

patient is incapable of making decisions, and there are no other authorized individuals able to make decisions;

- (e) the duties of a decision maker and the limits of that person's authority to give consent.

This *Act* can deal with disputes that might arise about giving or refusing health care. The Board will be a last resort.

CONCLUSION

Many aspects of the new legislation are laudable and long overdue, particularly those relating to health care decisions. Unfortunately, lawyers being lawyers, seem to be generally negative and critical of much of this "long time coming" legislation. It appears to me, that the legislation has been largely "social worker" driven, that it is too bureaucratic, and that there are a goodly number of vagaries and inconsistencies in the present legislation. Hopefully many of these concerns will be "fixed" by regulations, or in time, by judicial consideration. I fully expect that lawyers will in fact charge higher fees for such agreements than was intended by the drafters, and that the concept of the monitor will be largely ignored in Section 9 agreements.

However, as with other instances of a major change in practice as a result of new legislation, the Bar will adapt and forge ahead. In time, I submit that all in all, the new legislation will be a significant improvement over the current choices available. My personal wish is that the legislature will allow for the continued use of enduring powers of attorney as a parallel choice to the representation agreement.



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The following article was presented at the Trial Lawyers Association of BC Seminar Brain Injury Litigation: The Essential Conference, 4-5 February 2000. The full set of seminar materials can be purchased by calling TLABC, 604 682-5343 or toll free 1 888 558-5222.

The expert witness in a mild traumatic brain injury (MTBI) case

By Michael J. Slater, Slater Vecchio, Vancouver, BC

"The lawyer who relies on intuition or imagination and neglects the toil of preparation often finds himself wishing he had the opportunity to retry a lost cause"

Mr. Justice Dubin, Ontario Court of Appeal

INTRODUCTION

A mild traumatic brain injury (MTBI) case presents an excellent opportunity for the trial lawyer to use the authoritative literature to cross-examine defence medical experts. This approach can convincingly demonstrate to the trier of fact that the physical, cognitive, behavioural and emotional symptoms experienced by the plaintiff are recognized to be a consequence of MTBI by leading experts in the fields of neurology, behavioural neurology, neuropsychiatry, and neuropsychology.

THE EXPERT WITNESS

The role of the expert witness is to assist the trier of fact in areas where specialized knowledge is required - areas where the Judge or juror would be unlikely to form a correct judgment without assistance from an expert. The two elements necessary to justify the admission of expert testimony were enunciated by Lamont, J., in the majority judgment of The Supreme Court of Canada in *Kelliher v. Smith*:

(1) The subject-matter of the inquiry must be such that ordinary people are unlikely to form a correct judgment about it, if unassisted by persons with special knowledge.

(2) The witness offering expert evidence must have gained his special knowledge by a course of study or previous habit which secures his habitual familiarity with the matter in hand.

In The Supreme Court of Canada decision in *R. v. Abbey*, Dickson, J. described the role of the expert witness in the following way:

With respect to matters calling for special knowledge, an expert in the field may draw inferences and state his opinion. An expert's function is precisely this: to provide the judge and jury with a ready-made inference which the judge and jury, due to the technical nature of the facts, are unable to formulate. 'An expert's opinion is

admissible to furnish the Court with scientific information which is likely to be outside the experience and knowledge of a judge or jury. If on the proven facts a judge or jury can form their own conclusions without help, then the opinion of the expert is unnecessary.' *R. v. Turner* (1974), 60 Crim.App. R. 80 at p. 83. per Lawton, J.²

More recently, authors Sopinka, Lederman and Bryant, in their text, *The Law of Evidence in Canada*, comment that: "The hallmark of admissibility simply should be whether the experts' testimony would be helpful to the tribunal."³

Clearly where the expert assumes the role of an advocate, the trier of fact will give little if any weight to the expert's opinion. For this reason it is important to consider the guidelines referred to in *Ikarian Reefer: National Justice Compania Naviera SA v. Prudential Assurance Co. Ltd.*⁴ for weighing the credibility and admissibility of expert evidence. These guidelines were summarized in *Perricone v. Baldassarra*:⁵

1. Expert evidence presented to the court should be, and should be seen to be, the independent product of the expert uninfluenced as to form or content by the exigencies of litigation.
2. An expert should provide independent assistance to the court by objective unbiased opinion in relation to matters within his or her expertise. An expert witness should never assume a role of advocate.
3. An expert should state the facts or assumptions on which the opinion is based and should not omit to consider material facts which detract from that opinion.
4. An expert should make it clear when a particular question or issue falls outside of the expert's expertise.
5. If an expert's opinion is not properly researched because insufficient data is available, this must be stated with an indication that the opinion is no more than a provisional one.

Cross-examination of an expert witness is really no different from that conducted with any other witness. While the expert may employ specialized concepts and technical jargon in expressing an opinion, nevertheless, the opinion must be logical, make progressive sense and be comprehensible to the trier of fact.⁶ A proper direct examination should accomplish these objectives. The goal of cross-examination is to undermine the foundation laid in direct examination. The usual approach to the cross-examination of an expert witness employs questions designed to establish the following:

1. The expert is limited as to his education, qualifications, knowledge and experience;
2. The expert doesn't teach, conduct research, or publish and doesn't keep up with advances in the field through continuing education, conferences, etc.
3. The opinion is founded on incomplete or inaccurate information provided to the expert by the lawyer or other sources;
4. The opinion is based on hypothetical assumptions that are incomplete or inadequate;
5. The expert has employed inappropriate or outdated methodology;
6. Prior statements, testimony, published papers, expert reports or seminar presentations of the expert are inconsistent with the opinion presented at trial;

7. The expert harbors an intellectual bias or hidden motivation for testifying.⁷

8. The expert has not conducted a personal examination or assessment of the patient that may be contrary to ethical guidelines established by the expert's professional governing body. For example, the American Psychological Association has included the following section in their *Ethical Principles of Psychologists and Code of Conduct*:

7.02 Forensic Assessments.

(a) Psychologists' forensic assessments, recommendations, and reports are based on information and techniques (including personal interviews of the individual, when appropriate) sufficient to provide appropriate substantiation for their findings. (See also Standards 1.03, Professional and Scientific Relationship; 1.23, Documentation of Professional and Scientific Work; 2.01, Evaluation, Diagnosis, and Interventions in Professional Context; and 2.05, Interpreting Assessment Results.)

