#### Friday, January 12, 2018 Balgrist University Hospital, Zurich

Interdisciplinary Symposium Complex Spine Symposium -Cervical Spine



#### Der Balgrist



UniversitätsSpital Zürich

#### Management of Complex Cervical Spine Trauma Case Illustrations

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Fellow Royal Society Chair AOSpine SCI Knowledge Forum











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# Outline

- Illustrate the principles of management of "complex" cervical spine trauma
  - "complex": association with spinal cord injury; deformity; complex underlying spine pathology eg ankylosing spondylitis
- Refer to the AOSpine SCI Guidelines
  - Role and timing of surgical intervention
  - Role of methylprednisolone in SCI

## **Case Illustration Complex fracture with high cervical SCI**

- 26 year old professional gymnast, performing a trapeze act – missed a transfer and hit the safety net with an audible snap
- lost all movement and sensation below the neck
- Neuro exam: complete C4 ASIA A Balorist Univer
  - no sacral sparing

# XR/CT







## Next steps?

- Steroids Y/N?
- Timing of decompression?
- Traction?
- Open reduction? How?
- Anterior? Posterior? Anterior/posterior?
   January United States

# **Medical management + Traction**

- Methyl Prednisolone protocol
- Mean BP maintained over 85 Dopamine

Balorist Univer

Attempted closed reduction with Halo traction

# Traction













# Post op MR: Nov 2005



# 1 year followup

- Remains ASIA A
  Begained 1 motor level
  South of the second s

# **Case Illustration-2**

- 61 year old male
- PMx AF on warfarin, INR 1.87
- Initial presentation at ER
  - fell while intoxicated, axial neck pain, neurologically intact
  - seen at outside hospital, x-rays done, DC home.
- 3 days later
  - Re-presented to ER with progressive weakness of all 4 limbs
  - Transferred to TWH



- Power
  - Biceps 3/5, wrist extension 3/5, triceps, fingers 1/5.
  - Balorist University – Lower limbs were 0/5
- Sensory
  - T4 sensory level
- AIS A







# Options?

- Non Operative Treatment
  - HALO immbolisation
- Surgical Stabilization Balorist
  - Anterior alone
  - Posterior alone
  - Anterior and Posterior

## Treatment

Initial HALO immobilization in situ in ICU Reversal of anticoagulation Inotropes Posterior decompression C2 to T1 Large posterior epidural haematoma drained Instrumented fusion C2 (pars), C3 to C7 (lateral mass), T1

(pedicle)







# Outcome-1 year

- ASIA D
- Ambulatory
- January University Hosp Independent hand function

- 57 year old man
- Play fighting with friend 2 weeks earlier
- Attended local emerg DC
- Re-presented with neck pain/head going to side
- Referred to TWH
- Neuro: right hemiparesis
- PHx cerebral aneurysm repair

complet

January University







# Post halo traction - 15 lbs



## Post traction CT/pre-op( $R \rightarrow L$ )

















#### Knowledge Forum Spinal Cord Injury Spinal Cord Injury Management: Up-to-date Evidence Based Recommendations

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#### Clinical Practice Guidelines for the Management of Degenerative Cervical Myelopathy and Acute Traumatic Spinal Cord Injury



- AOSpine North America
- AOSpine International
- Cervical Spine Research
   Society
- American Association/Congress of Neurologic Surgeons

#### **Open Access**

Global Spine Journal Volume 7, Issue 3\_suppl, September 2017

http://journals.sagepub.com/toc/gsja/7/3\_suppl



#### **About the Guidelines**

- An international effort engaging
  - neurosurgeons
  - orthopaedic surgeons
  - physiatrists
  - neurologists
  - primary care physicians
  - additional specialists and allied health professionals
  - · Patients and patient advocates
- The Grades of Recommendation, Assessment, Development and Evaluation (GRADE) Working Group framework was used to develop the guidelines

