

Guidelines for the Triage and Transfer of Patients with Brain Injury to The Queen's Medical Center

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The Queen's Medical Center (QMC) is the only trauma center in the State of Hawaii designated by the American College of Surgeons, and provides trauma care, neurosurgery and neurocritical care capabilities on a continuous basis for all patients in Hawaii with head injury. It has been shown that the vast majority of patients with head injury (especially minor head injury) are treated non-operatively though, and can be cared for without the need for neurotrauma specialists.¹ However, since there is even a small possibility of significant morbidity and mortality that carries medicolegal risk, and since neurosurgery is not available on most neighbor islands, there is a desire to send most of these patients to QMC so that any possible deterioration could be treated by a neurosurgeon in the rare event that it occurs. This is also true for many hospitals on Oahu that do not have an on call neurosurgeon. The current trauma referral system therefore results in transfer of large numbers of patients with head injuries to QMC, regardless of whether or not they require the specialized care that is available there. This desire to provide the safest possible patient care has resulted in numerous unintended consequences: patient overcrowding at the only trauma center in the state, backup of patients awaiting transfer, and delay in transport of patients requiring the most emergent neurosurgery care. Because of Hawaii's unique island geography, most patients require transfer by airplane, resulting in large numbers of expensive interhospital transfers that consume precious resources and greatly increase the financial burdens on the state, hospitals, patients and third party payors. It has also led to physician burnout at QMC because of the large number of patients transferred unnecessarily, for whom care is provided by a very small number of physicians. Without change to the existing situation, there is a real possibility that neurosurgical care will become unavailable, even to patients with the most severe injuries.

The American College of Surgeons (ACS) provided a trauma system consultation for the State of Hawaii in October 2005, and reported that 32% of the patients transferred did not require care at QMC, and could have received all necessary care at the transferring hospital.² The ACS report stated that "An inclusive trauma care system statewide would minimize the necessity to transfer some of these less severely injured patients to Oahu, thus decreasing the load on the air transport system." The report went on to

recommend strongly that “transfer criteria and interhospital transfer agreements be established to cover all types of patients and all acute care facilities in the state.”

Likewise, the Board of Health Care Services of the Institute of Medicine reported that emergency trauma care in the United States “continues to suffer from severe fragmentation, an absence of systemwide coordination, and a lack of accountability.”³ The board called for drastic changes in emergency trauma care that provide “...improved coordination, expanded regionalization, and increased transparency and accountability” in the delivery of trauma care. The report advocated building a system of regionalized care that would alleviate overcrowded emergency departments, reduce costs, and ensure specialty coverage at the regionalized trauma facility.” It was deemed by the report that this “would be particularly appropriate for services provided by specialties with workforce numbers in the few hundreds or thousands, such as neurological and hand surgery.” The American Association of Neurological Surgeons and the AANS/CNS Joint Section on Neurotrauma and Critical Care have also advocated regionalization of trauma care to improve access for patients. The joint section states it is “...a plan which eliminates redundancy, provides patient safety nets, and lessens competition for limited resources, and... will ultimately improve quality and safety and also save money; it simply needs to be championed at a national level by all surgeons.”⁴

The Department of Health (DOH) of the State of Hawaii has assembled a Trauma System Planning Committee to plan implementation of the recommendations made by the ACS. The strategy adopted by the DOH was to “attempt to increase the capabilities of hospitals so that they could care for patients without transfer. In general, the patient is best served by remaining in their own community, as long as they can receive an appropriate level of care.”⁵

Any change that is implemented must be comprehensive and statewide. It must ensure rapid availability of neurosurgery and neurocritical care for those who need it, and ensure proper screening evaluation and care at the home hospital for those who do not. Change must therefore be implemented and coordinated at all hospitals, not just QMC, and education provided regarding care for patients with minor head injury. A statewide trauma performance improvement system with feedback provided in both directions between QMC and referring hospitals is essential. These guidelines are established to facilitate these goals and to initiate a statewide trauma care system that provides an appropriate level of care for each patient, improves access to neurosurgery care, and reduces costs as much as possible. While they are

initially established for QMC, the participation and assent of physicians and hospitals statewide will be sought, and ideally it will become the basis for written transfer agreements with referring hospitals.

It is emphasized that these guidelines are not intended to deny access to neurosurgical care for those patients who require it, nor to require non-neurosurgical physicians to provide neurosurgical care that is outside of their scope of practice, but rather to limit the transfer of patients to a trauma center who do not require neurosurgical care.

Guidelines for Management and Transfer of Patients with Head Injury in Hawaii

These guidelines apply only to patients with traumatic injuries, and should not be generalized to the care of other patients with brain disease. Likewise, they do not constitute a transfer agreement for all patients with brain dysfunction. All patient transfers should be discussed with the trauma surgeon on call to determine the need and priority for transfer.

