LETTER TO THE EDITOR

Protection of different Components of Danshen in Cerebral infarction in mice

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Danshen (*Salvia miltiorrhiza*, SM) is one of the most popular medicinal herbs in China. A variety of formulations are currently used in China for the treatment of cardiovascular diseases [1], including stroke [2], the second most common cause of death and a major cause of disability [3]. Danshen has many protective effects including antiinflammation, free radical scavenging, and antioxidation [4], which might be beneficial for stroke treatment [5,6]. Results from clinical trials on stroke, however, are not consistent.

A review analyzing 17 reports of clinical trials concluded that Danshen could decrease neurological symptoms and improve quality of life in stroke patients [4]. Another review assessing six trials involving 494 patients did not support the routine use of Danshen agents for the treatment of patients with acute ischemic stroke [7].

These different conclusions might be attributed to insufficient quality of these clinical trials and lack of large randomized clinical trials. Alternatively, the difference may be caused by the

Figure 1 Chemical structure of the five compounds from Danshen.

Figure 2 Effects of different components of Danshen on ischemic injury induced by MCAO in ICR mice. The upper panel: representative coronal brain sections from mice receiving vehicle control (saline, 1), salvianolic acid A (10 mg/kg, 2), salvianolic acid B (10 mg/kg, 3), danshensu (10 mg/kg, 4), caffeic acid (10 mg/kg, 5), and tanshinone IIA (10 mg/kg, 6). Sections were stained with TTC. Data are expressed as mean $\pm$ SD, and analyzed by one-way ANOVA followed by Dunnett's *t*-test. * $P < 0.05$, $n = 8-11$ in each group.

complexity of the formulations and difference in the ingredients across preparations. To date, 20 major compounds in Danshen have been identified [6], including danshensu, salvianolic acid A, B, C, caffeic acid, and tanshinone $\leftarrow$ A (Figure 1). Whether they have protective effect against stroke is unclear. Clarification of the cerebral protection of the main compounds from Danshen is useful to optimize the preparation of Danshen and may also lead to the development of novel drugs for stroke.

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Male ICR mice (30 ± 2 g, $n = 8-11$ in each group) were purchased from Sino-British SIPPR/BK Lab Animals (Shanghai, China). All animals were used in accordance with the guidelines of Second Military Medical University for Animal Care. The animals were subjected to middle cerebral artery occlusion (MCAO) as previously described [8], and received salvianolic acid A (10 mg/kg), salvianolic acid B (10 mg/kg), danshensu (10 mg/kg), caffeic acid (10 mg/kg) and tanshinone $\leftarrow$ A (10 mg/kg) via peritoneal injection immediately after operation. After 24 hours, neurological deficits were examined using a 5-point scale [8]. Mice were then sacrificed. Brain slices were prepared and stained with 1% 2,3,5-triphenyltetrazolium chloride (TTC, Sinopharm Chemical Reagent Co. Ltd., Shanghai, China) [8]. The infarction size was measured with an image analyzer (Image J 1.41; NIH). Data are expressed as mean $\pm$ SD, and analyzed with one-way analysis of variance (ANOVA) followed by Dunnett's *t*-test for pair-wise comparison.

Salvianolic acid B, danshensu, caffeic acid, and tanshinone IIA reduced the infarction size by 19.6%, 17.9%, 16.1%, and 14.3%, respectively ($P < 0.05$). Salvianolic acid A did not reduce the infarction size ($52 \pm 9.9\%$ vs. $56 \pm 9.0\%$) (Figure 2).

In conclusion, salvianolic acid B, danshensu, caffeic acid, and tanshinone $\leftarrow$ A can significantly attenuate the acute cerebral injury in mice.

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Conflict of Interest

The authors declare no conflict of interest.