Fig.*) and 6 days after treatment (*right of Fig.*). Two patients (*) died. DMSO (◆): DMSO + oxygen (◇)

tually died. In a follow-up 3 months after discharge. 1 patient showed no improvement from severe deficits and the remaining 7 patients showed *mild* to *no* deficit.

Conclusions

This pilot study indicates that DMSO is effective in reducing intracranial pressure in patients with a closed head injury and may improve outcome. Unlike two previous reports showing a reduction by DMSO of intracranial hypertension but no effect on mortality [1, 2]. the present study shows improvement both in neurological outcome and survival in 7 patients followed for 3 months after their injury. Little or no rebound of ICP was observed after DMSO. The drug appeared more effective when oxygen was delivered during the recovery period (Fig. 1). but this effect may have been due to the initially lower ICP on admission shown by the 4 patients in that group. DMSO may facilitate transport of oxygen molecules to ischaemic/hypoxic CNS tissue and may limit the formation of superoxide radicals from the available oxygen [9. 10]. The present study supports previous observations on the value of DMSO in patients with severe head trauma and intractable ICP who were refractory to conventional therapy [1. 2].

It is conclude that DMSO can effectively lower ICP in patients with closed-head injury and may have a positive effect on neurological outcome. There were no serious side effects after DMSO administration and the drug appeared safe in moderately high doses over 10 days. A more extensive clinical trial of DMSO in head injury patients is warranted.

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