CAUTIONS AND LIMITATIONS

PATIENT STABILIZATION AND TRANSPORT is an essential component of the early treatment of patients with brain injury. Recommendations from the Society of Critical Care Medicine (SCCM) for transport should be followed whenever possible during interhospital transfer and especially by the aeromedical transport services provided between islands.⁶ As per the SCCM guidelines, it is recognized that nonessential testing and procedures will delay transfer and should be avoided, however stabilization should be undertaken before transport when intracranial hypertension is suspected. The physician at the referring hospital should consider osmotic therapy with hypertonic saline if the fluid status is low, or the administration of mannitol if not.⁷ As per the Brain Trauma Foundation guidelines for the Management of

Severe Brain Injury,⁸ prophylactic hyperventilation should not be performed, but if intracranial hypertension is suspected, mild hyperventilation with a pCO₂ no lower than 35mm Hg can be initiated. Since severe hypocapnea can be associated with worsened outcome, it is encouraged to obtain an arterial blood gas when the patient is placed on the transport ventilator to optimize the pCO₂. This testing should not delay the transport though. Inotropic and/or pressor support should be maintained to keep MAP at least >80 mm Hg in these patients with increased intracranial pressure (ICP).

CT SCANNERS are available at essentially every hospital in Hawaii that receives patients with head injuries, which simplifies their evaluation and transfer, and these guidelines incorporate CT results as part of the criteria for transfer. Evaluation without a CT scanner involves another complicating factor to this process, and is specifically not addressed here. It can be added to a statewide trauma/disaster emergency care plan as needed. Decisions regarding when to obtain a CT scan on a patient with a head injury should follow recommendations from the medical literature, and additional information will be provided at the annual trauma symposium and during outreach educational sessions throughout the year.

INTOXICATION WITH ALCOHOL, CRYSTAL METHAMPHETAMINE, OPIATES OR OTHER INTOXICATING DRUGS can invalidate the usefulness of the Glasgow Coma Scale (GCS) Score as an evaluation tool in patients with head injury. The presence of these drugs does not obviate the need for CT scanning in patients with suspected injury, and in fact lowers the threshold to obtain one, since they may mask symptoms of intracranial pathology. In the absence of significant CT findings or clinical risk factors as described below, active observation by trained medical personnel in the hospital is prudent when the GCS is depressed and drugs are present in the patient. Failure to show progressive improvement in the GCS over 4 to 6 hours is cause for concern and a repeat CT scan should be obtained. Patients who are agitated because of drug intoxication may need to be sedated in accordance with the SCCM recommendations that a sedative and/or neuromuscular blocking agent may be necessary. Neuromuscular blocking agents should not be utilized unless adequate sedation and/or analgesia is administered. The referring physician should be cautious in utilizing medications that may significantly lower mean arterial pressure and cerebral perfusion. Hemodynamic stability with administration of sedatives or analgesics is essential to achieve before transport is initiated.

INFANTS AND YOUNG CHILDREN present unique challenges to the evaluation and treatment of head injury. The neurologic exam in general and the GCS score specifically may differ significantly from adults, depending on the age of the patient. Pediatric patients with head injury have a higher tendency than adults toward brain edema, hypoventilation or apnea, and require even earlier and more definitive airway support. The possibility of non-accidental trauma should always be considered and appropriate interventions activated when considered appropriate by the referring physician or other member of the health care team.

MEDICAL OBSERVATION is an active process by trained medical personnel with serial documentation of the patient's neurologic status and GCS every one to two hours. It is best performed repeatedly by the same person or persons, so that subtle changes can best be recognized.

TRIAGE AND TRANSFER CRITERIA

Severe head injury – patients with a GCS of 8 or less. These patients should be transferred to QMC as soon as possible for neurocritical care and neurosurgery consultation, including the possibility of intracranial pressure/brain tissue oxygen monitoring or possible craniotomy for mass lesion. A cranial burr hole procedure should rarely if ever be performed for these patients at the referring hospital (see discussion at end of guidelines). Protection of the airway and avoidance of hypoxia and hypotension are essential during evaluation and transport. However, patients with a GCS of 3 with dilated and unreactive pupils should not be transferred to QMC except in very rare circumstances, since the chance of meaningful neurologic recovery approaches zero. For example, patients with a bihemispheric gunshot wound to the brain or those with a severe anoxic brain injury with minimal brainstem reflexes present do not receive surgery or invasive monitoring. Patients do not have to be declared brain dead for the surrogate decision makers or Power of Attorney for Healthcare to decide that artificial support should be withdrawn. In the case that the patient appears to have no brainstem reflexes or minimal neurologic function, as per the CMS Conditions of Participation, Organ Donor Center of Hawaii should be contacted and the referring hospital staff should refer to their own hospital policy for brain death declaration.