AOSPINE





#### Early Intervention for Acute Spinal Cord Injury: *Time is Spine*

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PLoS one

# Cervical Spinal Cord Injury: Results of the Surgical Timing Early versus Delayed Decompression for Traumatic in Acute Spinal Cord Injury Study (STASCIS)

James 5-Harrop<sup>2</sup>, Bizhan Aarabi<sup>4</sup>, Christopher Shaffrey<sup>4</sup>, Marcel Dvorak<sup>5</sup>, Charles Fisher<sup>5</sup>, Paul Arnold<sup>6</sup>, Michael G. Fehlings1", Alexander Vaccaro2, Jefferson R. Wilson1, Anoushka Singh1, David W. Cadotte1, Eric M. Massicotte', Stephen Lewis', Raja Rampersaud'

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A Clinical Practice Guideline for the Management of Patients with Acute Spinal Cord Injury and Central Cord Syndrome: Recommendations on the Timing (≤24 hours versus >24 hours) of Decompressive Surgery



On Behalf of the Guideline Development Group

Sponsored by AANS/CNS, AOSpine North America and International and Rick Hansen Institute



American Association of Neurological Surgeons





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Author. vear	Measure	Early	Late	Effect size (95% CI: P value)
Study design		≤ 24 hours	>24 hours	
Cervical and Thoracic	and Lumbosacral SCI		•	
Dvorak, 2015	ASIA Impairment Score			Adjusted estimates †
Prospective cohort study	"Improved score" in AISA patients	n = NR	n = NR	Beta: 0.068 (-0.625 to 0.76); p = 0.848
	"Improved score" in AIS B, C, and D patients	n = NR	n = NR	Beta: 6.258 (0.618 to 11.897); p = 0.03
Wilson, 2012	ASIA Impairment Score (pre-op to	n = 33	n = 49	
Prospective cohort	a cute-care discharge (mean 24.8 ±			GX
study	29.2 days))			Una djusted RR
	≥ 1 grade improvement, n (%)	7 (21.2)	9 (18.4)	1.15 (95% Cl 0.48 to 2.79), p = 0.7499
	≥ 2 grade improvement, n (%)	3 (9.1)	1 (2.0)	4.45 (95% Cl 0.48 to 41.0), p = 0.2974
	ASIA Motor Score improvement (mean)	6.2	9.7	p = 0.18
	Pre-op to inpatient rehabilitation discharge (mean $89.6 \pm 47.4$ days)	n = 22	n = 33	Unadjusted RR:
	$\geq 1 \operatorname{grade} \operatorname{AlSimprovement} n(\%)$	9 (10 9)	10 (20 2)	1.22 (05% CL 0.61 + 0.2 02) = 0.4700
$\mathbf{G}$	≥ 2 grade AIS improvement, n (%)	6 (27.2)	1 (3.0)	8.9 (95% Cl 1.12 to 70.64), p =0.0154
	Multivariate analysis predicting	NR	NR	Adiusted Effect estimate§ = 13.0, p = 0.01
	rehabilitation discharge			
	Moon change (+ SD) from	5		ער אין
	Iviean change (± 5D) from			
	baseline in motor score improvement‡			
	S.o.	•		

<u>Main Results</u>: Patients treated early for central cord syndrome achieved significantly greater improvements in neurological and functional status than those decompressed late

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			C	
Author, year	Measure	Early	Late	Effect size
Study design		≤ 24 hours	>24 hours	
Acute central cor	d injury without instability			
Lenehan (2010)		n = 17	n = 56	OR <sub>adj</sub> **
Prospective	AIS Improvement at 6-months§	NR	NR	3.39 (95% CI 0.75 to 15.34), p = 0.1131
observational	AIS Improvement at 12-months§	NR	NR	2.81 (95% CI 0.48 to 16.60), p = 0.2548
study				Group Difference**:
	Total Motor Score Improvement at	NR	NR	7.47 (95% Cl -0.04 to 14.91), p = 0.0511
	6-months			• X N
	Total Motor Score Improvement at	NR	NR	6.31 (95% Cl 0.44 to 12.18), p = 0.0359
	12-months			
		n = 17	n = 56	Group Difference*
	FIM motor sub-score improvement	NR	NR	6.92 (95% Cl -0.11 to 13.96), p = 0.0537
	from discharge to 12-months	1		
	FINITOTALS CORE I mprovement from	NR	NR	7.79 (95% Cl 0.09 to 15.49), p = 0.0474
	discharge to 12-months			
			Ť	
	83105	St		

