Update on early management of acute spinal cord injuries

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Orthopaedic & Spinal surgeon

Overview:

- Aetiology/Cost
- Pathophysiology
- Early surgical intervention
- Emerging therapies
- Steroids
- BP augmentation
- Hypothermic augmentation
- Case review

Aetiology:

- Mechanical disruption of spinal cord
- Incidence in NZ
  - 80-130 spinal injuries per year
  - 30-50/million/year
  - Males 72/million Females 29/million
  - ** Males 15-29 make up half all new SCI
  - MVA = 54% Falls 24%

Pathophysiology:

- Tissue damage to the spinal cord has been divided into two phases:
  - Primary injury: **Unchangeable**
    - Axons, blood vessels, cell membranes disrupted by the initial trauma

  Secondary injury:** Modifiable**
    - Delayed progressive injury
    - Immobilization/reduction aims to reduce any worsening
    - Disruption of the blood/spinal cord barrier
    - Infiltration of inflammatory cytokines (6-12 hrs)

Three Phases of SCI - Patho

- Acute
  - Haemorrhage, oedema, inflammation
- Sub-Acute
  - Demyelination, axonal dieback
- Chronic
  - Cavitation formation intra-medullary

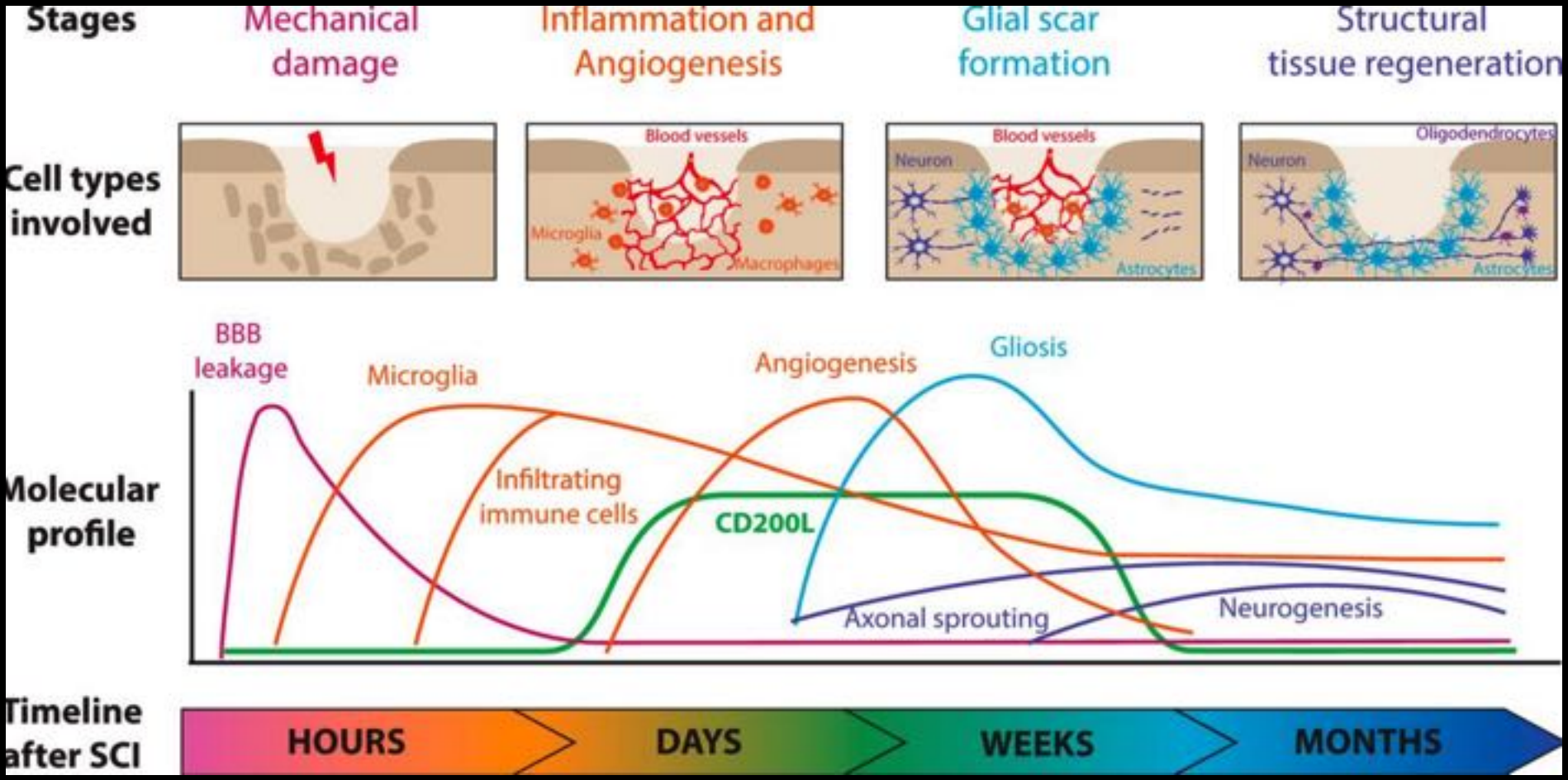
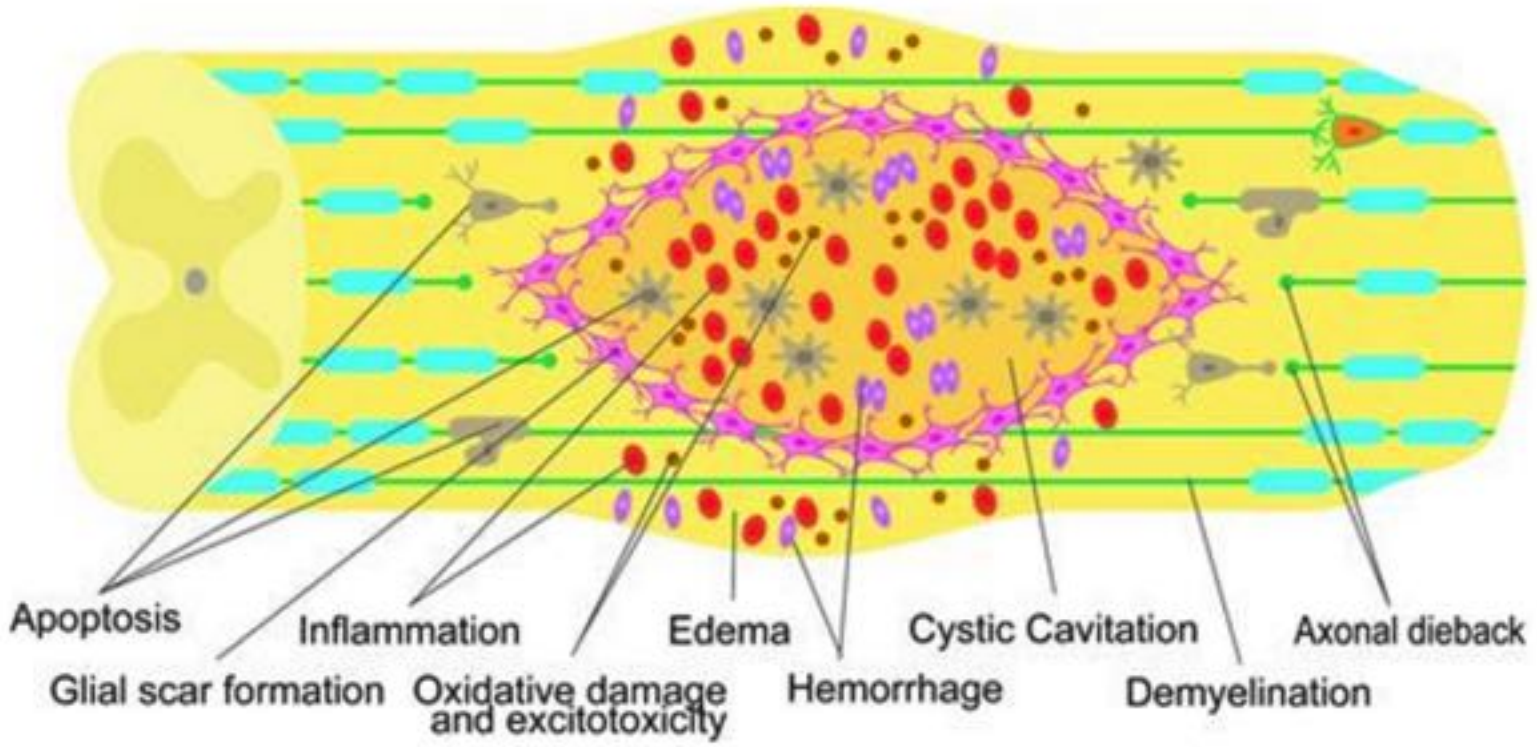
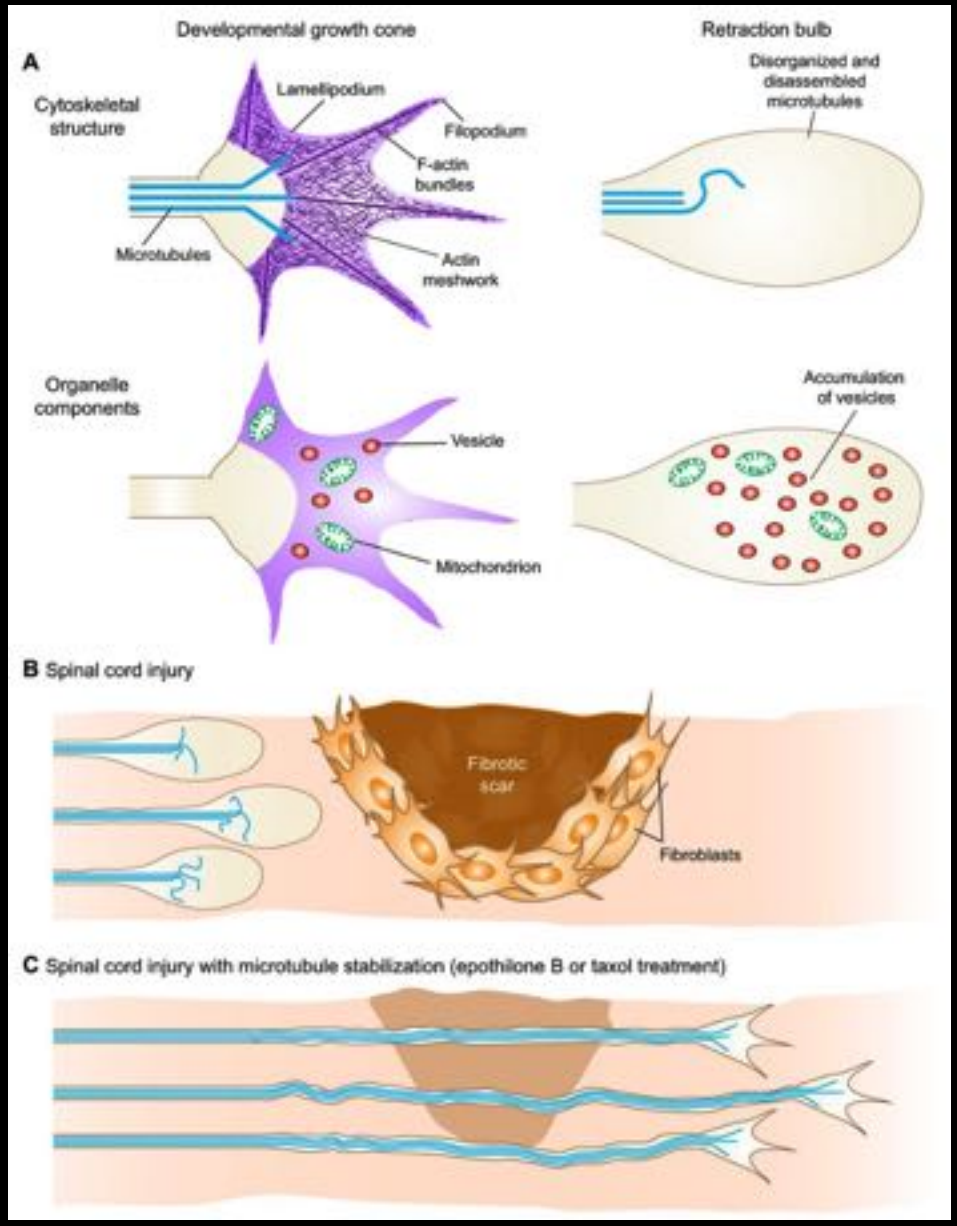

