Modern Medicine and Surgery: Stem Cell Treatment of Spinal Cord Injury

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Abstract: Spinal cord injury (SCI) is an important cause of morbidity worldwide, with associated significant reduction in quality adjusted life years (QALY). Stem cell therapy has perhaps been viewed by aspects of the profession as the experimental pathway with the greatest degree of optimism. That being said, the technique has now been explored for 20 – 30 years and despite this length of time the technique has not achieved any widely accepted cases of curative success.

This report explores potential explanation for the lack of curative, or restorative, success. The report then details potential pathways forward for exploration.

In addition to stem cell therapy, downloadable and transferable consciousness both advanced using IT and also primitive (using bacteria to transfer voltage gated ion channel electrical communication) as potential restorative, or curative, treatment avenues to explore in SCI repair are conceptualized and detailed.

Keywords (Terms): ESCs; Injury; MSCs; Neurons NGF; NPCs; Spinal Cord

1 Introduction
Spinal cord injury (SCI) is an important cause of morbidity worldwide, with associated significant reduction in quality adjusted life years (QALY) (AAOS, 2016; Eck & Marks, 2016; EUSTC, 2015; Ronaghi, 2010). Despite the important advances in the understanding of spinal cord injuries, to date, almost all therapies that have shown promise at the preclinical stage of study have failed to translate into clinically effective treatments (Eck & Marks, 2016; EUSTC, 2015; Fehlings, 2012). There still remains no cure for spinal cord injury (Eck & Marks, 2016; EUSTC, 2015; Kumar & Clark, 2016). Experimental research has investigated a number of techniques including stem cell therapy, neuro grafting, and other regenerative techniques (AAOS, 2016; EUSTC, 2015; Ronaghi, 2010).

However, success has been very limited and as aforementioned no cure for spinal cord injury has been achieved (Eck & Marks, 2016; EUSTC, 2015; Kumar & Clark, 2016).

Stem cell therapy has perhaps been viewed by aspects of the profession as the experimental pathway with the greatest degree of optimism. That being said, the technique has now been explored for 20 – 30 years and despite this length of time the technique has not achieved any widely accepted cases of curative success (Eck & Marks, 2016; EUSTC, 2015; Kumar & Clark, 2016; Fehlings, 2012; Ronaghi, 2010).

This report assesses the situation in addition to providing initial conceptualization of both IT and primitive (bacterial) transfer of consciousness (and electrical communication) as other avenues to achieve restorative repair of SCI.

2 Development of the Nervous System
Neuronal development typically involves a neuron sending out an axon toward distant targets to which signals are delivered and several dendrites which receive signals from other neurons in addition to circulating messengers (Alberts, 2002; Ronaghi, 2010; Vawda, 2012). The path of axons and dendrites are led by growth cones (which propagate the axons and dendrites along their paths) and receive structural support from a substratum of extracellular matrix or cell surface (Alberts, 2002; Lodish, 2000; Saladin, 2001). Pioneering neurites may already have traversed the pathway (Ronaghi, 2010; Saladin, 2001). The growth cones sense guidance cues (by way of guidance molecules) from the surroundings (example, extracellular environment) for signal (biologic) directed growth. The growth cones respond to these guidance cues through what is termed a chemotropic response. Guidance molecules include: Netrins; Slits (Sli); Ephrins; Semaphorins; Cell Adhesion Molecules (CAMs); BMPs, GABA; FGFs; BMPs; L1; and, others.

Of particular note is that target tissues release important chemicals and factors including NGF which facilitate nerve growth and development toward the target (Saladin, 2001; Vawda, 2012).
Continued neuronal development, differentiation and attainment of function involves complex and intricate chemical, physiological and biological reactions (Saladin, 2001).

3 Spinal Cord Injuries
SCI causes myelopathy, damage to white matter, and myelinated fiber tracts that carry sensation and motor signals to and from the brain (Saladin, 2001). The gray matter damage causes segmental losses of interneurons and motor neurons and restricts therapeutic options (Ronaghi, 2010). Different sources and types of cells have been tested in clinical trials for SCI, including embryonic stem cells (ESCs), neural progenitor cells (NPCs), mesenchymal cells (MSCs; and, BMSCs), olfactory ensheathing cells and Schwann cells (Ronaghi, 2010; Vawda, 2012).

4 Problem Identification and avenues for exploration
Stem cell therapy has perhaps been viewed by aspects of the profession as the preferred experimental pathway to pursue despite the lack of widely accepted cases of curative success in the 20 - 30 years of pursuit.

