Objective of the study: Asparagus racemosus is a well known plant of medicinal value, with proven antioxidant, anti-inflammatory and immunomodulatory properties. Antioxidants are known to enhance wound healing. So the present study is aimed to investigate the wound healing profile of Asparagus racemosus on dead space wound model. Materials and methods: The aqueous extract of the roots of Asparagus racemosus was used to study the effect on wound healing in albino rats using a dead space wound model. The extract was administered orally in the dose of 200mg/kg or 400mg/kg for 10 days. The granulation tissue breaking strength and hydroxyproline, hexosamine and hexuronic acid of granulation tissue were measured. Results & Discussion: The extract showed a significant increase in granulation tissue breaking strength, and a significant increase in hydroxyproline, hexosamine and hexuronic acid in granulation tissue. The observed effects in the two groups suggest the facilitatory effect of Asparagus racemosus on wound healing and the possible utility of this plant to enhance wound healing.

Key words: Asparagus racemosus, anti-inflammatory, wound healing, dead space wound.
Statistical analysis: Statistical analysis was done by using one way analysis of variance (ANOVA) followed by Post Hoc test wherever required using SPSS package. Significance was noted at p value < 0.05.

RESULTS:
Toxicity study: The animals did not show any toxic symptoms on the central nervous system, cardiovascular system, gastrointestinal tract or on general behavior even with the dose of 8000mg/kg. For the subsequent studies one tenth of smaller doses (i.e. 200mg / kg & 400 mg /kg) were selected for studies on wound healing.

Dead space wound model.
Breaking strength: There was a significant increase (p = 0.001) in the breaking strength of granulation tissue in groups II & III when compared to the control (228.18±12.12g) in group I. (Fig.1a).

Biochemical parameters: There was a significant increase (p = 0.001) in the hydroxyproline content of granulation tissue in group II & III (28.7±7.1 & 34.19±1.51) as compared to the control group I (12.43±1.11). There was no significant difference in the hydroxyproline contents in between the tissues of two doses of test drugs (Fig.1b). The hexosamine and hexuronic acid contents (20.22± 0.78; 21.45±0.71 & 33.18±1.16; 37.7± 1.97) in the granulation tissue in group II & III were significantly increased (p<0.001) when compared to the control group (11.9±0.64 & 19.19 ± 1.9). (Fig.1c &1d).

Histopathological study: There was a good connective tissue response observed in group II & III which was accompanied by a decrease in inflammation. Histopathological study showed that there was a significant increase in the fibroblasts in group II & III and a significant increase in the connective tissues (Fig 2a & 2b).

DISCUSSION: It is a well accepted fact that wounds in most tissues heal by repair, through a process of laying down nonspecific connective tissues[12]. Granulation tissue formation, wound contraction and scar formation are some of the many phases of wound healing. In many cases, the last phase is known as remodelling phase. The use of a single wound model in wound healing studies is inadequate and no reference standard exists that can collectively represent the various phases of wound healing. Among the different models, deadspace wound model has been used in this study to assess the effect of Asparagus racemosus extract on the various phases of wound healing.

In dead space wound, the increase in tensile strength of granulation tissue may be due to increase in collagen concentration and stabilization of fibers. [13] The root extracts of Asparagus racemosus is known to increase the levels of IL-1 and TNF which in turn stimulate the fibroblast activity and increases the collagenase activity[14,15]. Thus Asparagus racemosus not only aids in wound healing but also helps in wound remodeling. Increase in wound breaking strength (WBS) and role of antioxidants was experimentally proved by Michel and Fredrickson[16]. The faster wound healing and remodeling observed with Asparagus racemosus extract may be due to stimulation of interleukin -8, an inflammatory alfa -chemokine which affects the function and recruitment of various inflammatory cells, fibroblasts and keratinocytes. It is proposed to increase the gap junctional intracellular communication in cultured fibroblasts and to induce a more rapid maturation of granulation tissue [16, 17]. In our current study the aqueous extract of Asparagus racemosus increased the cellular proliferation and collagen synthesis at the wound site. This conclusion is supported by the observed increases in total protein, total collagen content and increase in increase in hydroxyproline content of granulation tissues. The glycosaminoglycans are a major component of the extracellular matrix of skin, joints, eyes, and many other tissues and organs. In spite of their simple structure, they demonstrate remarkable viscoelastic and hygroscopic properties which are relevant for dermal tissue function. Biological activities in skin are due to their interaction with various extracellular binding proteins. Due to an influence on signaling pathways, hyaluronic acid is involved in the wound healing process and scar less fetal healing. In clinical trials, topical application of hyaluronic acid has improved the healing of wounds[18]. In addition the mucopolysaccharide hyaluronic acid protects granulation tissues from oxygen free radical damage and thereby stimulates wound healing.[19]

Among the glycosaminoglycans, dermatan sulfate and dermatan have also been implicated in wound repair and fibrosis. Their ability to bind and alter protein – protein interactions has identified them as important determinants of cellular responsiveness in development, homeostasis and disease[20,21]. In our study, hexuronic acid and hexosamine concentrations which are the components of glycosaminoglycans were significantly increased with aqueous extract of Asparagus racemosus as compared to the control. The glycosaminoglycans are known to stabilize collagen fibres by enhancing electrostatic and ionic interactions with it and possibly control their ultimate alignment and characteristic size. In our current study Asparagus extract in both the doses increased the levels of these compounds considerably. It is therefore likely that the observed increase in tensile strength was not only due to increased collagen synthesis, but also due to its interaction with glycosaminoglycans leading to its proper deposition and alignment in the extracellular matrix.

Applications: Chronic non healing ulcers are a recurrent concerns for most of the clinicians in their clinical practice. Our study has demonstrated the beneficial effects of Asparagus racemosus on wound healing. This extract availability and cost makes it an useful adjunct in wound healing therapy. In addition Asparagus racemosus extract has shown antioxidant, anti-inflammatory, immuno-modulatory properties, with minimal side effects. Therefore it could also have some use in the treatment of ulcers in diabetic patients.

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