(b) Except as noted in (c), below, psychologists provide written or oral forensic reports or testimony of the psychological characteristics of an individual only after they have conducted an examination of the individual adequate to support their statements or conclusions.

(c) When, despite reasonable efforts, such an examination is not feasible, psychologists clarify the impact of their limited information on the reliability and validity of their reports and testimony, and they appropriately limit the nature and extent of their conclusions or recommendations.

USE OF AUTHORITATIVE LITERATURE IN THE EXAMINATION OF EXPERT WITNESSES

The use of authoritative literature such as texts, journal articles, and other scholarly publications is unique to the examination of expert witnesses. The law in this area was canvassed in *Privest Properties Ltd. v. Foundation Co. of Canada*,⁸ where Drost, J. makes the following comment:

In my opinion, the assessment of reliability and trustworthiness of expert opinion evidence involves very different considerations from those required in the case of factual evidence. In the case of expert opinion evidence, the need for cross-examination is, if anything, greater than in factual situations, because the trier of fact is likely to be in a poor position to assess the credibility of a scientific opinion without the assistance of cross-examination by opposing counsel, or to adopt the felicitous phrase employed by the late Mr. Justice McColl in *Abermin Corp. v. Granges Exploration Ltd.* (10 August 1990), Vancouver Reg. C884398 (BCSC), without exposing the opinion "... to the vagaries of opposing counsel's(sic) inquiring minds".

Drost, J. adopts the conventional rule expressed in the oft-cited reasons of Mr. Justice Beck in *R. v. Anderson*:

I think an expert witness may be examined as to what is in the books. Medical works are produced which are recognized by the profession as standard authorities. An

expert witness is being examined, who gives evidence as to specified diseases and their remedies. It is found by reference that his statements are at variance with what is laid down by the best authors on the same subject. Surely it must be the right of counsel to confront the witness with books written by scientific men [or women], leaders in their profession, for the purpose of showing either that the witness is mistaken, or that he may explain and reconcile, if he can, the real or apparent difference between what he has said and what is found in the books. If it was otherwise, men of insufficient learning, or veritable quacks, might palm off their crude opinions on juries as scientific knowledge.⁹

Use of authoritative literature in direct examination

In direct examination "the expert is permitted to refer to authoritative treatises and the like, and any portion of such texts upon which the witness relies is admissible into evidence."¹⁰ In *R. v. Anderson*,¹¹ Beck, J. stated the basis for the admissibility of texts as the foundation of the expert's own opinion:

When a medical man or other person professing some science is called as an expert witness, it is his opinion and his opinion only that can be properly put before the jury. Just as in the case of a witness called to prove a fact, it is proper in direct examination to ask him not merely to state the fact, but also how he came by the knowledge of the fact, so in the case of an expert witness called to give an opinion, he may in direct examination be asked how he came by his opinion. An expert medical witness may, therefore, upon giving his opinion, state in direct examination that he bases his opinion partly upon

his own experience and partly upon the opinions of text-writers who are recognized by the medical profession at large as of authority. I think he may name the text-writers. I think he may add that his opinion and that of the text-writers named accords. *Further, I see no good reason why such an expert witness should not be permitted, while in the box, to refer to such text-books as he chooses, in order, by the aid which they will give him, in addition to his other means of forming an opinion, to enable him to express an opinion; and again, that the witness having expressly adopted as his own the opinion of a text-writer, may himself read the text as expressing his own opinion.* [emphasis added]

In a similar vein, Drost, J. refers to the following comments by the authors of *The Law of Evidence in Canada*:

Peculiar to the examination of experts is the utilization of textbooks. In support of any theory, an expert is permitted to refer to authoritative treatises and the like, and any portion of such texts upon which the witness relies is admissible into evidence. *Moreover, it appears that, if a written work forms the basis of the expert's opinion, then counsel is allowed to read extracts to the expert and obtain his or her judgment on them. The written view of the author thereby becomes the opinion of the witness.* If the witness does not adopt the writing as being authoritative and in accord with the witness' own opinion, nothing may be read from the text, for that would be tolerating the admissibility of pure hearsay. [emphasis added]¹²

Use of authoritative literature in cross-examination

A powerful weapon in the cross-examination of the expert witness involves the careful use of the authoritative literature to weaken the testimony of the opposing expert and to elicit testimony favourable to the cross-examiner - to, in effect, transform the opposing expert into your own *tourguide* through the authoritative literature.

In cross-examination the expert may be questioned on any text or other publication which he acknowledges as authoritative or recognizes as a standard work in his field. The cross-examiner is then permitted to read from the authority to test the opinion of the expert. The expert cannot be cross-examined about any text or authority, which he does not regard as authoritative.^{13,14,15} The evidentiary justification for this rule of cross-examination is summarized in *The Law of Evidence in Canada*:¹⁶

Learned treatises may be used in a similar way in cross-examination of the expert to confront him with an authoritative opinion which contradicts the view expressed by the witness on the stand...

By so doing, the treatise is not used for the hearsay purpose of proving the truth of the opinion contained therein, but as a means of testing the value of the expert witness' conclusion. It becomes not positive evidence, but as in the case of the cross-examining tool of prior inconsistent statements, it is utilized to challenge the expert's credibility; to test whether the witness has intelligently and competently read and applied what has been authoritatively written on the subject. If the witness adopts a passage in the text, it is the expert and not the text writer's opinion that is admitted into evidence.

