This talk was presented by **Dr. Robert Mahar** (Lecturer, Department of Medicine, Division of Physical Medicine and Rehabilitation) at the February Refresher Course for Family Physicians in Halifax.

Whiplash is the prototype soft tissue neck injury. There are obviously many other processes which will produce injury to the cervical spine.

Pathophysiology

Whiplash is an acceleration-deceleration mechanism of energy transfer to the neck. It may result from rear end or side-impact motor vehicle collisions, but can also occur during diving or other mishaps. The impact may result in bony or soft-tissue injuries (whiplash injury), which in turn may lead to a variety of clinical manifestations (Whiplash - Associated Disorders -WAD)

Whiplash injury has classically been attributed to rear-end impacts, which was thought to result in forced flexion of the neck. This belief has been refuted in subsequent experimental studies and computer models that have clearly defined the sequence of events following a rear-end collision.

At the time of impact, the vehicle is accelerated forward, followed after 100 ms by a similar acceleration of the patient's trunk and shoulders induced by the car seat. The head, with no force acting upon it, remains static in space, resulting in forced extension of the neck as the shoulders travel anteriorly under the head. Following extension, the inertia of the head is overcome, and it is also accelerated forward. The neck then acts as a lever to increase the forward acceleration of the head and force the neck into flexion. The forces involved are considerable; at impact speed of 20 mph (32 km/h) the human head reaches a peak acceleration of 12 G during extension.

In the "Spine: State of the Art Reviews" (7.3 - September 1993) it is stated "typically the injured individual is the occupant of a stationary vehicle that is struck from behind, although injury can occur following side and head-on collisions. Injury results because the neck is unable to compensate adequately for the rapidity of head and torso movement resulting from the acceleration forces generated at the time of impact. When the physiologic limits of cervical structures are exceeded, anatomic structure of the soft tissues of the neck (including muscles, ligaments, and joint capsules) results."

Although the mechanism is well understood, the actual pathology is not well defined. Most experts agree that injuries occur to the neck muscles. As well, there may be straining or cartilagenous injuries to supporting structures of facet and apophyseal joints. Injury can occur to anterior and posterior longitudinal ligaments. Esophogeal and laryngeal damage has been reported. There are alleged injuries to the brain. This is controversial and far from certain. Injury may occur to the tmj and low back.

Clinical Spectrum of Whiplash-Associated Disorders

- neck pain
- headache

- dysphagia
- cervicobrachalgia
- tmj dysfunction
- low back pain
- dizziness/vertigo/tinnitus
- anxiety
- Myofascial type of pain

In the text "Spine: State of the Art Reviews" (7.3 - September 1993), it states "myofascial pain is a poorly understood clinical entity despite the fact that it may account for the majority of persistent neck, head and upper thoracic pain following whiplash injury... the trigger point is regarded as a characteristic feature of myofascial pain. Myofascial trigger points are circumscribed (2-5 mm in diameter), self-sustaining, hyperirritable foci of tenderness reported to be located within a taut band of musculoskeletal or its associated fascia. Compressing this hyperirritable focus is locally painful and may give rise to characteristic referred pain, tenderness, and autonomic phenomenon. The area of pain referral, which is surprisingly consistent, is termed the 'zone of reference'.

Myofascial pain is thought to result from an acute muscle strain or overload that occurs at the time of impact. One hypothesis is that a small area of neuromuscular irritability develops and becomes self-sustaining. A tender point may then develop in a band of contracted muscle. Patients recognize certain factors as aggravators of myofascial pain. Aggravating factors are usually related to activities or postures that cause contraction of involved muscles. Alleviating factors generally attribute to relaxation of the involved muscles".

Sequence of Symptoms

Injury occurs. No significant symptoms at the scene. Later that evening, they are aware of some stiffness. The next morning "they can hardly move", "stiff all over". Seek medical examination. Variable duration of this phase.

Motor Vehicle Collision Dynamics

Factors to consider in history include:

1.Type of vehicle striking and struck - Mass ratio. The weight or mass of the striking and struck vehicle have significant influence on injury occurrence. E.g. A large car of 4000 lb and a small car of 2000 lb hit head-on at 30 mph. Mass ration is 2:1. At collision, larger car will slow to 10 mph and the smaller car will be instantly propelled backwards at 10 mph. Larger car has a 20 mph total velocity change while smaller car has 40 mph velocity change. Smaller cars have more severe crash injuries.

2. Speed of travel - This is of absolute importance at high speeds. At low speeds, the correlation between crash velocity and injury occurrence is less predictable

3. Aware if impending collision - Those occupants aware of the impending rear

end crash had less severe injuries. Obviously this is helpful up to a certain speed.
4. Injury to other passengers

5. Extent of damage to vehicle - In general, there is a positive correlation between the extent of damage to the vehicle and the risk of injury. However, this is far from absolute.

6. Position of head - Looking off to the side or down or up is more likely to produce an assymetric load to the neck. It may increase the risk of facet joint injury.