Stages
Mechanical damage
Inflammation and Angiogenesis
Glial scar formation
Structural tissue regeneration
Cell types involved
Blood vessels
Microglia
Macrophages
Blood vessels
Neuron
Astrocytes
Oligodendrocytes
Neuron
Astrocytes
Molecular profile
BBB leakage
Microglia
Infiltrating immune cells
CD200L
Angiogenesis
Gliosis
Axonal sprouting
Neurogenesis
Timeline after SCI
HOURS
DAYS
WEEKS
MONTHS

FIGURE.


Apoptosis
Inflammation
Edema
Cystic Cavitation
Axonal dieback
Glial scar formation
Oxidative damage and excitotoxicity
Hemorrhage
Demyelination

Barriers to regeneration:

- Limited regenerative potential of CNS
  - Finite number of cells capable of regeneration
  - Restricted plasticity of adult CNS
  - Understanding increasing about how the scar itself can block axonal regeneration

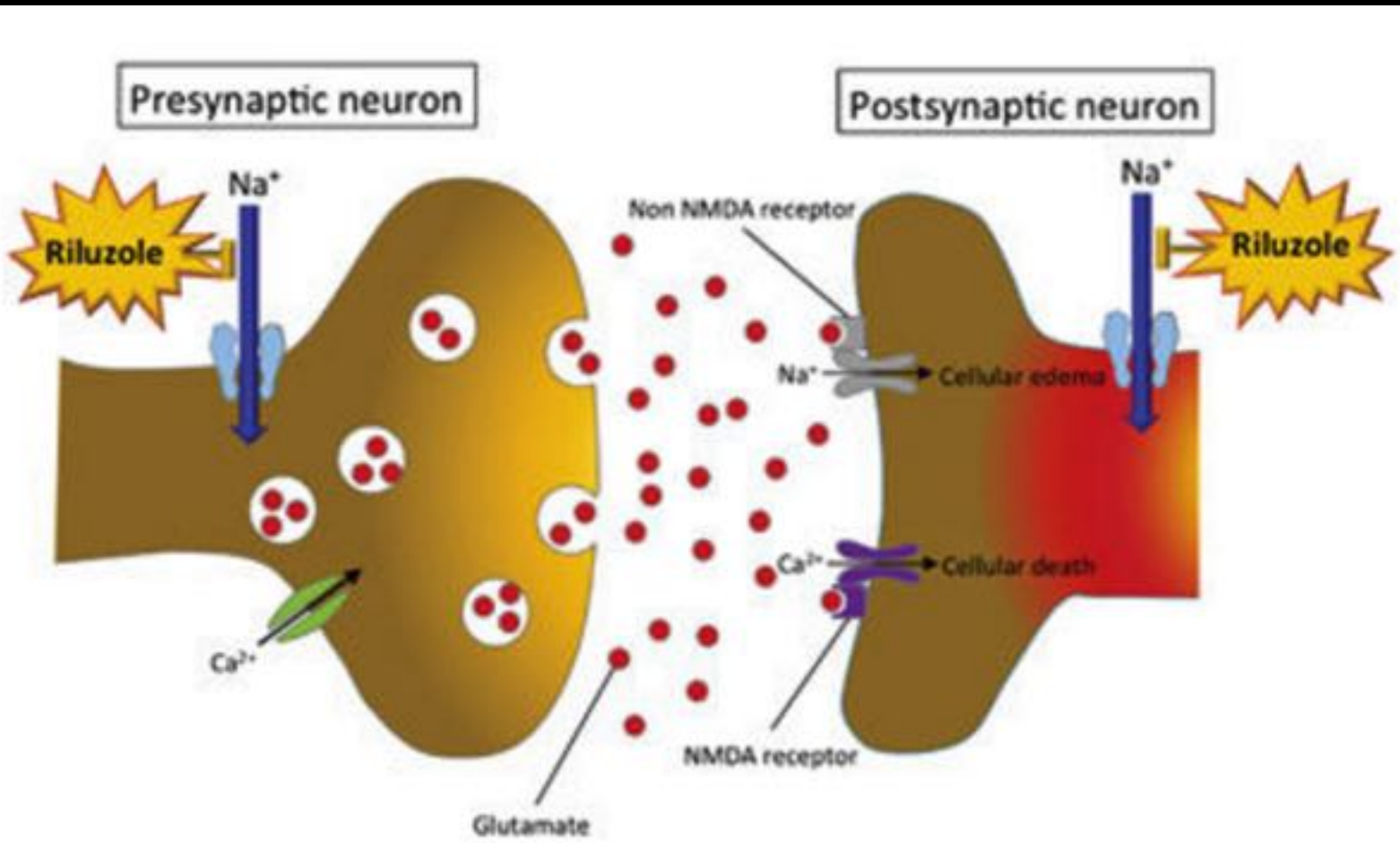

Developmental growth cone
Retraction bulb
A
Cytoskeletal structure
Lamellipodium
Filopodium
F-actin bundles
Microtubules
Actin meshwork
Disorganized and disassembled microtubules
Organelle components
Vesicle
Mitochondrion
Accumulation of vesicles