It is important to note that it is immaterial that the expert witness does not agree with or acknowledge the validity of the particular published work, only that he agrees that it is regarded in his field of expertise as an authoritative source. In the *Privest Properties Ltd.*

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use. Drost, J. considered whether it makes any difference whether, before permitting cross-examination on the particular writing from the text or journal, the expert recognizes the text or journal as authoritative or merely recognizes the authority of the author:

There are cases that support either conclusion, and it seems to me that it becomes a question of fact in each instance. Does the witness recognize the authority of - as distinct from accepting the validity of - the particular writing, whether due to the status of the text or journal from which the writing is taken or due to his or her recognition of the status and authority of the author? In any event, it is apparent that the traditional rule does little damage to the hearsay rule. No textual opinion offered in chief or in cross-examination is admissible unless an expert witness adopts it as his own.¹⁷

CONCLUSION

Cross-examination of an expert by utilization of the authoritative literature is an exception to the rule that you do not ask a question in cross-examination unless you know the answer. The literature keeps the expert honest and provides an opportunity to put your case before the trier of fact without calling any additional viva-voce evidence that would be subject to further cross-examination. When an expert is asked to agree with an extract from a text or other such publication that the expert acknowledges as authoritative, the reply will be of assistance to the examiner, regardless of the answer. If the expert agrees with the opinion expressed in the extract, then it forms part of the evidence and strengthens your case. Having the opposing expert confirm the authority of the opinions expressed in the text, journal or other publication in cross-examination will have a much greater impact than the same evidence given in direct examination. If the expert disagrees with the opinion expressed by the authoritative source, then the expert's credibility can be compromised, thereby weakening the opposition's case. While an opinion that is not adopted by the expert does not form part of the evidence at the trial, the examiner has at least had the benefit of placing an opinion from an authoritative source before the trier of fact that is contrary to the opinion expressed by the opposing expert.

SOME BASIC POINTS TO CONSIDER IN CROSS-EXAMINATION OF DEFENCE EXPERT IN A MILD TRAUMATIC BRAIN INJURY CASE¹⁸

1. Review report of defence expert with your own expert. What questions would your expert ask of opposing expert?
2. Locate prior statements, testimony, published papers, expert reports, seminar presentations, etc. of expert witness that are inconsistent with expert's opinion.
3. Request copies of expert's data and other facts on which the opinion is based that are not included with the report.
4. Did the expert employ inappropriate or outdated methodology?
5. Is the opinion founded on incomplete or inaccurate information provided to the expert by the lawyer or other sources?
6. Is the opinion based on hypothetical assumptions that are incomplete or inadequate?
7. Were inappropriate statements made by expert to client during evaluation?
8. Does the expert harbor an intellectual bias or hidden motivation?
9. Review educational and professional background of the expert. Is expert lacking in education, qualifications, knowledge and experience in MTBI?
10. Does the expert teach or conduct research in MTBI?

11. Has the expert written any books or articles on MTBI?
12. Does the expert keep up with advances in the field through continuing education, conferences, etc.?
13. Has the expert ever treated any patients with MTBI?
14. Research authoritative literature on MTBI.
15. Is expert familiar with MTBI literature?
16. What articles, texts, journals, etc. does the expert consider authoritative?
17. What publications does expert subscribe to? What's on the expert's bookshelves?
18. What information has expert reviewed? Is it all contained in the file?
19. Examine the entire file of the expert prior to cross-examination. Look for notes, draft reports, correspondence with counsel, investigation reports, journal articles, etc. Is information missing that should be there?
20. Has expert had discussions with anyone other than counsel concerning the case?
21. Does the expert testify for both plaintiff and the defence?
22. What is MTBI?
23. Is it necessary to lose consciousness or is a dazed or altered state of consciousness sufficient? (see "Definition of mild traumatic brain injury" in *Journal of Head Trauma Rehabilitation*, 1986, 8(3) 86. Definition requires only one of the following for MTBI: 1) any period of loss of consciousness, 2) any loss of memory for events immediately before or after the accident, 3) any alteration in consciousness (e.g., feeling dazed, disoriented or confused), or 4) a focal neurological deficit that may or may not be transient)
24. What is the pathophysiological mechanism responsible for MTBI?
25. Is the brain a delicate, jello or custard like substance?
26. Are the frontal lobes referred to as the "dashboard of the brain" because of their susceptibility to injury due to the sharp bony ridges underneath the frontal lobes? (see article by Varney and Menefee, 1993)
27. Is it necessary to strike your head to sustain a MTBI?
28. What is "shaken baby syndrome"?
29. What is the significance of a Glasgow Coma Scale (GCS) score of 13-15? (Note: it was never intended by the originator of the scale (Dr. Brian Jennett) to be used in MTBI cases)
30. What is the significance of post traumatic amnesia (PTA)? Does amnesia indicate diffuse brain damage? (see Jennett article)
31. Can an acceleration/deceleration or whiplash type injury produce a MTBI? (see articles by Gennarelli, Ommaya, Jane, Oppenheimer, and Lezak)
32. What are the differences between a diffuse and focal brain injury?
33. Can a focal injury or contusion to the brain occur without loss of consciousness? (e.g., Phineas Gage)
34. What is diffuse axonal injury (DAI)?
35. What is a concussion? Is the brain damaged in a concussion?
36. What is the effect of repeated concussive injuries? (Lezak, Gronwall, Kelly. See article "Brett Lindross ends career: concussion-prone Islander heeds brain damage warning" in *The Globe and Mail*, May 2, 1996)
37. Would you expect MTBI patients to have normal results on a neurological exam, CT scan, MRI, or EEG?
38. Is neuropsychological testing more sensitive to MTBI?
39. What tests are sensitive to MTBI? Did expert administer those tests? (Kay, 1992)
40. What pattern of test results suggest MTBI?

41. Is it appropriate to use the MMPI in MTBI cases?
42. What is the significance of collateral information from family, friends and co-workers as to changes noticed in a person who has sustained a MTBI?
43. Is it important to utilize all the information from collateral witnesses before forming an opinion as to MTBI? Did defence expert have this information or were inquiries made? (Varney and Menefee, 1993)
44. What are the common symptoms associated with MTBI? (See definition in *JHTR*. Physical symptoms include: nausea, vomiting, dizziness, headache, blurred vision, quickness to fatigue, lethargy. Cognitive deficits include attention, concentration, memory, speech/language, or executive functions. Behavioural changes and/or alterations in degree of emotional responsivity include irritability, quickness to anger, disinhibition, or emotional lability)
45. Did plaintiff suffer from these problems before the accident?
46. Did expert inquire how these problems affected plaintiff's life?
47. Assuming a diagnosis of MTBI, what is the usual recovery period?
48. Do a significant minority of persons never recover?
49. Is it true that the longer the symptoms have lasted the more likely they will be resistant to treatment?
50. Is there any treatment recommended for MTBI?