			Jum	
Author, year	Measure	Early	Late	Effect size
Convical SCI		s 24 nours	>24 nours	
Fehlings 2012	Innatient postoperative	n*=182	n*=131	Unadjusted BB (95% CI)
Prospective cohort study	complications Cardiopulmonary Construct Failure Requiring Surgery	32 (17.6) 3 (1.6) 0 (0) 4 (2.2)	34 (26.0) 1 (0.8) 2 (1.5)	0.68 (0.44 to 1.04) 2.16 (0.23 to 20.53) Incalculable
	Neurologic Deterioration	(2.2)	2(15)	2.88(0.33(023.40))
	Pulmonary Embolism	6 (3 3)	8 (6 1)	0.54 (0.19 to 1.52)
	Systemic Infection	1 (0 5)	1 (0.8)	$0.72(0.05 \pm 0.11.40)$
	Wound Dehiscence	1 (0.5)	1 (0.8)	0.72 (0.05  to  11.40)
	Mortality: <30d post-injury	3 (1.6)	0 (0)	Incalculable
	Mortality; >30d post-injury			X
Cervical and Thoracolumbar SCI				
Bourassa-Moreau, 2013 Retrospective cohort study	Acute stay postoperative complications	n = 90 15 (16.7)	n = 341 91 (26.7)	Unadjusted RR (95% CI)† 0.62 (0.38 to 1.02)
<sup>2</sup>	Pressure Ulcer	12 (13.3) 18 (20.0)	83 (24.3)	0.82 (0.52 to 1.29)
	Other Complications	11 (12.2) 3 (3 3)	9 (2 6)	0.76(0.41(01.39)) 1.26(0.35 to 4.57)
$\sim 0^{\circ}$	Mortality	5 (5.5)	5 (2.0)	1.20 (0.33 (04.37)
Thoracolumbar SCI				
Rahimi-Movghar, 2014	Postoperative complications	n=16	n=19	Unadjusted RR (95% CI)
RCT	Deep vein thrombosis	1 (6.2)	1 (5.2)	1.2 (0.08 to 17.5)
	Wound infection	NR	1 (5.2)	Incalculable
	CSFleak	NR	1 (5.2)	Incalculable
	Meningitis	NR	1 (5.2)	Incalculable
	Decubitisulcer	NR	1 (5.2)	Incalculable
	Revision of surgical screws	2 (12.5)	3 (15.7)	0.79 (0.15 to 4.16)
	Bilateral rod fracture	NR	1 (5.2)	Incalculable
	Death	1 (6.2)	1 (5.2)	1.2 (0.08 to 17.5)

#### From Evidence to Guidelines: Toronto 2015



#### Our Multidisciplinary Guideline Development Group

- Neurosurgeons
- Orthopedic Surgeons
- Neurologists
- Critical Care Physicians
- Physical medicine/Rehabilitation Specialists
- Nurse

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- Patient Advocates
- Researchers
- Methodologists

#### Key Questions and Points of Consideration

- What is the overall certainty of this evidence?
- Is there important uncertainty about how much people value the main outcomes?
- Are the desirable anticipated effects large?
- Are the undesirable anticipated effects small?
- Are the desirable effects large relative to undesirable effects?
- Are the resources required small?
- Is the incremental cost small relative to the net benefits?
- What would be the impact on health inequities?
- Is the option acceptable to key stakeholders?
- Is the option feasible to implement?