B Spinal cord injury
Fibrotic scar
Fibroblasts
C Spinal cord injury with microtubule stabilization (epothilone B or taxol treatment)

Early surgical intervention:

- Relieve compression and prevent ischaemia
- How soon??
- Surgical Timing Acute Spinal Cord Injury Study – 313 prospective patients
  - 2.8x more likely to improve 2 or more grades if surgery perform within 24 hrs vs after
- 8hrs – Meta-analysis suggested statistically different improvement – Many believe unrealistic

Emerging therapies

- Many and numerous trials
  - Riluzole – Neuroprotective (AMS) – Na channel bl
  - Minocycline – Anti-inflammatory/ Crosses BBB
  - Cethrin – Stops Rho inhibition of neuronal growth
  - ATI-355 – Promotes axonal sprouting
  - GCSF – increases Stromal cells at SCI site
  - HGf – increases neuronal survival
  - Mg – enhances tissue sparing
  - FGF – preserves motor neurones around SCI

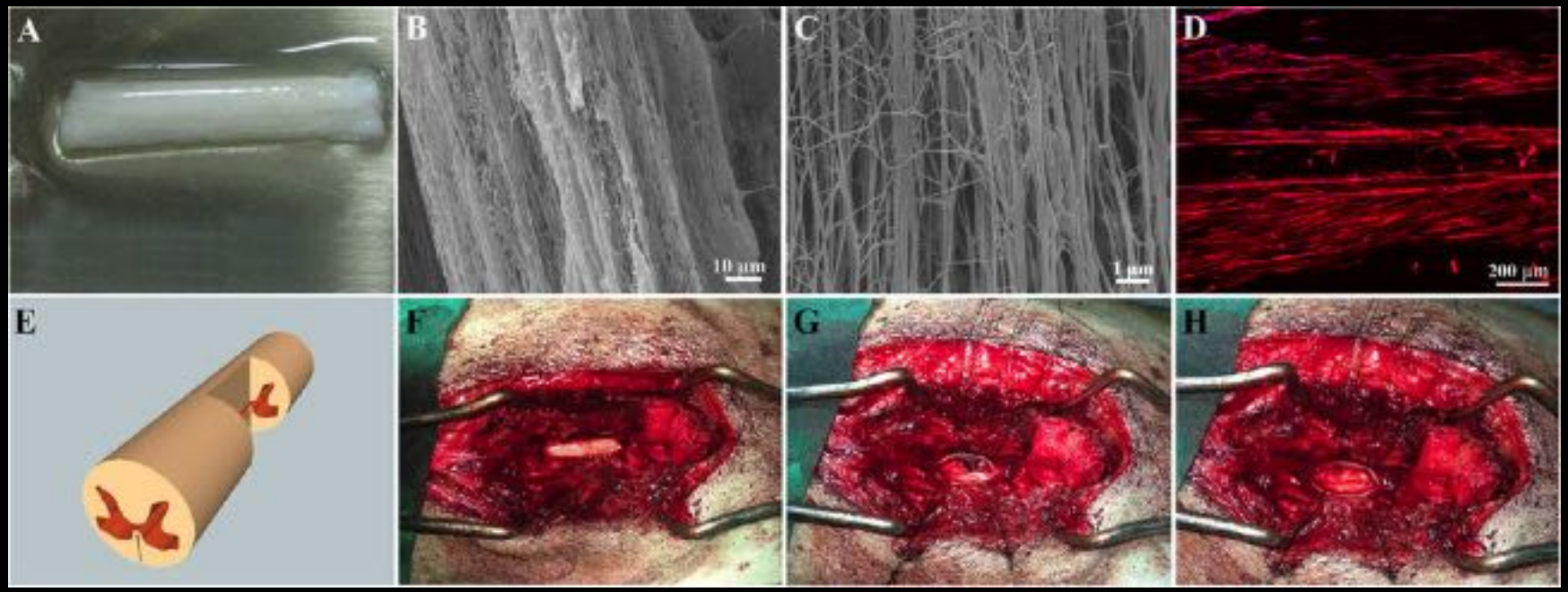

Presynaptic neuron
Postsynaptic neuron
Na+
Riluzole
Non NMDA receptor
Na+
Cellular edema
Na+
Riluzole
Ca2+
Cellular death
Ca2+
NMDA receptor
Glutamate