**CROSS-EXAMINATION OF A DEFENSE
PHYSIATRIST IN A MTBI CASE**

Dr. T - (for Defendants) Cross-exam by Mr. Slater

- Q Thank you. Doctor, in arriving at a diagnosis of a traumatic brain injury you are going to want a history from the patient obviously, correct?
- A Yes.
- Q You are going to want to look at all the available medical information, right?
- A Correct.
- Q You are also going to want to look at the results of neuropsychological testing, if it is available?
- A It can be very important, yes.
- Q Right. You agree that you refer people for neuropsychological testing?
- A That's correct.
- Q And that's because the insensitivity of the neurological examination and the mental status examination, correct?
- A They will play a role in terms of what information they are going to give you. So there is different information obtained from different aspects of what you look for. So neuropsychological will give you different information to your history, to your physical exam.
- Q But the reason neuropsychological testing developed the way it has is because the insensitivity of the neurological examination (inaudible); isn't that correct?
- A Yes, gives you a more detailed assessment of the patient's - functioning at that point in time.
- Q You would want to see the results of neuro-diagnostic testing, if any?
- A It can be very helpful, yes.
- Q And you would also want to independently verify circumstances surrounding the motor vehicle accident to test whether or not the history received from the patient was accurate, correct?
- A Yes, that's helpful.
- Q And you would also want, if you had the opportunity, to interview persons close to the person that you are examining. For example, spouses, employers, co-workers, you would want to obtain as much

information as you could get from credible, reliable people, correct?

- A That's correct.
- Q And the reason you are looking for that is you are looking for changes that occurred after a particular event that would assist you in determining whether or not the traumatic event was significant in terms of behavioral changes, emotional changes physical changes, cognitive changes, correct?
- A Correct.
- Q And if that evidence is reliable and credible that there was a significant change in an individual's functioning in those areas that would be of some assistance to you in [assessing] the rest of the information gathered to determine whether or not there was a mild traumatic brain injury?
- A You have to look not just for traumatic brain injury, but for any other diagnosis that may be warranted.
- Q One of the problems that you have, I would suggest, doctor, speaking generally, in arriving at a diagnosis of mild traumatic brain injury is that only in the rarest of cases will you ever have any direct information about what the person looked like prior to the accident, what they - how they performed in terms of an actual image of the individual; you don't have that, do you?
- A No.
- Q Now, doctor, you would also agree that in order to follow a definition of mild traumatic brain injury if we have either a dazed situation or a situation involving some PTA it can't be more than thirty minutes loss of consciousness, if we are talking loss of consciousness, or it can't be less than a Glasgow Coma Scale of thirteen or fifteen and it can't have PTA more than twenty-four hours?
- A That's correct.
- Q So what they are doing is that they are excluding all those categories because they are moderate or severe traumatic brain injury, correct?
- A That's correct.
- Q Now, under the comments, the comments aren't required for the definition. They are just to give you some background information and understand how the definition applies; isn't that right?
- A That's correct.
- Q So you would agree with me that when they go onto say that the definition includes under three; the brain undergoing an acceleration/deceleration movement, i.e. whiplash without direct external trauma to the head; you would agree with that?
- A Yeah, any type of trauma that involves the brain and the head which travel at different speeds and because they travel at different speeds that can induce injury to the brain.
- Q What you are talking about here in these types of injuries is you are talking about different densities in the brain, for example, the white and the gray matter?
- A That's correct.
- Q And you are talking [about] in particular if there is a rotational component like you have in an accident where a car is whipping around the different densities of the brain are moving at different speeds?
- A That's correct.
- Q And what you are getting is shearing or tearing of axons in the brain; are you not?
- A It is a theoretical concept. We haven't actually proved that, but that's what we believe at this point in time.
- Q Well, you have done reading in the area; haven't you, doctor?

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- A I believe that at this point of time.
- Q You are familiar with the work of Oppenheimer (phonetic)?
- A No.
- Q Are you aware of work of Omayo (phonetic) and Oppenheimer and Gennarelli (phonetic); are you aware of situations where people have actually examined brains of people who have sustained concussions?
- A Yeah.
- Q And they have died for other reasons, they have examined the brain and there it is, shearing and tearing of axons?
- A That's been shown in animal models.
- Q Would you agree that it is generally regarded as accepted in the field of traumatic mild traumatic brain injury that the mechanism of the injury is the shearing and stretching of axons hence the diffuse axonal injury?
- A Yeah, I believe that.
- Q Now, doctor, would you agree with me that - and you know who Thomas (Gennarelli) is?
- A Yes.
- Q He is the one that did all the research with the monkeys, correct?
- A Yes.
- Q They took those monkeys and they subjected them to known forces of acceleration/deceleration, killed them and examined their brains?
- A True.
- Q So they were getting a whiplash type of concussive injury, correct?
- A True.
- Q And they found a [diffuse axonal] injury: correct: is that right?
- A Yes.
- Q Now, Gennarelli, you would agree with me, says that a hit on the head, in this type of injury - the only significance of a hit in the head is the extent to which you create the acceleration/deceleration forces?
- A That's correct.
- Q And it's the acceleration/deceleration which is more important than the hit on the head?
- A Yeah, because with the hit in the head it's a sudden deceleration. It is the same thing and it is a sudden change in speed.
- Q Without getting into physics in any detail, if you have a motor vehicle accident where there is a rotational component in the sense of a vehicle being spun sideways and then a double contact, that's what we are talking about here in terms of motor vehicle accidents, whiplash head injuries, in general sense, correct?
- A Yes.
- Q So then it becomes an assessment of what happened to the person after the accident, what do they recall, bringing your expertise into consideration, looking at neuropsych evidence, looking at the collateral evidence before and afterwards, that's the process of a diagnosis of a mild traumatic brain injury, correct?
- A That's correct.
- Q You didn't have any collateral information other than what you told me, correct?
- A That's correct.
- Q You didn't have any neuropsychological evidence, did you?
- A No, I didn't.
- Q Now, doctor, you are aware of, I take it, a book called Mild Head Injuries by Levin (phonetic); are you not?
- A Yes.
- Q That - probably came along in a time when he was