			positi		
Form	nulating F	Recomme	endations	9	
		S	, ,	~~~	~?
Balance of consequences	Undesirable consequences <i>clearly</i> <i>outweigh</i> desirable consequences in most settings	Undesirable consequences probably outweigh desirable consequences in most settings	The balance between desirable and undesirable cons equences <i>is closely</i> <i>balanced or uncertain</i>	Desirable consequences probably outweigh undesirable consequences in most settings	Desirable consequences <i>clearly</i> <i>outweigh</i> undesirable consequences in most settings
	0	0	0	0	0

		0		-
Type of recommendation	We recommend against offering this option	We suggest not offering this option	We suggest offering this option	We recommend offering this option
<u> </u>	0	0	0	0
0	201	Jul 1		
	83	JIST		

#### Final Recommendations

- We <u>suggest</u> that early surgery (within 24 hours) be considered as a treatment option in adult patients with traumatic central cord syndrome
- We <u>suggest</u> that early surgery be offered as an option for adult acute SCI patients regardless of level.

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#### Methylprednisolone for Acute Incomplete Spinal Cord Injury: AOSpine Guidelines

#### Michael G. Fehlings MD PhD FRCSC FACS FRSC



www.uhn.on.ca/programs/spine

### **AANS/CNS SCI Guidelines 2002**

This chapter remains the most controversial of the Guidelines. The readers are advised to carefully review the available data and Comments provided within this Supplement to establish their own perspective on this evolving matter.

Mithael LJ. Apuzzo

#### Pharmacological Therapy after Acute Cervical Spinal Cord Injury

#### RECOMMENDATIONS CORTICOSTEROIDS:

Standards: There is insufficient evidence to support treatment standards.

Guidelines: There is insufficient evidence to support treatment guidelines.

Options: Treatment with methylprednisolone for either 24 or 48 hours is recommended as an option in the treatment of patients with acute spinal cord injuries that should be undertaken only with the knowledge that the evidence suggesting harmful side effects is more consistent than any suggestion of clinical benefit.

Hadley et al. Pharmacological Therapy after Acute Cervical SCI. Neurosurgery, 2002.

## **AANS/CNS SCI Guidelines 2013**

#### RECOMMENDATIONS

Level I

 Administration of methylprednisolone (MP) for the treatment of acute spinal cord injury (SCI) is not recommended. Clinicians considering MP therapy should bear in mind that the drug is not Food and Drug Administration (FDA) approved for this application.

Hurlbert et al. Pharmacological Therapy for Acute SCI. Neurosurgery, 2013

# What has changed to warrant change in recommendation?



#### **Evaluating the Body of Evidence**

- What's new since 2002?
- Two key pieces of data that I suspect came after the closure of the literature search by Hurlbert et al
- One meta-analysis of the literature (Cochrane review): Level I data (2012)

32105152

- Not included (
- One prospective cohort study: Level II
  - Subanalysis of the STASCIS trial (2012)
  - Examined complications on cervical SCI
    - » Not included



DOI: 10.1002/14651858.CD001046.pub2.

#### **Cochrane Review 2012**

- •8 trials included in this review
- •7 used Methylprednisolone

Methylprednisolone sodium succinate improves neurologic outcome up to one year post-injury if administered within eight hours of injury and in a dose regimen of: bolus 30mg/kg over 15 minutes, with maintenance infusion of 5.4 mg/kg per hour infused for 23 hours

*no evidence of significantly increased complications* or mortality from the 23hour therapy.

High-dose methylprednisolone steroid therapy is the only pharmacologic therapy shown to have efficacy in a Phase 3 three randomized trial when administered within eight hours of injury

