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## Review article

## Anti-paralytic medicinal plants – Review

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## ABSTRACT

Paralysis is the loss of the ability of one or more muscles to move, due to disruption of signaling between the nervous system and muscles. The most common causes of paralysis are stroke, head injury, spinal cord injury (SCI) and multiple sclerosis. The search for cure of paralysis is yet to be found. Many ethnobotanical surveys have reported the use of medicinal plants by various ethnic communities in treating and curing paralysis. The present review discusses the use of medicinal plants in India for ameliorating and curing paralytic conditions, as well as discusses some of the important developments in future possible applications of medicinal plants in treatment of paralysis. This review reports the use of 37 medicinal plants for their application and cure of ailments related to paralysis. Out of the 37 plants documented, 11 plants have been reported for their ability to cure paralysis. However, the information on the documented plants were mostly found to be inadequate, requiring proper authentication with respect to their specificity, dosage, contradictions etc. It is found that despite the claims presented in many ethnobotanical surveys, the laboratory analysis of these plants remain untouched. It is believed that with deeper intervention on analysis of bioactive compounds present in these plants used by ethnic traditional healers for paralysis, many potential therapeutic compounds can be isolated for this particular ailment in the near future.

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## 1. Introduction

Paralysis is a disease related to nervous disorder caused by damage of nerves and spinal cord that control muscles. The most common causes of paralysis are stroke, head injury, spinal cord injury, broken neck and multiple sclerosis.<sup>1</sup> Other causes of paralysis include nerve diseases such as amyotrophic lateral sclerosis, autoimmune diseases such as Guillain-Barre syndrome, Bell's palsy, which affects muscles in the face, and Polio virus.<sup>2</sup> Paralysis can be of localized form, where a specific section of the body is paralyzed, such as the facial paralysis (Bell's Palsy) and paralysis of hand, or generalized form where a larger area of the body is affected, such as the condition where one limb is paralyzed or where the arm and leg on one side of the body are paralyzed. Therefore, depending on the condition and body part(s) affected by paralysis, a number of

medical terms are used to describe different types of paralysis. Examples are namely, monoplegia – where one limb is paralyzed, hemiplegia – where the arm and leg on one side of the body are paralyzed, paraplegia – where both legs and sometimes the pelvis and some of the lower body are paralyzed, tetraplegia – where both the arms and legs are paralyzed (also known as quadriplegia). Paralysis when left untreated for a long period could lead to the 'death' of the affected part i.e. wasting of muscles and tissues. Paralysis can also cause a number of associated secondary conditions, such as urinary incontinence (an inability to control the flow of urine) and bowel incontinence (where stools leak from the back passage). It may also affect sexual function in both men and women. In cases of permanent paralysis, treatment aims mostly at assisting a person live as independently as possible by addressing any associated complications that arise from paralysis, such as pressure ulcers (sores that develop when the affected area of tissue is placed under too much pressure), bladder and bowel problems, and treating spasms and complications resulting from paralysis. Mobility aids such as wheelchairs and orthoses can help a person with paralysis.<sup>1</sup> However, all these forms of treatment mostly

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focused on assisting patients to attain a little degree of controlling their movement, as there is currently no cure for paralysis.

## 2. Alternative medicines used in paralysis

Across the globe, traditional medicines in the form of crude herbal extracts of single plant or combination of plants, with or without additional minerals have been used in alleviating and curing diseases related to problems of nervous system, some of which includes *Calotropis procera*, *Satureja thymbra*, *Coridothymus capitatus*, *Thunbergia laurifolia*, *Annona reticulata*, *Annona squamosa*, *Plumeria rubra*, *Crateva magna*, *Crateva religiosa*, *Argyrea osyrensis*, *Suregada multijflora*, *Cassytha filiformis*, *Oxyceros horrid*, *Citrus aurantifolia*, *Citrus medica*, *Cissus hastate*, *Cissus repens*, *Aloe vera*, *Ricinus communis*, *Tamarindus indica*, *Alocasia macrorrhizos*, *Murraya koenigii*, *Lygodium flexuosum*, *Cassia occidentalis*, *Datura metel*, *Phyllanthus reiculatus*, *Glycosmis arborea*, *Aerva persica*, *C. procera*, *Hyocyamus niger*, *Cymbidium aloifolium*, *Gardenia ternifolia* and *Mikania hirsutissima*.<sup>3–13</sup> In India many plants and plant products are vended in markets that claim for ability to treat paralysis, some of which are Punarnava powder (containing Hogweed or *Boerhavia diffusa*), Ashwagandha powder (containing *Withania somnifera*).<sup>14,15</sup> The poly herbal drug Majoon-e-Azaraqi is an ancient herbal Unani compound formulation which is therapeutically use in nerve strengthening, hemiplegia, facial paralysis, tremor, trembling, rheumatism, epilepsy and neurasthenia. Majoon-e-Azaraqi is constituted of 15 ingredients (*Strychnos nuxvomica*, *Borago officinalis*, *Lavandula stoechas*, *Cochlospermum religiosum*, *Cocos nucifera*, *Pinus gerardiana*, *Eletarria cardamomum*, *Curcuma zeodaria*, *Pastinaca secacul*, *Santalum album*, *Emblica officinalis*, *Terminalia chebula*, *Aquilaria agallocha*, *Syzygium aromaticum* and Sugar).<sup>16</sup> In homeopathic approach, *Rhus toxicodendron* is used in treating paralysis of the lower extremities, treatment of all forms of paralysis which are of a rheumatic origin or brought on by getting wet or exposure to dampness in any form, and in treatment of paralysis due to nervous fevers and typhus. *Aconite napellus* is considered as the sovereign remedy for almost every species of paralysis in homeopathy.<sup>17</sup> *Gelsemium sempervirens* (Gels.) is another plant used in homeopathic for treatment of paralysis.<sup>18</sup> In addition, the homeopathy treatment use *Agaricus muscarius*, *Cocculus indicus*, *Solanum dulcamara*, *Strychnos nux-vomica*, *Hypericum perforatum* and *Atropa belladonna*, which are all poisonous sources, in treatment of various paralytic manifestations.<sup>19</sup> The use of *Acanthus ilicifolius*, *Cedrus deodara* and *Rubia cordifolia* in paralysis is also reported.<sup>20,21</sup> Apart from these well known reports from different forms of alternative medicines for their application of paralysis, the present review emphasizes on the various ethnobotanical documentation of medicinal plants reported for their use in treatment of ailments related to paralysis in different parts of India. Extensive literature search using Pubmed, Medline, Scopus and Google were conducted in order to extract articles related to ethnobotanical surveys in different parts of India.