Cracking down on Mild Head Injury

A practical approach, for the family physician, towards the diagnosis of mild head injury and post-concussion syndrome

By Michel P. Rathbone, MB, ChB, PhD, FRCP(C),
Manu Mehdiratta and Heather Finlayson

Since the advent of mechanized transportation 175 years ago, mild head injury (MHI) has become an increasingly common neurological disorder.

Patients with MHI are treated by emergency physicians, family physicians, psychiatrists, neurologists, orthopaedic surgeons and physiatrists. MHI has a prevalence of 180 people per 100,000, which accounts for 80% of all head injuries. Although commonly transient after MHI, many patients develop post-concussion syndrome (PCS), and as many as 15% suffer from persistent PCS. More people suffer from MHI than from Parkinson's disease, multiple sclerosis, Guillain-Barre syndrome, motor neuron disease, and myasthenia gravis combined.¹ MHI has a tremendous impact on patients and caregivers, and has substantial economic implications.

WHAT ARE MHI AND PCS?

Despite substantial data on MHI and PCS, some physicians have difficulty distinguishing these entities from malingering. MHI implies occult traumatic brain injury.² Although there is variability in the formal definition of MHI, the characteristics, listed in Table 1, are the most commonly cited, and serve as a useful guide for the physician.

PCS is a relatively new term which describes a constellation of somatic and psychological symptoms that develop following MHI. The symptoms, described in Table 2, can last for at least three months.

Who is most at risk for MHI and PCS?

Physicians should be aware of risk factors for MHI, so that high-risk individuals can be identified and queried about a possible history of head injury (Table 3). The greatest risk factors are being male and young. Some studies report a 2:1 male-to-female ratio for MHI. The difference is apparently due to the prevalence of motor vehicle accidents, assaults and gunshot wounds in young males.

Other risk factors include substance abuse of any kind (especially alcohol), lower socio-economic status, living in overcrowded areas, a history of psychiatric problems, relationship difficulties, learning disabilities and past head injury.

How is MHI caused?

MHI occurs when the head is suddenly accelerated or decelerated. For example, a deceleration injury occurs when a person falls, and their moving head hits a hard surface. Acceleration injury occurs when a stationary head is given sudden momentum, as can be the case with whiplash, or from being struck.⁵ The brain has a jelly-like consistency, so with sudden head movements, inertia causes the jelly-like brain to lag behind in the cranial vault and be compressed against the skull. Simultaneously, the brain is being pulled away from the opposite side very rapidly, forming a pocket of negative pressure, which then sucks the brain back, causing contralateral injury.

During MHI, rotational forces cause the head to move on the neck,

Table 1

MOST COMMON CHARACTERISTICS OF MHI

- 1) Initial Glasgow Coma Scale score of 13-15
- 2) Loss of consciousness (LOC) lasting less than 30 minutes, if at all.
- 3) Duration of post-traumatic amnesia (PTA) of less than 24 hours (although, if present, usually persists for only a few minutes to hours).
- 4) Absence of focal neurologic signs^{1,3,4}
- 5) MRI and CT studies rarely show brain parenchymal or vascular abnormalities with few exceptions.^{1,2}

leading to shearing stresses, particularly at the level of the upper reticular formation of the brain stem, which explains immediate loss of consciousness.^{5,6}

The shearing forces lead to diffuse axonal injury (DAI).⁷ This occurs as the forces cause distortions in the brain which disrupt axons and small vessels. Axonal injury leads to swelling and lysis of the axons and the release of excitatory neurotransmitters.

Vascular injury may produce petechial hemorrhages or focal edema. The injury distribution tends to spread in the parasagittal deep white matter, from the cortex to brain stem.⁸ The same mechanism applies to both mild and severe head injuries; there is simply greater damage proportional to the magnitude of force applied.⁹

It is important to remember that many head injuries cause loss of consciousness, but brain damage can occur without loss of consciousness. Changes demonstrable on the MRI may occur without loss of consciousness and even have been reported after roller coaster rides.

POSTCONCUSSION SYNDROME (PCS)

Symptoms of PCS are frequently the reason patients will consult their family physician following MHI. Sometimes, it is not until days, weeks or months after the injury. While there are specific criteria to diagnose PCS (Table 2), different combinations of symptoms may be present depending on the time after the injury and the severity of the injury.¹⁰

Post-concussion syndrome develops in approximately 50% of patients with MHI and the symptoms may last up to one year. In 15% of MHI patients, symptoms last longer than one year, and are known as persistent post-concussion syndrome (PPCS).¹⁰

SOMATIC SYMPTOMS OF PCS

Two of the most common presenting features of PCS are headache and "dizziness." Although headaches can result from serious underlying brain disorders, frequently no anatomical abnormality is found to explain them. The various causes of post-traumatic headache are listed in Table 4.

Vertigo occurs in 40% to 60% of patients with MHI. Often it is caused by a peripheral vestibular problem rather than brain damage. The most common cause is benign positional vertigo, which is thought to be caused by stimulation of the semicircular canals due to debris floating in the endolymph, and exacerbated by rapid head movements¹¹. Central lesions causing vertigo are uncommon, but may be related to damage of the brain

Table 2

DSM-IV CRITERIA FOR POST-CONCUSSION SYNDROME

History of MHI (Note: DSM-IV criteria for MHI are slightly different from those described above).