#### **Updated Meta-Analysis**



# Motor score in patients treated within 8 hours at final follow-up of 6-12 months

		MPSS			ontrol			Mean Difference	Mean Di	fference
Study	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Rando	m, 95% CI
RCT					-					
Bracken 1990-3	15.99	13.06	65	11.21	13.03	68	49.2%	4.78 [0.34, 9.22]	8	
Dtani 1994	14.2	15	70	10.3	15.4	47	30.5%	3.90 [-1.73, 9.53]		
Pointillart 2000 Subtotal (95% CI)	18	27.4	27 162	23.7	24.6	23 138	4.7% 84.4%	-5.70 [-20.12, 8.72] 3.88 [0.50, 7.27]	·	
Heterogeneity: Tau <sup>2</sup> =	0.00; 0	$hi^2 = 1$	.85, df	= 2 (P =	= 0.40);	$i^2 = 09$	6			
Test for overall effect	Z = 2.2	5 (P =	0.02)					O		
Prospective cohort		1					N'L			
Evaniew 2015 Subtotal (95% CI)	13.7	15.6	44 44	14.1	21.6	44	15.6% 15.6%	-0.40 [-8.27, 7.47]		
Heterogeneity: Not an	olicable									
Test for overall effect	Z = 0.1	0 (P =	0.92)			$\square$	)	C		
Total (95% Ci)			206		$\mathcal{O}$	182	100.0%	3.21 [0.10, 6.33]		•
Heterogeneity: Tau <sup>2</sup> =	0.00; C	$hi^2 = 2$	.81, df	= 3 (P.+	= 0.42);	$1^2 = 09$	6		10 6	+ 1
Test for overall effect	Z = 2.0	2 (P =	0.04)	$\frown$	- 102				-10 -5 Control	Favors MPSS
Test for subgroup dif	ferences	: Chi <sup>2</sup> =	0.96,	df = 1 (	P = 0,3	3), l <sup>2</sup> =	0%		Tarois Control	ravois Mr35

Mean Weighted Difference in motor score recovery for MPSS vs. MPSS Non-treated Patients :3.21 (95%CI: 0.10, 6.33)



RESEARCH ARTICLE

0

# Patients with Spinal Cord Injuries Favor Administration of Methylprednisolone

Christian A. Bowers <sup>1</sup>, Bornali Kundu <sup>1</sup>, Jeffrey Rosenbluth<sup>2</sup>, Gregory W. J. Hawryluk <sup>1 \*</sup>

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PLOS ONE | DOI:10.1371/journal.pone.0145991 January 20, 2016

# Risk Difference for Death 24 hour MPSS vs. Control

			MPSS	2.		Control				0
Outcome	Author (Year)	Events	Total	(%)	Events	Total	(%)	Effect Estimate (%)	Weight (%)	RD (%) [95% CI]
Death	Bracken 1990-2	7	162	(4.32)	12	171	(7.02)		28%	-2.70[-7.64,2.25]
	Otani 1994	- 1	81	(1.23)	3	70	(4.29)		24%	-3.05 [-8.37, 2.27]
	Matsumoto	0	23	(0)	0	23	(0)		11%	0.00[~8.08,8.08]
	Evaniew 2015	0	44	(0)	0	44	(0)		37%	0.00[-4.33,4.33]
	Pooled:	8	310	(2.58)	15	308	(4.87)		49 <b>4</b> . 1993 (1	-1.51 [-4.13, 1.12]
	Overall Effect: P	= 0.261;1	Heteroge	neity: IA	2 - 0%	2000				0.01857538975567755
Differ	cence in rat	tes o 1.51	of d %	eatl (95)	h fo %C	r M 21: -	PSS 4.13	5 vs. Contro , 1.12)	ol Patie	nts:

## Risk Difference for Wound Infection 24 hour MPSS vs. Control

			MPSS	2		Control	C	, O		0
Outcome	Author (Year)	Events	Total	(%)	Events	Total	(%)	Effect Estimate (%)	Weight (%)	RD (%) [95% CI]
Wound Infection	Bracken 1990-2	11	156	(7.05)	6	167	(3.59)		30%	3.46[-1.45,8.37]
	Pointillart 2000	0	35	(0)	0	30	(0)	an 10	21%	-0.22[-6.08,5.63]
	Matsumoto	0	23	(0)	0	23	(0)		11%	0.00[-8.08,8.08]
	Evaniew 2015	0	44	(0)	0	44	(0)		38%	0.00[-4.33.4.33]
	Pooled:	11	258	(4.26)	6	264	(2.27)	_		0.98[-1.70, 3.66]
	Overall Effect: P	= 0,472; }	leteroge	neity: IA3	2 = 0%			· × · ·		

