MRI and neurology in acute whiplash trauma

No correlation in prospective examination of 39 cases

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39 consecutive cases of whiplash injury of the neck were examined clinically and with MRI at a mean of 11 days after trauma. 26 of these showed changes on MRI with disc lesions in 25, 10 of which were classified as disc herniations, and a muscle lesion in 1 case. All had neck pain or headache. 29 cases had neurological deficits, mostly sensibility disturbances. 22 of the 26 cases with pathologic MRI findings had neurological signs, as had 7 of the 10 cases with disc herniation. The relationship between the MRI findings and the clinical symptoms and signs was poor.

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Earlier investigations of whiplash injuries with MRI have been performed several weeks after injury on selected patients with persisting symptoms (Yarnell and Rossi 1988, Jónsson 1992). We report the initial clinical symptoms and signs in relation to the early magnetic resonance findings after acute whiplash injury.

Patients and methods

This prospective study includes 39 consecutive patients, 20 women and 19 men, with a mean age of 32 (18–52) years, treated between November 1991 and May 1992 at our department for whiplash injury in car accidents. Those with a head injury, unconsciousness, fracture or dislocation of the cervical spine or a previous history of neck injury or neck pain were excluded from the study.

16 of the collisions were front-end impacts, 15 rear-end, 2 single and roll-over, and 6 side collisions. 37 patients had cars equipped with a headrest and 36 used seat-belts. 29 of the injured were drivers, 8 frontseat and 2 rearseat occupants.

The patients were initially examined at the emergency department by an orthopedic surgeon and acute radiographs were obtained in all cases. On the same day as the MRI was performed a neurological examination (Table 1) by one of the authors was done, without knowledge of the MRI findings. A standardized questionnaire, including VAS scales, was used for evaluation of symptoms.

MRI was performed with a mean of 11 (4–15) days after the injury in a blind manner by two radiologists who did a first reading separately and a second reading together in order to achieve consensus in all cases (Table 1). The reading was performed without any knowledge of the patients' symptoms or clinical findings. MRI parameters included the evaluation of disc-bulging, either with impingement of the anterior subarachnoid space or with medullary compression, foraminal stenosis, dorsal ligamental thickening, osteophyte extension, and of intramedullary or paravertebral soft tissue injury. All changes were graded on a 4-point scale; 0 normal, 1 slight, 2 moderate, 3 severe.

A Philips T5 magnetic working at 0.5 Tesla (T) was used in all cases. All patients had a sagittal T1-weighted and a gradient-echo (GE) sequence. In case of any pathological changes GE transverse images were also obtained. 12 patients with normal findings had no transverse images. The examination time did not exceed 30 min.

Results

26 patients showed changes on MRI. Disc lesions were seen in 25 patients. 10 had disc herniation, 3 with medullary and 7 with dura impingement. 4 patients had foraminal stenosis.

1 patient had a vertebral hematoma but no signs of fracture on plain radiograms (Case 17). In Case 3 a rupture of the longissimus colli muscle was seen,

Table 1. Observations in 39 patients with whiplash injury

	Neurological findings													MRI findings					
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1			+	+				+		+	+		4		1 C4/5				
2				+	+			+		+					1 C4/5, 1 C5/6				
3					+	+		+	+	+	+					2 C5/6			a
4									+	+									
5				+				+								1 C4/5			
6				+	+														
7		123			+			+	+	+		+	134						
8		12	+			+			+	+				+		2 C3/4, 3 C6/7L	2 C6/7R	C6/7R	b
9		3							+		+								
10										+									
11					+										1 C5/6	2 C5/6			
12																2 C4/5/6L	1 C4-6L	C4-6L	
13								+	+		+				1 C4/5	1 C4/5R			
14		1				+		+	+	+		+	1234			2 C6/7R			
15					+			+								1 C3/4/5/6			
16																			
17																			c
18		123	+					+	+	+	+								
19																			
20		123	+			+	+	+	+	+					1 C5/6	1 C4/5			
21					+								1		1 C4/5/6	2 C4/5/6			
22															1 C3/4/5	1 C3/4/5/6, 2 C6/7 L			
23																			
24		23	+		+				+	+						2 C2/3R			
25				+				+	+	+	+					3 C5/6R		C5/6R	
26										+									
27			+	+	+			+	+	+					1 C6/7				
28															1 C5/6	1 C5/6R			
29								+							1 C5/6				
30	+								+	+						1 C5/6/R			
31				+	+					+					1 C3/4/5				
32																			
33						+		+	+	+		+							
34		3							+	+		+	4		1 C4/5/6	1 C4/5R			
35															1 C5/6	1 C4/5R			
36															1 C5/6		1 C3/4R		
37						+				+					1 C4/5/6				
38		123			+					+			4						
39	+				+	+		+							1 C5/6	1 C4/5L			