## 3. Anti-paralytic plants from ethnobotanical surveys in India

The extensive literature survey on the use of medicinal plants for paralysis in India showed that relatively few documentation of medicinal plants have been done, and even lesser laboratory authentication and analysis have been done in relation to the applicability in paralysis. Among the total of 29 states and 7 union territories of India, researchers have reported the use medicinal plants for paralysis so far only from 16 states namely Tamil Nadu, Andhra Pradesh, Jammu & Kashmir, Rajasthan, Chhattisgarh, Odisha, Uttar Pradesh, Himachal Pradesh, Uttarakhand, Madhya Pradesh, Manipur, Karnataka, Assam, Maharashtra, West Bengal and

Telangana, from where a total of 37 plants, belonging to 25 plant families (Table 1) have been reported for their application/cure of ailments related to paralysis.<sup>51–79</sup> Amongst these families, plants belonging to Asteraceae represented the highest, followed by Fabaceae and Mimosaceae. Lesser number of plants from the family Euphorbiaceae, Lamiaceae, Liliaceae, Rubiaceae and Ranunculaceae are represented for their use in this regard. Members of plants belonging to Acanthaceae, Asclepiadaceae, Araliaceae, Bombacaceae, Caesalpinaceae, Cannabinaceae, Celastraceae, Marsiliaceae, Meliaceae, Malvaceae, Menispermaceae, Moraceae, Oleaceae, Orchidaceae, Rutaceae, Vitaceae and Urticaceae represented the least for their used in paralysis (Fig. 1). Nine different plant parts were found to be used for various treatment of the ailment. In most of the cases, the leaves are mostly used, followed by roots, seeds, whole plants, stem, barks, fruit, flower head and bulb respectively (Fig. 2). Amongst the 37 plants reported, 11 plants are reported for their ability to cure paralysis (Table 2). However, in most of the ethnobotanical studies, the information mentioned and documented are inadequate, wherein the use of the plant, the mode of use, the methods of preparation, dosage, durations, specificity, effectiveness and contradictions are not discussed in details. In addition the type of paralysis (whether localized or general paralysis, monoplegia, hemiplegia, paraplegia or tetraplegia) for which the plants is used is mentioned only in 6 plants (Table 3). The remaining 26 plants are reported for their use in paralysis without specifying any details about their ability to cure, as well as the types of paralysis for which they are used for. No doubt, there information are undeniably useful, as ethnobotanical survey data and traditional knowledge of medicinal plants are one of the irreplaceable pools of knowledge, in which unplumbed information are stored. It is believe that with deeper research into the bioactive composition and mode of actions of the chemical contents of these documented medicinal plants, a goal for finding important lead compounds for treatment of ailments and complications associated with neural disorders leading to paralysis, can indeed be achieved in the future.

## 4. Laboratory studies on plants used in paralysis

In the last decades few laboratory studies have been conducted to understand the efficacy of medicinal plants for their application in ailments related to nerve injury or functions. Maryam Tehranipour and Tooba Ghadamyari reported that alcoholic root extract of *Salvia staminea* could increase neuronal density of motoneurons in anterior horn of spinal cord following sciatic nerve compression.<sup>80</sup> Spinal cord ischemia/reperfusion (I/R) injury may lead to immediate or delayed paraplegia in 4%–33% of patients undergoing surgery on the thoracic aorta.<sup>81</sup> Therefore, in an attempt to prevent any undesired complications, various methods of spinal cord protection have been suggested, including temporary shunts or partial bypass, hypothermia, drainage of cerebrospinal fluid, and pharmacologic measures.<sup>82–84</sup> Despite the use of these methods, paraplegia remains a persistent complication.<sup>85</sup> Tetramethylpyrazine (TMP), also called ligustrazine, is an alkaloid extracted from the Chinese herbal medicine, *Ligusticum wallichii* (chuanxiong).<sup>86</sup> For hundreds of years, TMP has been routinely used for the treatment of heart, kidney, and brain diseases.<sup>33,87,88</sup> Spinal cord I/R induce significant increase in the concentration of malondialdehyde (MDA) in the spinal cord, indicating lipid peroxidation.<sup>89</sup> Studies showed that TMP treatment reverse the increase in MDA levels to a considerable extent, and ameliorated the down regulation of spinal cord superoxide dismutase (SOD) activity, thereby confirming the antioxidant role of TMP in I/R.<sup>22</sup> In animals that had significant impairment of motor function, evidence of both necrosis and apoptosis was apparent. The Bcl-2 proteins comprise both anti-apoptotic family members, for example, Bcl-2, Bcl-xL, and Mcl-1, and proapoptotic molecules such

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