Current symptoms involving cognitive impairments in at least one of the following:

- Memory or learning
- Concentration

At least three of the following symptoms lasting for at least three months:

- Easy fatigability
- Disordered sleep
- Headache
- Vertigo/dizziness
- Irritability or aggression without provocation
- Anxiety, depression or affective liability
- Personality changes, e.g., social or sexual inappropriateness
- Apathy or asponanaeity

Symptoms are associated with a significant impairment in social, academic or occupational functioning and represent a significant decline from a previous level of functioning. (DSM-IV)

stem. Myofascial injury to the cervical-spine can cause the ill-defined and poorly understood syndrome of cervicogenic vertigo. The clinical diagnosis of vertigo is often difficult. Referral to specialists and special investigations is warranted in persistent cases. Less commonly seen is post-traumatic tinnitus and hearing loss, either due to damage to middle ear structures (tympanic membrane rupture, ossicle disruption etc.) or vestibular damage.

Anosmia, due to damage to the cribriform plate, nasal bones or frontal and temporal lobes with involvement of the olfactory nerve, may contribute to anorexia and depression. Importantly, patients with anosmia tend to have a poor behavioral prognosis, perhaps because of inferior frontal lobe damage.¹²

Most somatic symptoms resolve with time. However, some of the 10% to 15% of MHI patients that continue to suffer after one year complain that at least one symptom is more severe than it was at the time of the injury. Patients with persistent somatic symptoms are most likely to develop PPCS.¹³

Neuropsychological symptoms

Significant impairment of neuropsychological functions may occur within days of MHI.¹⁴ The most commonly reported symptoms are irritability, anxiety, depression, personality change, fatigue, sleep

disturbance, decreased libido and decreased appetite.¹⁵ These symptoms may be reported by over 50% of patients within three months of injury.^{16,17}

Premorbid personality and psychological state influence the emotional response to the injury and various factors interact to produce psychological sequelae after MHI.¹⁸⁻²⁰ These factors can be categorized into three types: 1) Pretraumatic, such as pre-existing psychosocial difficulties; 2) Peritraumatic, such as brain damage and fear; 3) Post-traumatic, such as intellectual impairment, ensuing psychosocial difficulties and compensation and litigation.¹⁹ For example, a patient's underlying subjective experience of somatic or cognitive problems may lead to emotional dysfunction. In head injury, the temporal and frontal lobes usually bear the brunt of the damage.⁵ Involvement of these areas, particularly the amygdala region of the temporal lobe and the orbitofrontal cortex, affects the modulation of emotion and personality stability.¹⁸

The psychological sequelae of PCS result from a complex interaction between organic and non-organic effects. Therefore, the syndrome may develop differently in different individuals. In some patients, cerebral dysfunction predominates. In other patients, psychological influences appear paramount.¹⁹ Physicians presented with a patient suffering from psychological symptoms of PCS must recognize that, whether the etiology is biogenic and/or psychogenic, the impairment is real.

Cognitive impairment is one of the most consistently described and worrisome outcomes of MHI. Problems include difficulties with concentration, attention, memory, word finding, executive functioning and information processing. Damage to an individual's information processing capacity may be primarily responsible for impaired cognition in PCS.^{12,21} When required to work with multiple stimuli simultaneously, MHI patients have difficulty due to reduced processing speed as they are unable to handle parallel information. This often leads to the perception that the patient is absent-minded or forgetful, because he/she must devote full concentration to the task at hand.

Patients may also appear distracted, as they are unable to disregard irrelevant stimuli, leading to concentration deficits. As a result of these problems, patients become confused and frustrated and unable to follow tasks to completion.¹⁵ This is in line with the theory that PCS is mainly due to a stress reaction from a chronic inability to cope after head trauma, which arises from one's continuous attempts to compensate for cognitive deficits.³ Cognitive deficits also have been attributed to frontal parenchymal lesions which may impair executive function, while temporal lobe lesions have been associated with impaired memory.

Prediction of cognitive status and functional outcome following MHI may be possible to some degree, based on acute injury characteristics and neurologic variables. There is some suggestion that patients with

Table 3

RISK FACTORS FOR MHI AND PCS

- Substance abuse (especially alcohol)
- Lower socio-economic status
- Overcrowded areas
- History of psychiatric problems, relationship difficulties, learning disabilities
- Past head injury

Table 4

COMMON CAUSES OF CHRONIC POST-TRAUMATIC HEADACHES

- **Damage to superficial nerves causing neuritic pain, including occipital neuralgia**
- **Cervicogenic headaches from injury to neck structures (usually soft-tissue)**
- **Post-traumatic vascular migraine-like headaches**
- **Muscle contraction ("tension") headaches**
- **Mixed forms of headache**
- **Exacerbation of previous headaches**
- **Analgesic abuse headaches**
- **Subdural hematoma**
- **CSF fistulas**

Kushner D. Mild traumatic brain injury: Toward understanding manifestations and treatment. *Archives of Internal Medicine* 1998;158:1617-1624.

brain lesions on CT or MRI scans are more likely to suffer from impaired neuropsychological status,²² which may be related to the parenchymal lesions mentioned above. However, a recent study showed that neither positive CT scan findings, nor history of LOC seem to be predictive of subsequent neuropsychological status.²³ Conversely, the mechanism of injury is of some value. MHI caused by objects striking the head, (e.g. assault or being struck by falling objects), predicts a greater likelihood of disruption of cognitive function than acceleration/deceleration injuries, when the head hits a stationary object or nothing at all, as in whiplash.²³ Thus, physicians should consider the mechanism of injury when assessing the risk of development of PCS.

PCS persisting one year after MHI also appears related to an interaction between organic and non-organic factors, particularly chronic pain, depression and anxiety.¹ Both depression and chronic anxiety may affect concentration as well as cognitive functioning, including concentration, attention, memory and executive function. Chronic pain may result from various bodily injuries and headache, and can reduce the capacity to perform complex cognitive tasks due to fatigue, sleep deprivation and analgesic use.¹⁸ Risk factors for prolonged disability from work and persistent symptomatology have been identified and can aid the clinician in the prediction of which patients will suffer from PPCS. These include advanced age, premorbid psychological problems, lower occupational and educational status, female gender and previous head injuries.²³

Patients suffering from cognitive and emotional complaints as part of PCS should be referred for neuropsychological evaluation.