Moderate head injury – any patient with a GCS of 9 to 12, or patients with a GCS of 13, 14 or 15 with clinical risk factors/significant CT findings present. If there are no clinical risk factors/significant CT findings, especially in the presence of drug or alcohol intoxication, these patients should be observed in a medical setting. Repeat CT scanning should be performed within 6 to 8 hours, or immediately for any neurologic deterioration, defined as a decrease in GCS of 2 or more points, development of a new focal neurologic deficit or seizures. If there are clinical risk factors/significant CT findings present, the patient should be transferred to QMC for neurotrauma evaluation and treatment.

Mild head injury – patients with a GCS of 13, 14 or 15 with loss of consciousness, but no clinical risk factors/significant CT findings present. Patients with GCS 14 and no clinical risk factors/significant CT findings should be observed in a medical setting. CT should be repeated within 6 to 8 hours if the patient's GCS has not improved to 15. Those who present initially with GCS 15 should either be observed in a medical setting or discharged if there is a reliable and competent person who can observe them for the next 24 hours if there has been no drug or alcohol use. Those with witnessed loss of consciousness longer than 5 minutes, post-traumatic amnesia, vomiting or severe headache, and those who still have alcohol or drugs present in their body should not be sent home and should be observed in a medical setting. Patients with clinical risk factors or significant CT findings should be transferred to QMC for neurotrauma evaluation and treatment.

Minimal head injury – patients with a GCS of 15 without loss of consciousness and no clinical risk factors/significant CT findings present. Patients greater than 2 years of age can be discharged if there is a reliable and competent person who can observe them for at least 24 hours and return them promptly to the hospital for any neurologic changes. Children younger than 2 years of age should be actively observed in a medical setting, and this is an option for older patients or those considered unreliable for return to the hospital in the event of a neurologic change.

CLINICAL RISK FACTORS

CSF leak – bleeding from the ear should not be confused with CSF. Antibiotics should not be given prophylactically for a CSF leak, since they do not prevent meningitis and have a slight tendency to select a more virulent organism if meningitis does develop. A CSF leak is not a contraindication to antibiotics that are indicated for another reason though.

Penetrating intracranial trauma – patients suspected on clinical grounds to have penetration of the skull by knife, gunshot wound or other mechanism should undergo CT scanning as soon as possible, and should be transferred to QMC in most cases if a penetrating wound is confirmed on CT. Patients with gunshot wounds and post-resuscitation GCS 3 or 4 (and especially those with dilated and unreactive pupils) with a bullet path that traverses both hemispheres of the brain, the ventricles, or the brainstem should not be transferred to QMC, since there is essentially no chance for any meaningful recovery with treatment.

Focal neurologic deficits – this includes abnormal asymmetry of the pupils, dysconjugate gaze that is new for the patient, or objective hemiparesis. If the CT is negative, a brainstem injury or carotid artery injury should be considered in patients with hemiparesis and transfer to QMC is appropriate. It should be remembered that spinal cord injury is only very rarely a cause of hemiparesis.

SIGNIFICANT CT FINDINGS

1. **Depressed calvarial skull fracture** – defined for this purpose as a fracture where one bone segment is depressed more than 1 cm below the other. These patients warrant transfer to QMC for neurotrauma evaluation, especially if the fracture is open, is located near a venous sinus, or involves the posterior table of the frontal sinus. Fractures of the orbit, face and jaw are transferred per the recommendation of the facial trauma specialist in conjunction with the trauma surgeon.

2. **Basilar skull fracture with or without CSF leak** – the base of the skull is defined as the anterior margin of the foramen magnum to the foramen cecum, at the anterior part of the anterior cranial fossa (just anterior to the cribriform plate). This includes the mastoid and petrous portions of the temporal bone, the sella turcica and the planum sphenoidale/cribriform plate/ethmoid/sphenoid sinus roof. Fractures that are arbitrarily described by the radiologist as “basilar” will need to be defined anatomically, since they often do not involve these structures. A true basilar skull fracture has a higher risk of cranial neuropathies and hearing loss in addition to CSF leak, and transfer to QMC is appropriate.

3. **Shift of the midline brain structures of 4mm or more** – hematoma or brain edema from other injuries can cause displacement of the injured brain and potentially herniation through the openings in the rigid dural structures. This condition requires neurocritical care and/or neurosurgical care and the patient should be transferred to QMC. The shift is measured by drawing a line from the midline of the frontal skull to the internal occipital protuberance (midline occipital bone), then measuring the distance from the septum pellucidum (the membrane that separates the lateral ventricles from each other) or other midline structure to this line.