Cell based therapies:

- Schwann cells
  - Facilitate peripheral nerve repair – Graft into SCI
- Olfactory ensheathing cells
  - Allow neuronal growth and regeneration
- Mesenchymal stem cells
  - Multi-potent connective tissue cells
- Neuronal precursor cells
  - Multi-potent CNS cells
- Oligodendrocyte precursor cells

Biomaterials:

- Biomaterials which can be impeded with growth factors
- Fill defect and release factors around SCI



Steroids

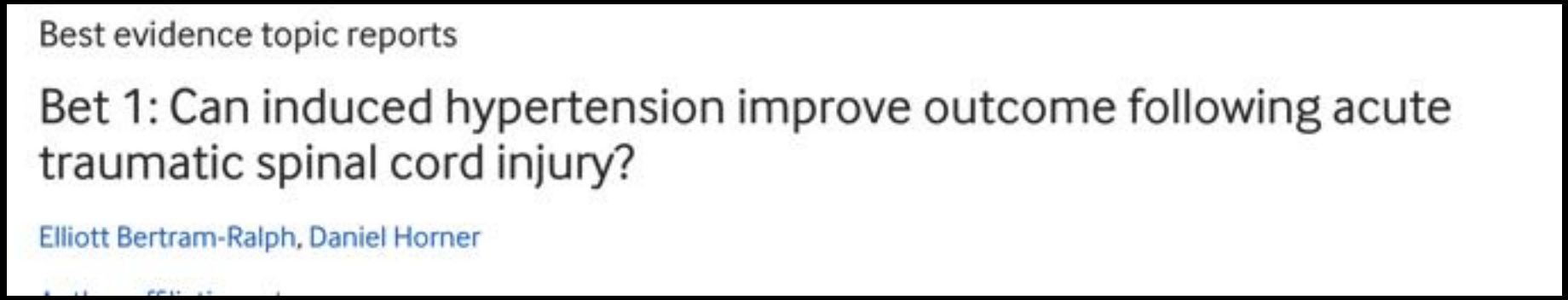
- Not routinely used in NZ or Aus
- Methylpred decreases oxidative stress
- National Acute Spinal Cord Injury Study I/II/III
  - No benefit in initial analyses
  - Sub-group benefit in NASCIS II/III if treated within 8 hrs with higher doses and for 48 hrs – Post-hoc
  - 30mg/kg bolus & 5.4mg/kg/hr for 23 hrs
  - AANS guidelines for SCI – Not recommended
  - AO spine guidelines for SCI – Give if <8hrs

THE GREY ZONE

JASON MCMILLAN

BP Augmentation

- Enhance & maintain cord perfusion
  - MAP 85-90 current recommendation from AANS guidelines on SCI
  - Initiate as soon as possible and maintain for 7 days
  - Enough evidence to suggest it helps but not to recommend firmly as best practice


Best evidence topic reports

Bet 1: Can induced hypertension improve outcome following acute traumatic spinal cord injury?

Elliott Bertram-Ralph, Daniel Horner

Hypothermic Augmentation:

Hypothermic Augmentation:

- Rapid cooling to 32-34 degrees with endovascular control for 72 hrs
  - ? Neuro-protective after cardiac arrest
  - Early pilot study of n=14 suggested some improvement in ASIA A patients

Protocol Synopsis*

ARCTIC (Acute Rapid Cooling for Traumatic Injuries of the Cord)

A prospective, multi-center trial of moderate intravascular hypothermia for the treatment of acute traumatic cervical spinal cord injury.