7. Seatbelt - Use of the seatbelt decreases the incidence of head injury significantly. Most epidemiological studies have found that seatbelts increase the risk of minor and moderate neck injuries in automotive collisions. "It appears that there is a trade-off: in order to save lives, belt usage may cause some injuries."

8. Headrest and its position - In the proper position, this reduces injury. If the head restraint is low or absent and the occupant is able to extend backward beyond anatomic limits, the soft tissues may fail to tolerate the rate of loading.

9. Strike any surfaces within the vehicle - commonly head on visor, windshield, knee on dashboard, chest against steering wheel

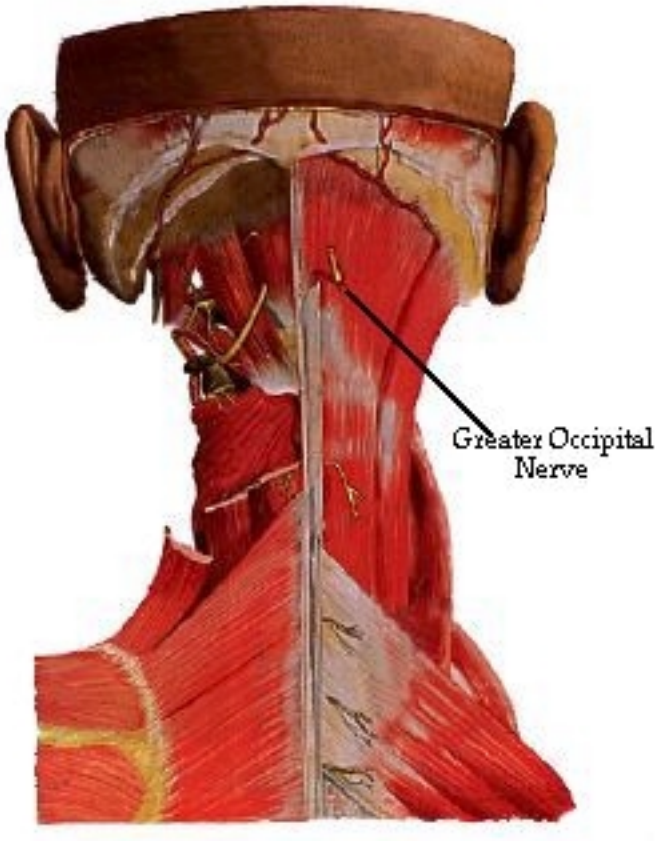
10. Site of impact - side collisions produce more severe injuries than rear crashes. No large mass elements such as engine or bumper to disperse force, side structures are usually of lighter material, involve more vehicle rotation and there is less depth between the striking vehicle and the body of the occupant.

11. Damage to the seat - if the seat breaks off, increases risk of injury and indicative of force imparted

12. Symptoms at the scene - Severe symptoms at the scene are more likely to indicate a bone or joint or neurological injury. Many individuals who we suspect have a facet joint injury are asymmetrically loaded and complain of a fairly localized burning pain on one side of the posterior neck at the scene.

Occipital Headaches

Within two months of injury, 50-80% report headaches in addition to neck pain. After 2 years, 10-25% still complain of headaches. Mechanism is not clear. The following diagram illustrates one hypothesis as it relates to occipital headaches and the postulate that the greater occipital nerve mediates this. It is surrounded by the trapezius and the splenius capitis or neck muscles.



Diagnosis

Quebec Task Force Recommendations

Patients with Grade 1 WAD do not usually need x-rays, -alert, not on alcohol or obtunded by other drugs and no physical signs.

Patients with presumptive Gd II and III- AP, lat, open mouth -all 7 vertebrae. They do not feel flexion and extension views are indicated unless 3 view plain films are equivocal.

Treatment

Quebec Task Force Recommendations[1]

[1] THE QUEBEC CLASSIFICATION OF WHIPLASH ASSOCIATED DISORDERS

"Most therapeutic interventions currently used have not been scientifically validated in a rigorous manner. These unproven treatments include cervical pillows, acupuncture, spray and stretch, TENS, ultrasound, laser, heat, ice, massage, muscle relaxants and psychosocial interventions."

"Treatments evaluated in a scientifically rigorous manner show little or no evidence of efficacy. There is little or no evidence of efficacy for soft cervical collars, corticosteroid injections of the zygoapophyseal joints, pulsed electromagnetic treatment..." . Use of soft cervical collars beyond the first 72 hours probably prolongs disability in WAD.

Interventions that promote activity such as mobilization manipulation, and in exercises in combination with analgesics or non-steroidal anti-inflammatory agents are effective on a time-limited basis.

Based on limited evidence and reasoning by analogy, it is the Task Force consensus that the use of NSAIDS and analgesics, short term manipulation and mobilization by trained persons, and active exercises are useful in Gd II and III WAD, but prolonged use of soft collars, rest, or inactivity probably prolongs disability in WAD."

Reassure that WAD's are almost always self limited. They should be informed that the injury involves temporary discomfort and rarely results in permanent harm. "All interventions, particularly at inception of the episode, should be accompanied by reassurance about favourable prognosis and the need to resume usual activities as soon as possible."