-20.00 0.00 10.00 20.00 Fayors MPSS Favors Control

Difference in rates of wound infection for MPSS vs. Control Patients

0.98% (95%CI: -1.70, 3.66)

## Risk Difference for Pneumonia and PE 24 hour MPSS vs. Control

			MPSS	8 C	0	Control					$\sim$
Outcome	Author (Year)	Events	Total	(%)	Events	Total	(%)		Effect Estimate (%)	Weight (%)	RD (%) [95% CI]
PE	Bracken 19902	6	156	(3.85)	2	167	(1.2)	i -		81%	2.65 [ -0.79, 6.09]
	Pointillart 2000	11	35	(31.43)	9	30	(30)	-	<u> </u>	- 2%	1,43 [ -21.05 , 23.91 ]
	Evaniew 2015	2	44	(4.55)	0	-44	(0)	1		18%	4.44 [ -2.92, 11.80 ]
	Pooled:	19	235	(8.09)	11	241	(4.56)		-	$\mathbf{O}$	2.94 [ -0.15, 6.03 ]
	Overall Effect: P	= 0.062; 1	Heteroge	eneity: IA:	2 = 0%						S. 6 S
Pneumonia	Bracken 19902	44	156	(28.21)	41	167	(24.55)			67%	3.65 [ -5.96 , 13.27 ]
	Evaniew 2015	7	44	(15.91)	C 4	-44	(9.09)		il.	- 33%	6.82 [-6.93, 20.56]
	Pooled:	51	200	(25.5)	45	211	(21.33)	Ř	5		4.69[-3.19, 12.57]
	Overall Effect: P	= 0.243; 1	leteroge	sneity: M	2 = 0%			. (			000000000000000000000000000000000000000
	)	0	$\overline{C}$				-20	00	0.00 10.00	20.00	
	4	10						Favor	s MPSS Favors Contro	1	

**Difference in rates of pneumonia and PE for MPSS vs. Control Patients** 

> 4.69% (95% CI: -3.19, 12.57) 2.94% (95% CI: -0.15, 6.03)

## **Role of Steroids in Cervical SCI**

Balorist Unive

- New data from the STASCIS study
- MPSS and early surgical intervention-
  - Lower complications
  - Improved neurological outcomes

# In Cervical SCI Cases, Steroids have a 12.6% reduced risk of complications



Independent analysis of STASCIS data: Joseph Detorri PhD; Spectrum Research Folie 57

**M1** MGF; 18.10.2013

complex spine symposium complex spine symposium January 2018 January 12th, 2018

#### Our Recommendations

#### **MPSS**

When started within 8 hours of injury, we suggest that a 24 hour infusion of high dose MPSS be offered to adult patients with acute SCI as a treatment option

We suggest not offering a 24 hour infusion of high dose MPSS to adult patients who present after 8 hours with acute SCI

For adult patients with acute SCI, we suggest not offering a 48 hour infusion of high dose MPSS

#### **Take Home Points re: MPSS and SCI**

- IV MPSS post SCI should be considered a valid option
- Importantly, there is no existing evidentiary basis to recommend against its use as a treatment option in this context
- Decisions surrounding this therapy should be left to the discretion of the physician
  - --considering the characteristics of the presenting patient
- Consider the use of MPSS (24 hrs infusion; started within 8 hrs) in cervical SCI and incomplete SCI in combination with surgical decompression

#### Take home messages

- Time is Spine
  - Early surgical intervention for acute spinal cord injury (within 24 hours of injury) should be undertaken regardless of level of injury, when medically feasable
- Small Effects can Matter especially with Cervical Injury
  - High dose methlyprednisolone (NASCIS-2) can be administered sately within 8 hours after SCI for 24 hours and is suggested as a valid treatment option for non-penetrating spinal cord injury
- Traction
  - An option to reduce complex traumatic cervical deformity and greatly simplify the management