SLNs are nanocarriers composed of phospholipid, dispersed in water or in surfactant solution (50–1000 nm). The absence of the hydrophilic domain in SLNs enables it to carry lipophilic compounds but allows nanoparticle to cross the BBB with ease [29].

NLCs are modified SLNs composed of solid and liquid lipid. The combination of lipid in NLCs helps to improve drug loading capability, biocompatible, and stability [30].

Polymeric nanoparticles (PNPs): PNPs are colloidal particles comprising of active ingredient entrapped or adsorbed on solid macromolecule and the size varying from 1 to 1000 nm. PNPs in case of the intrathecal drug delivery provide advantage of greater stability, high encapsulation efficiency, controlled release kinetics, and charge modification. Systemic delivery for the CNS includes polymer such as poly(butyl cyanoacrylate), poly(lactic acid), poly(glycolic acid) (PLGA), chitosan, and poly(ethylenimines). These polymers help in the entrapment of drug and peptide molecules. This polymers biocompatible, biodegradable, helps in the better entrapment of drug, helps to cross BBB and prolong the drug lifetime in the body. Local delivery for the CNS includes polymers such as PLGA, poly(methylidene malonate), poly(epsilon-caprolactone), and chitosan [31]. Camptothecin-loaded PLGA NPs were delivered locally and demonstrated to be effective for treatment of an intracranial tumor model [32].

Magnetic NPs (MNPs) are nanomolecules consisting of iron-oxide as a metal core often coated with the organic fatty acid, polysaccharides, and polymers. The metal core has an unpaired electron that contributes to its magnetic property and the polymers help in the stabilization and prevent the separation into particles and carrier medium. Iron as core material provides low toxicity, easy elimination and is used in oxide form due to its stability. MNPs are considered as one of the impending system for the brain delivery, due to easy permeation through BBB and low toxicity. Fig. 7 shows the method for delivery of the drug to the affected site of the spinal cord. The unpaired electron charge of the iron gets attracted toward the magnet and the movement of the magnet helps in the delivery of the drug [33].

Colloidal gold nanoparticles (AuNP) appear to be popular carrier for drug, due to their inert and nonimmunogenic properties, better bioavailability, and ease of preparation. AuNP is composed of gold which act as metallic core and the polymers are coated covalently over this particle with an organic layer. The covalent bond between gold and polymer facilitated to improve biocompatibility, biophysical properties, and targeting specially in case of proteins, peptide, and gene therapy [34]. The tunable, nanoconjugate, easy penetration through BBB and low toxicity properties of the gold with polymer, AuNPs can be considered as ideal drug delivery for the intrathecal targeted drug delivery, as shown in Table 2.

3.2. Hydrogels-Mediated Drug Delivery

Hydrogels are 3D nanostructured cross-linked networks polymer consisting of large amount of water molecule. Highly superior property such as native extracellular

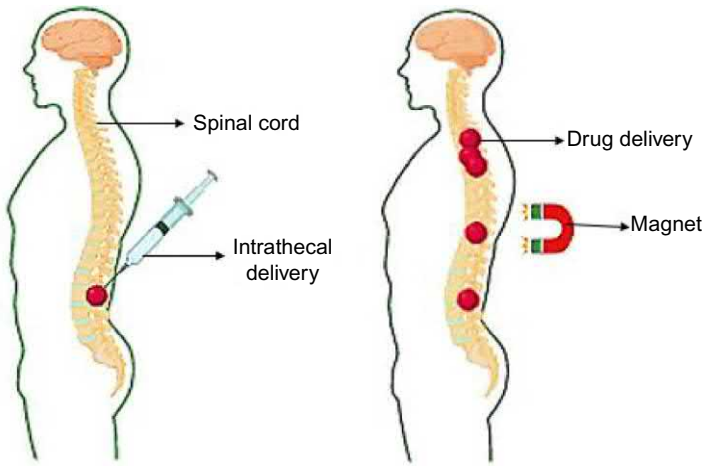

FIG. 7 Magnetic nanocarriers for intrathecal drug delivery system.