Work Recommendations

Grade	Clinical Presentation
0	No complaint about the neck. No physical signs.
I	Neck complaint of pain, stiffness, or tenderness only. No physical signs
II	Neck complaint AND Musculoskeletal signs *
III	Neck complaint AND neurological signs **
IV	Neck complaint AND fracture or dislocation

* Musculoskeletal signs include decreased range of motion and point tenderness.

** Neurological signs include decreased or absent deep tendon reflexes, weakness, and sensory deficits.

Symptoms and disorders that can be manifested in all grades include deafness, dizziness, tinnitus, headache, memory loss, dysphagia, and temporomandibular joint pain.

Immediate return for Gd I; Gd II "return to usual activities ASAP should be encouraged, typically in less than one week for Gd II."

"Work alterations may be prescribed for Gd II and III WAD, but should be temporary, except for clinical circumstances justified as unusual by the attending clinician or for atypical work environments. The work alteration should be reassessed within three weeks."

"Soft collars are not recommended and should be discouraged. Even in Gd III WAD, soft collars should not be used because they do not adequately immobilize the spine."

Drugs

"No meds should be prescribed in Gd I WAD. In Gd II and III WAD, non-narcotic analgesics and NSAIDs can be used to alleviate pain for a period of less than one week. In Gd III WAD, narcotic analgesics may occasionally be needed for pain relief in the acute phase."

"In chronic cases (at three months or more) minor tranquilizers and antidepressants may be a necessary part of multidisciplinary management. Muscle relaxants should not be used."

Physical Treatments

"The Task Force consensus is that manipulative treatments by trained persons for the relief of pain and facilitating early mobility can be used." "Long term repeated manipulations without multidisciplinary evaluation is not justified."

"Physiotherapy should emphasize early return to usual activity and promotion of mobility. Treatments given for pain relief are recommended primarily on the basis of consensus. Long term physiotherapy without multidisciplinary evaluation is not justified."

They propose an "ideal" patient care guideline:

"The most important principle is to prevent chronicity."
"Unresolved disability in Gd I WAD requires a specialized consultation at three weeks and a mandatory multidisciplinary consultation after six weeks. For Gd II and III WAD, specialized consultation for unresolved cases should take place at six weeks and mandatory multidisciplinary consultation at 12 weeks. Gd I patients with persisting problems should be reassessed in seven days, and Gd II and II WAD patients who have not returned to usual activity in three weeks should be reassessed." Of course these consultations are not readily available in the "real world".

Natural History

Most people recover. In the Quebec study, median time to recovery was 31 days. There are big differences from province to province. Is this due to varying social and insurance

policies? Most people recover over one year.

Risk of developing arthritis[2] is not clear. Unfortunately this cases often involve Medico legal issues[3], so it is wise to document things well at the time of initial evaluation.

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[2] Risk of Developing Arthritis

The 1993 issue of Spine states:

"Although Hohl and Hopp noted that patients with preexisting degenerative change fared slightly better than those without, the occurrence of sharp reversal of the cervical lordosis in this group was associated with a poorer outcome. Balla found a poor correlation of mild degenerative change with neck pain and stiffness, headaches, and upper limb radiation. By contrast, Maimaris et al recorded that symptoms persisted four times as frequently in patients with preexisting degenerative change, and Watkinson et al., reviewing Norris and Watt's series, recorded that no patients with degenerative changes were free of symptoms at a mean of 10.8 years after injury. Hildingsson and Toolanen failed to find any correlation between postural and degenerative changes and outcome."

Croft and Foreman in their 1989 text "Whiplash Injuries - The Cervical Acceleration/Deceleration Syndrome" state "Degenerative changes, as previously discussed, may enhance the effects of the injury, due to the arthopathy of the joints and the ligamentous laxity associated with the condition. Pre-existing degenerative changes, 'no matter how slight,' adversely affect the prognosis."

[3] Medico legal Classification of Injury Severity

The common classification is one which attempts to describe the injury as mild, moderate, or severe.

Mild (first degree strain) - "This describes injuries where there is rapid healing, minimal work loss, and the patient is symptom-free about six months after the injury. These are 'mild' but not 'slight' or 'trivial'".

Moderate (second degree strain) - "Serious symptoms, substantial work loss, and patients generally recover normal lifestyle within six months to two years. 50% will have functional recovery within 12 months. 'Functional recovery' is defined as the ability to perform all normal activities with a competence reasonable for the patient's age, skill, and needs. However, functional recovery may take some years longer, and the patient may never be entirely symptom free."

Severe (third degree strain) - "Often accompanied by other significant injury such as fracture or concussion. Symptoms onset certainly within 48 hours. Long term or even permanent disability. Many patients, up to about 15% will never achieve a functional recovery. 40-70% of patients will permanently have intermittent continuing pain and stiffness which is unpleasant but not materially disabling."

This system is flawed by virtue of attempting to define the anatomic severity of a soft tissue injury by the duration and self reported severity of the symptoms.