PSYCHOSOCIAL OUTCOMES

The family physician often has a key role in evaluating and addressing the significant effects that PCS can have on aspects of the patient's life including vocation, family life and medicolegal concerns. There are variable

reports of the percentage of patients that return to work following MHI,^{20,24} but it is clear that many do not regain their premorbid level of employment for at least some period of time. This can be highly stressful for the patient and their family, both financially and psychologically, particularly as many people perceive occupation as an important part of their identity. Family life may be disrupted by both loss of work and psychological strains, due to the symptomatology of PCS. Marital discord is frequently encountered in PCS. It may be related to depression, anxiety about the injury, role reversal and sexual dysfunction.

In these cases, physicians should consider the health of the entire family and how this relates to the well-being of the patient. Support groups may be valuable to educate the family and to help them discuss and deal with the stresses that can arise.¹⁵

Almost inevitably, physicians working with MHI patients will become involved in medicolegal issues. Many injuries are perceived to result from negligence, or are covered by insurance. This is complicated by controversy over the existence and variability of PCS. The importance of complete, accurate and legible charting by the physician cannot be over-emphasized. Legal issues are a great source of stress for patients who must deal with insurance companies, lawyers, the Workers' Safety Insurance Board etc. while attempting to cope with their symptoms and lifestyle adjustments. Furthermore, patients are often in the position of having to defend themselves against accusations of malingering for financial gain.

Conversely, some patients and lawyers tend to attribute all medical problems to a recent accident because of symptoms since the accident. Clear medical records are most helpful in sorting out these issues.

DIFFERENTIAL DIAGNOSIS OF PCS

Alternative explanations for persistent symptomatology following MHI must be considered. The principal differential diagnosis is of an adjustment disorder with depressed and anxious mood as a neurotic reaction to the injury.²⁴ Mild neurocognitive disorder, which is due to a general medical condition, causes similar symptoms. Dementia, resulting from head trauma, must be excluded.

Two important psychiatric conditions that may present following MHI are post-traumatic stress disorder (PTSD) and depression. PTSD reportedly occurs in between 17% and 33% of MHI patients.²⁵ Symptoms accompanying PTSD include depression, uncontrollable anger, irritability, mistrust of others, jumpiness and hyperalertness, feeling emotionally distant from family and friends, feelings of isolation, anxiety, lack of affect, moodiness, fear of loss of control, sleeplessness, nightmares,

Table 5

THREE IMPORTANT QUESTIONS IN ASSESSING HEAD INJURY

- 1) **Was the head injury related to a significant deceleration/acceleration of the head, such as a fall of greater than 2m or a major motor vehicle accident?**
- 2) **Was there a coma (a GCS score helps) and how long did it last?**
- 3) **Was there post-traumatic amnesia and how long did it last?**

Table 6

FURTHER ASPECTS TO DETERMINE WHEN DEALING WITH MHI PATIENTS

- Determine whether there were any signs of hemodynamic instability
- Seizures
- Skull fractures
- Nausea, vomiting

flashbacks, problems with memory, and difficulty keeping a job. These symptoms usually begin 24 to 48 hours after the injury, but they may develop months or years later. Depression is one of the leading affective symptoms after MHI and frontal lobe damage is also associated with post-traumatic depression.¹⁵

Somatoform disorders may account for some symptoms of PCS. Somatization is commonly precipitated by physical injury and is maintained by anxiety and neuroticism, desire to maintain the illness role, financial rewards, and iatrogenic factors such as numerous investigations and treatments.

HISTORY AND PHYSICAL EXAMINATION

The first step in evaluating a head-injured patient in a primary care setting is to obtain a history, which helps to quantify the degree of brain injury that may have resulted from the incident (Figure 1). Three questions are particularly helpful: 1) Was the head injury related to a significant deceleration/acceleration of the head, such as a fall greater than six feet or a major motor vehicle accident which likely involved significant acceleration forces? 2) Was there a coma (a GCS score helps) and how long did it last? 3) Was there a post-traumatic amnesia, and what was its duration? (Table 5).

Other important questions include determining whether there were any signs of hemodynamic instability, seizures, skull fractures or other associated symptoms (e.g., nausea, vomiting) following the injury.¹⁰ (Table 6).

Together, the responses from these questions help the physician to assess the amount of diffuse axonal injury that likely occurred, and assess whether the patient's chronic symptoms are in line with this.

Once the MHI history has been obtained physicians should determine if the patient is suffering from PCS by asking about the various symptoms listed in Table 2. To check whether the concentration and attention symptoms are due to organic brain injury, ask the patient to recall all of the memory and concentration problems they have had since their injury.

Medical history prior to head injury is especially important. All current medications should be evaluated for their potential to cause sedation, confusion or syncope. This includes antidepressants and narcotic analgesics. An occupational and scholastic history is also essential in order to help patients adapt to their jobs following head injury. In addition, a patient who works in a physical setting with heavy machinery should be evaluated for ability to safely return to work following the injury.

A complete neurological examination should search for focal neurological deficits and mental status should be assessed. The head and neck also should be carefully examined, since trauma to the head also may involve injury to structures such as the skull, cervical spine and eye.

INVESTIGATIONS

The indications for CT scanning in patients with MHI are controversial, but patients with certain high-risk factors should receive a CT. These include loss of consciousness, a GCS score of less than 15, a history of lethargy, amnesia, confusion, focal neurological signs, or if the patient had a post-traumatic seizure and subsequently had a fall.¹⁰ In the primary care setting, physicians should review the results of any CT that was taken immediately after the injury. If no CT was done, but the risk factors mentioned above are still present, one should be arranged immediately.