It is important that the scientific community direct concerted attention to the key factors having negated stem cell therapy from having achieved any accepted cases of curative success.

Key barriers to success include:
1. The transplanted stem cells fail to achieve the intended growth into the desired neuronal form
2. The stem cell derived neuron (or, nerve) fails to function appropriately
3. Inflammation
4. Glial scarring

The report now systematically works its way through the above key factors hindering success to date with stem cell therapy of SCI, focusing on factors 1 and 2. This is followed by conceptualization of new avenues for exploration.

With respect to factors 1 and 2 above, one challenge is that in nature the development, differentiation, and attainment of desired function with respect to neurons (nerves) occurs over many years, and involves very complex chemical, electrical, physiological and biological reactions (Barrett, 2015).

In order to achieve restorative (and curative) stem cell treatment of SCI, it would likely require the mimicking of this ‘long complex developmental process.’ Current techniques do not appear to achieve this.

The neurons need to learn:
1. The ability to grow, differentiate and learn
2. The ability to attain and utilize the desired function

The scientific community needs to address the above issue adequately in order to achieve restorative success in the stem cell treatment of SCI. It would seem worth considering measures including the following:

- Exogenous growth of nerves using complex (perhaps multidimensional) computer simulated (and guided) chemical signalling designed to mimic that occurring with neuronal development in humans in nature, in order to achieve successful growth and attainment of function of the given nerve.
- Three dimensional printer technology may also be assistive with respect to the above, for instance to achieve at least part of the process endogenously. It would seem that the current technology (produced through three dimensional printing) designed in USA that, in the main, provides only structural support for guidance of growth of the nerve would be unlikely by itself to achieve any curative success.

Conceptualization of future avenues for exploration in order to achieve restorative and curative success in SCI repair
1. Stem cell therapy, for instance prenatal (prefetal), to knock out (or, cause mutagenesis) of any genes that may be inhibiting nerve tissue from achieving restorative growth similar to that of tissues which achieve regenerative regrowth following injury.

2. In line with the predicted advent of downloadable consciousness, development of an implant to transfer the consciousness of the CNS from an area higher than the SCI to an area subsequent to the SCI (or, traverse through it). This would need to take into account anatomical considerations. Given that a person appears, from an external perspective, unconscious if either suffering brainstem damage or widespread cortical damage (Kumar & Clark, 2016; Lindsay et. al., 2010; Talley & O’Connor, 2014) the commencement (point of origin) of the implant may have to be at the level of the brainstem or higher and insert into a site at a location below the
SCI (or, traverse through it), although it is noted that all cells may possibly contain some degree of consciousness. Whilst this may seem some time away, there is optimism in programs of USA revolving around mind mapping (BRAIN Initiative) that could potentially merge to further facilitate the progress of curative SCI repair (Pappas, 2013; WH, 2014). Other indications that it would not seem unrealistic to commence conceptualization of the application of such technology: there are reports of governments having achieved thought technology but not able to release it until extensive testing has been conducted with respect to safety; there exists corporate pursuit of downloadable consciousness technology.

3. Given the above may be some time away, a more primitive electrical communication transfer would seem reasonably argued as achievable through the concepts detailed by the current author in previous reports in respect of the ion-gated channel communication able to be achieved through strategic use of bacteria (and possibly other infective agents) (Raymond, 2016 a; Reilly, 2015). Bacteria have been shown, through methods including molecular mimicry, to mimic neurons, specifically mimic the ion-gated channel electrical communication that neurons (for instance, neurons nearby) are performing. The method of restorative and curative SCI repair therefore conceptualized: bacteria therapeutically guided to be in attachment to an area at the level of the brainstem or higher and mimic the ion-gated channel electrical firing (activity) of the neurons of interest, also in contact with an implant that contains a scaffold with bacterial culture (or, other electrical transfer medium) that travels to a site subsequent to the SCI (or, traverses through it) to communicate with bacteria that are therapeutically attached to the given neurons of interest (for instance, motor and sensory) that were previously deprived by the SCI. With that said, the current author would be of the opinion that careful consideration first be put before community and ethics committees with respect to the method based on issues including the possible low-level consciousness of certain agents as detailed previously by the author (Raymond, 2016 b).

5 Conclusion
Stem cell therapy has perhaps been viewed by aspects of the profession as the experimental pathway with the greatest degree of optimism in respect of achieving restorative (and curative) success in SCI repair, yet despite 20 – 30 years of exploration the technique has not achieved any widely accepted cases of curative success. The current report has detailed potential pathways forward for exploration.

References
Listed Alphabitically