Case:

- Mrs JW
  - 61 year old female
  - Riding horse in Dannevirke
  - Fell landing in head
  - 20 mins complete quadraplegia
  - Arrive ED WPH 7:02pm – Cat 1
    - Assessed, recognized as SCI - CT

CT – 8.35pm

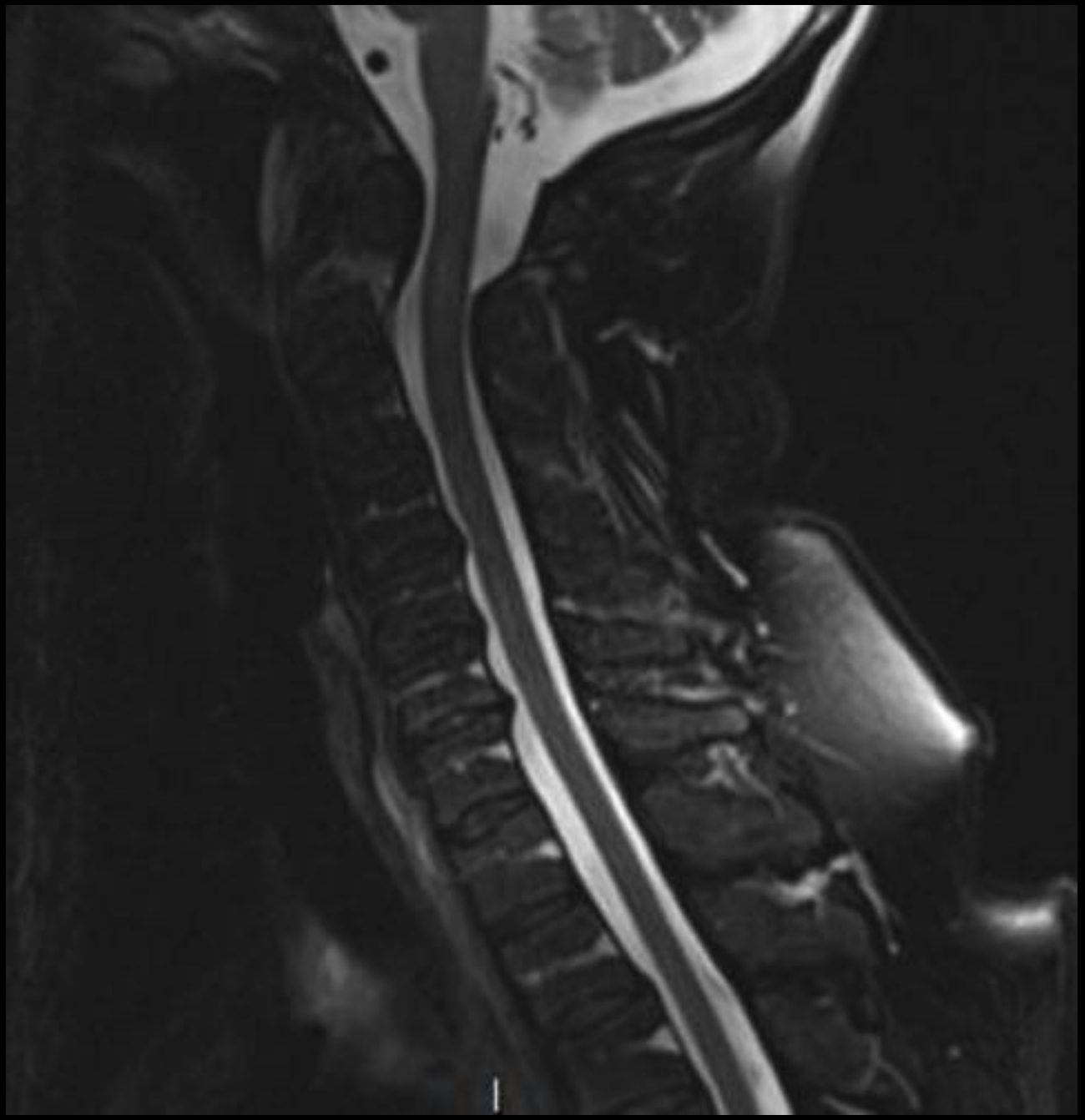
- Severely displaced C2 #
- Examined and films TF to Burwood