4. **Solitary cerebral contusion** - measuring 10mm or more in diameter or **multiple contusions** measuring 5mm or more in diameter. This may reflect a large focal injury to the brain or a diffuse injury with smaller contusions, and this injury may result in elevated ICP and the need for specialized neurologic care. The patient should be transferred to QMC.

5. **Subarachnoid hemorrhage (SAH)** - measuring 5mm or more in thickness, measured at the area of approximately the average thickness. Also, when there is a clinical history suggestive of aneurysmal hemorrhage, which may have preceded or even caused the traumatic accident. Trauma is the most common cause of SAH, and small areas of SAH associated with mild head injury do not require specialized intervention in the absence of other risk factors. The SAH associated with aneurysmal

rupture is usually located in the basal cisterns near the circle of Willis, or in the Sylvian fissure, whereas traumatic SAH is usually over the cortical surface of the brain.

6. **Acute subdural hemorrhage (SDH)** - measuring 5mm or more in thickness, except when found in the interhemispheric fissure or along the tentorium cerebelli/skull base. These last areas are common and do not require surgery or specialized care in the absence of other risk factors. Chronic or acute-on-chronic SDH are not considered acute post-traumatic injuries, and in general should not be transferred to the trauma center. These chronic SDH patients should be referred to the neurosurgeon of choice of the patient's primary care physician or the patient. If there is no such choice, the patient should be referred through the referring hospital's normal referral pattern for neurosurgery. Patients with acute SDH > 5mm may require surgical evacuation, and transfer to QMC is appropriate. Patients with acute SDH < 5mm who have been taking anti-platelet or anti-coagulant medications should also be considered for transfer.

7. **Epidural hemorrhage (EDH)** –measuring 5mm or more in thickness, especially when located in the temporal region or the posterior cranial fossa. This condition may worsen rapidly and the patient should be given significant priority for transfer to QMC. Small EDH that have no mass effect can be observed clinically in the medical setting, and should generally undergo a repeat CT within 6 to 8 hours or so, or immediately if there is a decline in the patient's neurologic function.

NON-SIGNIFICANT CT FINDINGS

These findings by themselves do not mandate neurotrauma evaluation or transfer to QMC.

1. **Isolated non-depressed calvarial skull fractures** - whether open or closed. For purposes of these guidelines, a depressed skull fracture is defined as one that is depressed more than 1 cm from the

surrounding skull. Those involving the posterior table of the frontal sinus or the base of the skull may be significant and may require transfer to QMC (see above).

2. **Isolated pneumocephalus** – small areas of intracranial air without a depressed or open skull fracture, CSF leak or other risk factor does not warrant transfer to QMC.
3. **Solitary cerebral contusion** – measuring less than 10mm in diameter, or **multiple contusions** measuring less than 5mm in diameter. These patients should be admitted for medical observation and should undergo repeat CT in approximately 8 hours, or earlier if there is neurologic deterioration. Patients with GCS less than 9 who are not intoxicated may be the exception and may warrant transfer to QMC, since diffuse axonal injuries may appear on CT as only small contusions.
4. **Subarachnoid hemorrhage (SAH)** – measuring less than 5mm in thickness. Note that trauma is the most common cause of subarachnoid hemorrhage, and when traumatic it is usually located over the top of the brain. Aneurysmal subarachnoid hemorrhage is usually located at the base of the brain near the circle of Willis, and the clinical history should be considered in light of the CT findings. No specific treatment is required for small post-traumatic SAH.
5. **Isolated subdural hemorrhage (SDH)** – measuring less than 5mm in thickness, especially when located in the interhemispheric fissure or along the tentorium cerebelli or skull base. These patients should be admitted for medical observation and should undergo repeat CT in 8 hours, or earlier if there is neurologic deterioration.
6. **Isolated epidural hemorrhage (EDH)** – measuring less than 5 mm in thickness, especially if located in the occipital or parietal areas. EDH in the posterior cranial fossa or in the temporal region are at higher risk for causing brainstem compression. Patients with small EDH should still be observed medically and a repeat CT obtained in 8 hours, or sooner if there is any neurologic deterioration.

BURR HOLES should be considered only in rare instances when no CT scan is available, the patient cannot be transferred to QMC in a timely manner, and is deteriorating neurologically. Burr holes are not therapeutic in most cases, and are used primarily to establish the diagnosis of intracranial hematoma when no CT is available. Formal craniotomy is required if there is a subdural or epidural hematoma, the patient's GCS/neurologic exam is deteriorating rapidly, and arrival at QMC is more than 4 hours away. Standard technique should be used.¹⁰ Telephone discussion with a neurosurgeon is recommended prior to undertaking such a procedure. Most importantly, there needs to be a surgeon capable of doing the procedure and immediate availability of the necessary equipment. Training for this procedure will be provided at designated neighbor island hospitals as needed as part of the statewide trauma system education plan.

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