MRI is becoming increasingly popular, but its use in the evaluation of head injury is not yet clear. MRI is especially useful for identifying diffuse axonal injury, cortical contusion, subcortical and brain stem injury, and fluid collection extra-axially. CT, which is used acutely, is better for the detection of subarachnoid hemorrhage and fracture. In the chronic situation, an MRI may be indicated to evaluate more subtle brain injury, which could underlie chronic symptoms.¹⁰

Other potential investigations that should be considered, depending on symptoms, include a CT of the cervical area, if there is neck pain, and plain films of the skull, thoracic and lumbar areas.

MANAGEMENT

Once the acute and chronic symptoms have been established and evaluated, it is appropriate to consider various management strategies. If the patient presents with PCS symptoms early after MHI, management should be aimed towards the somatic complaints (i.e.; headache and vertigo). It is important to ensure there has been meticulous documentation of baseline neurological and emotional status for medicolegal purposes and progress monitoring. If the patients meet the criteria for PCS, as indicated in Table 2, they should be referred to a neuropsychologist and a psychiatrist with expertise in head trauma. It is very important to assure the patient that 85% of patients do recover within a year or so, and that they should not immediately consider themselves irrevocably brain damaged. A fine line must be drawn between adequate early treatment and inducing a sense of invalidism.

Antidepressant or anxiolytic medications often help with some of the psychological components of MHI and PCS, but their long-term use should be avoided. Amitriptyline and clomipramine are commonly used antidepressants for the treatment of headache, fatigue and depression. These medications can be especially helpful for somatic complaints rooted in emotional dysfunction, as somatic symptoms are often resistant to treatment.

If the physician feels that a patient is not recovering, due to somatic or psychiatric complaints, referral to a neurologist or psychiatrist is warranted.

The psychosocial aspects of MHI and PCS should not be overlooked, and the family should be counselled, along with the patient, about what to expect and about the organic nature of the symptoms. However, patients should not be encouraged to adopt the role of a sick person, as this often promotes the development of PPCS. Occupational history, as mentioned earlier, should be taken into account when advising patients about their capacity to return to work.

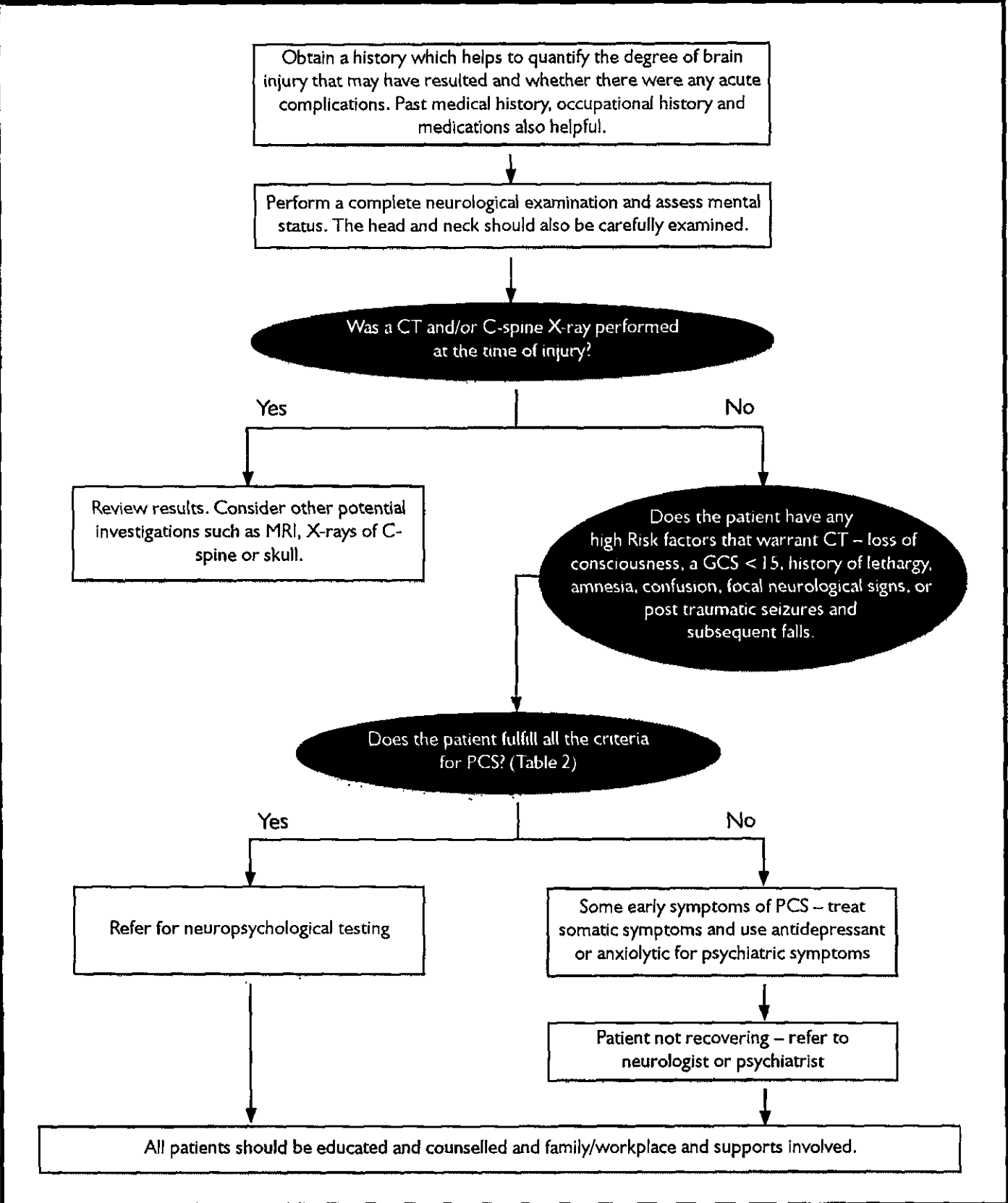
CONCLUSION

In summary, the family physician's goal should be to ensure that MHI patients do not develop long-term symptoms, and are able to maintain their role in society.

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Figure 1

APPROACH TO THE PATIENT WITH MILD HEAD INJURY PRESENTING WITH NONSPECIFIC CHRONIC SYMPTOMS



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