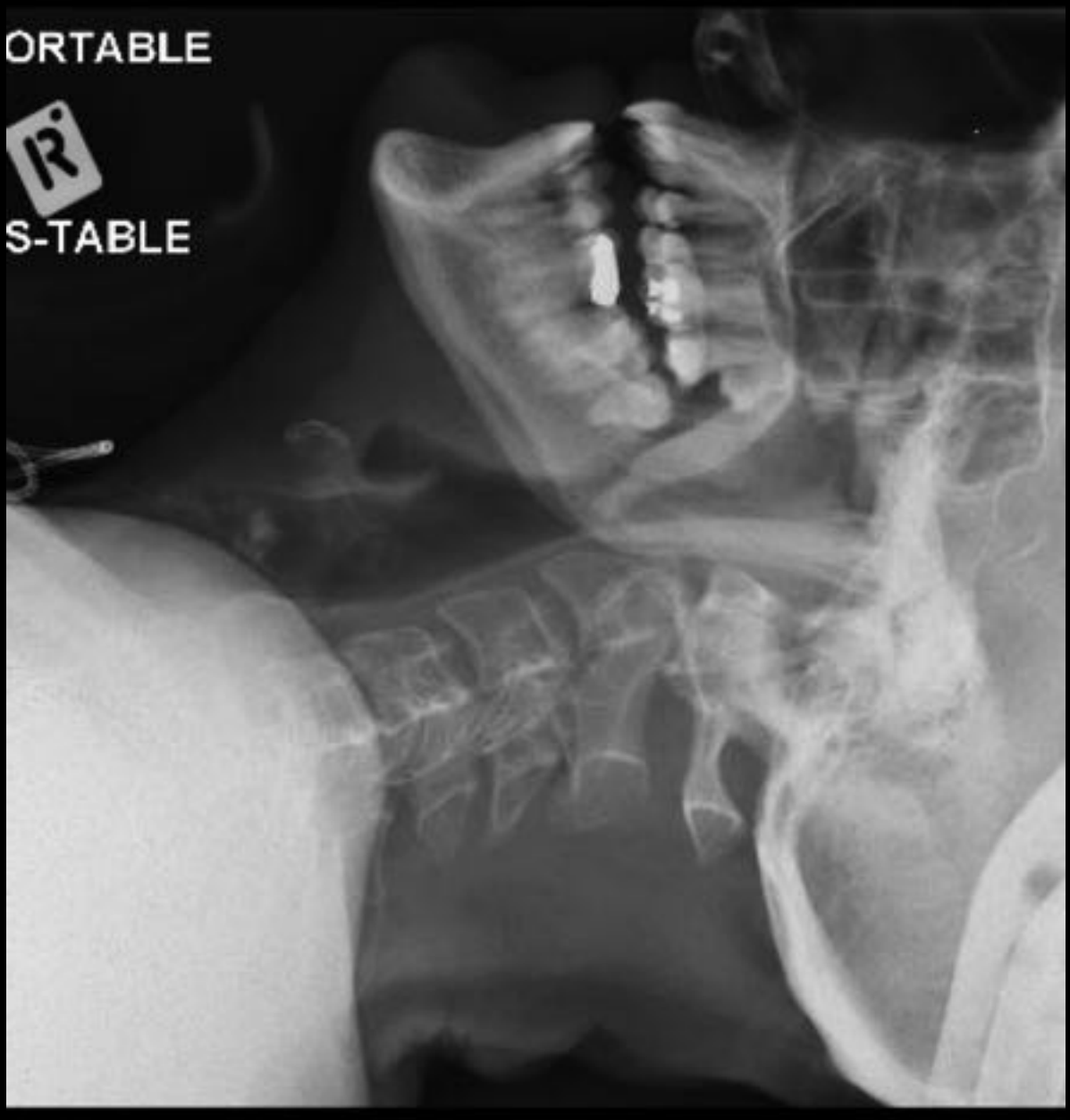
Taken to OT

- MUA/Halo traction – Under sedation
- II shot in OT
  - 0030
  - Fracture reduced within 5 hours

Call-out MRI - 0130

- Good team co-ordination
- Patient claustrophobic
  - OT, MRI, ICU + traction all under sedation
  - Traction placed in ICU maximal flexion as requested by Burwood




ORTABLE
S-TABLE

Phone call too BSI 0730

- Need to review
  - PACS issues – cant see
  - Now need spinal surgeon to r/v
- Phone call 1200
  - Too unstable to transfer in collar
  - Want reduced again in HALO jacket
  - Orthotics call-out (not on site)
  - OT again 3.40PM


(15:41)

ICU-ICU Tf

- Finally!!!
- Most important issue is reduction/decompression was achieved ASAP
- Delays after that unlikely to cause any ongoing issues (except frustration)