A Case
B Pharyngeal reflex absent
C Superficial sensation test for Trigeminal nerve
  1 ophthalmic
  2 maxillary
  3 mandibular
D Reduced muscle strength, upper extremity
E Finger wiggle
F Dysdiadochokinesia
G Positive postural fixation test (Grassé)
H Finger-nose-test positive
I Positive Romberg test
J Light-touch test absent or decreased
K Superficial pain test decreased
L Two-point discrimination decreased
M Temperature test decreased
N Muscle-stretch reflexes decreased
  1 biceps
  2 triceps
  3 brachioradialis
  4 finger-flexor
O Reduced signal intensity of the intervertebral discs
P Ventral disc bulging
Q Dorsal disc bulging
R Extension of osteophytes
S Spinal stenosis
T Other findings
  a muscle rupture
  b medullary cord signal intensity changes
  c vertebral hematoma Th1

Changes on MRI
1 slight
2 moderate
3 severe
L left
R right

and Case 8 had increased signal intensity of the medulla.

Initially 37 patients complained of neck pain and 25 had occipital headache. 27 patients presented with shoulder discomfort or interscapular pain. 10 patients reported amnesia but had not been unconscious, 9 had vertigo, 11 visual symptoms like blurred vision and photophobia, 6 had auditory symptoms, and 6 complained of dysphagia. 20 had numbness of arm and hand and 7 mentioned radiating pain. 1 had nystagmus.

29 patients had neurological deficits. 7 of the 10 patients with disc herniation and foraminal stenosis reported neurological deficits. In 3 of these cases (3, 8, 25) the clinical findings were in agreement with the MRI findings.

At follow-up, 6 months after injury, 8 patients still had neurological deficits. 11 had neckpain and headache, 4 reported impairment of memory and concentration, 7 had radiating pain, 4 numbness of arm and hand. 5 were still on sick-leave. 2 were operated on with discectomy and anterior fusion. 26 patients had no symptoms or signs at follow-up.

Discussion

Our consecutive series is comparable to earlier whiplash studies concerning age, sex and type of car accident (Hohl 1974, Greenfield and Ilfeld 1977, Hodgson and Grundy 1989).

Contrary to early reports (Hohl 1974, Otremski et al. 1989, Radanov et al. 1992) the majority of our cases had neurological deficits on clinical examination. The difference may be explained by our early examination as well as by the discrete neurological findings which could be overlooked on a routine examination in the emergency department. Further, the clinical assessment of cutaneous sensibility is crude and objective investigations are necessary to verify our findings.

Pathologic MRI findings were present in two thirds of the cases. Previous whiplash studies are retrospective on selected cases and not comparable to our findings. However, in a recent MRI investigation of the cervical spine in asymptomatic subjects without neck injury, 19 percent showed major abnormalities (Boden et al. 1990). 10 percent had herniated nucleus pulposus, compared to 25 percent in our series, which also is higher than the incidence of filling defects observed on cervical myelograms of asymptomatic subjects (Hitselberger and Witten 1968). Thus it seems that patients sustaining whiplash injuries of the cervical spine have a higher than normal frequency of MRI findings.

Jónsson (1992) found no ligament rupture on MRI, 6–8 weeks after injury, but proposed that MRI be performed within a few weeks after injury. However, our study revealed only 1 patient with muscle damage and none with ligament rupture. These findings are contrary to the results in earlier studies (Macnab 1971), but in accordance with recent studies in pigs (Svensson et al. 1993)

Despite many pathologic findings on MRI, we found no relationship between these lesions and the neurological deficit in the acute phase. Only 3 cases with disc herniations had segmental radicular pain and sensitivity disturbances corresponding to the affected level.

Our results support earlier findings that hand and arm pain and numbness rarely are caused by nerve root compression in whiplash patients (Hohl 1989). Further, recent studies have shown that brainstem dysfunction might explain some of the symptoms and signs (Hildingsson 1990, Oosterveld et al. 1991, Radanov et al. 1992). The etiology of the different symptoms seems multifactorial, including lesions in neural tissues not explained by the MRI findings.

Thus, neither studies performed several weeks after injury (Yarnell and Rossi 1988) nor our study made shortly after injury could demonstrate significant soft-tissue lesions explaining the symptoms and physical findings.

Thus it seems unnecessary to investigate these cases early after injury with MRI.

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