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SHORT RESEARCH REPORT: CLINICAL

The use of CT in the management of minor head injuries in Queenstown

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ABSTRACT

AIM: This study retrospectively reviewed the management of head injury at Lakes District Hospital in Queenstown, New Zealand. The aim is to describe the management of minor head injury with particular reference to the current Traumatic Brain Injury guidelines of the New Zealand Guidelines Group.

METHODS: We identified all patients with head injury as a primary diagnosis who were seen in the Emergency Department at Lakes District Hospital during 2013–2015. We recorded clinical criteria indicating need for computed tomography (CT) scanning according to current guidelines for management of minor head injury.

RESULTS: A total of 883 patients were seen with head injury as their primary diagnosis: 280 patients aged >15 years had a minor head injury that met current criteria for immediate CT scanning. Of these, 66 (23.6%) actually had a CT head scan.

CONCLUSION: The rate of CT head scanning for minor head injury in Queenstown does not comply with current New Zealand guidelines.

KEYWORDS: Rural health; craniocerebral trauma; healthcare disparities; guideline adherence

Introduction

The most recent estimate of the usually resident population of Queenstown and suburbs (excluding Wanaka) is 27,492 people.[1] It is one of the fastest growing districts in New Zealand. Queenstown hosts large numbers of domestic and international tourists, accounting for 9% of all commercial accommodation nights in New Zealand.[2]

Lakes District Hospital is situated 183 km from the base hospital in Southland and 279 km from Dunedin Hospital, which provides neurosurgical and intensive care services. Lakes District Hospital, a 10-bed rural hospital staffed mainly by vocationally registered Rural Hospital Doctors, has an emergency department. On-site imaging is limited to standard radiographs and point-of-care ultrasound. The nearest computed tomography (CT) scanner is at Dunstan Hospital, a rural hospital that is 80km distant. Most weeks the Dunstan Hospital CT scanner operates on weekdays during working hours. Ambulance transport for hospital transfers outside of working hours can be challenging to organise, and adverse weather can hinder helicopter evacuation.

Queenstown is known for its adventure sports (particularly snow sports and mountain biking) and hospitality. Binge drinking and assaults are common. Trauma forms a large portion of the workload of Lakes District Hospital. In 2014–15 the New Zealand Accident Compensation Corporation (ACC) reported 1351 concussion or brain injury claims in Otago, which represents 10% of all such injuries reported in New Zealand over the same period, despite Otago containing only 5% of the New Zealand population.[3] Absent any other difference between Otago and the rest of New Zealand that might explain such excessive numbers, it seems likely that it may be due to the combination of youth, sport, alcohol, and

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high visitor numbers in Queenstown. It is not possible to confirm it from ACC data.

More than 10 years ago, Stiell *et al*. produced and validated the Canadian CT Head rule, which has high sensitivity and reasonable specificity for the diagnosis of significant intracranial injury in minor head injury.[4] The Canadian CT Head rule has been adapted for use in New Zealand by the New Zealand Guidelines Group.[5]

This study aimed to investigate adherence to the New Zealand Traumatic Brain Injury guidelines (Box 1) for patients in Lakes District Hospital with minor head injury over the years 2013–2015.

Methods

Using the emergency department's electronic patient management system, all patient contacts coded with a primary diagnosis of head injury, concussion, or scalp laceration were downloaded. Young people aged ≤15 years were excluded, as were patients who were returning for review. An Excel spreadsheet was built to include details of each patient's age, sex, mechanism of injury, and the presence of any of the 'high risk features' that the New Zealand Guidelines identifies as indications for an immediate CT head scan. Individual patient notes were then searched. If a high risk feature was not noted as present in either electronic medical or nursing notes it was assumed to be absent. Following data collection, a group of patients who fulfilled the criteria for the diagnosis of minor head injury (Glasgow Coma Scale (GCS) 13-15) was obtained by excluding patients defined as having a head injury that was major (GCS < = 8), moderate (GCS 9-12) or minimal (no change in mental status).

Skiing or fast mountain biking, jumping a bike, skis or snowboard, and damaging a helmet were judged as high risk mechanisms of injury, along with more standard descriptions.

Results

During 2013–2015, 883 patients with head injuries were seen at Lakes District Hospital, including 657 patients aged ≥16 years. The average age of adult patients was 37 years: 63.8% were male.

WHAT GAP THIS FILLS

What is already known: Validated guidelines for emergency management of minor head injury are well known and in everyday use. In New Zealand, people who live in rural areas have CT scans at much lower rates than urban dwellers.

What this research adds: In Queenstown only 23.6% of people with minor head injuries in whom CT is indicated are imaged.

Of all adult head injuries, 41% occurred while participating in sport, 28.5% were caused by falls, 23% were alcohol related, and 9.4% were the result of assault. Nineteen (2.9%) head injuries were moderate or severe, 481 (73.2%) were minor, and 157 (24.0%) minimal. Of 481 patients with minor head injury 280 (58%) had high risk features documented in their clinical record that would mandate immediate CT head according to New Zealand Guidelines. The most common high risk features were high energy mechanism of injury (162 patients), antegrade amnesia (107 patients) and GCS <15 at 2 h post injury (63 patients). CT head scans were performed on 66 (23.6%) of 280 patients with minor head injury who met NZ guideline criteria for CT scanning.

Discussion

Less than one in four Lakes District Hospital patients presenting with a minor head injury who met New Zealand guidelines criteria for an immediate CT head scan actually had a CT head performed, which is consistent with the previously demonstrated per capita public CT scanning rate for Queenstown residents which is 57% of nearby larger centres.[6]

Retrospective chart audits have limitations including being prone to bias when the data abstraction is undertaken by a single investigator.[7] The present study, however, is more likely to underestimate rather than overestimate the number of patients with high risk features who did not receive CT head scans. Clinical notes did not usually refer specifically to Guideline CT criteria and it was often not possible to determine the GCS two hours post-injury as the time of injury was not recorded. Unless there was clear evidence in the notes that a high risk feature was present, it

Box 1. Excerpt from the New Zealand Traumatic Brain Injury Guidelines

CT scans should be immediately requested for adults who have sustained a head injury, if they have any one of the following risk factors:

- any deterioration in condition
- a Glasgow Coma Scale score of less than 13 when assessed, irrespective of the time elapsed since the injury
- a Glasgow Coma Scale score of 13 or 14 two hours after the injury
- a suspected open or depressed skull fracture
- any sign of basal skull fracture (haemotympanum, 'panda' eyes, cerebrospinal fluid, otorrhoea, Battle's sign)
- post-traumatic seizure
- focal neurological deficit
- more than one episode of vomiting
- amnesia for more than 30 minutes for events before the injury.

CT scanning should be immediately requested for adults with any of the following risk factors who have experienced an injury to the head with some loss of consciousness or amnesia since the injury:

- age 65 years or older
- coagulopathy (history of bleeding, clotting disorder, current treatment with warfarin)
- high-risk mechanism of injury (a pedestrian struck by a motor vehicle, an occupant ejected from a motor vehicle, or a fall from a height of greater than one metre or five stairs).

Indications for CT Head[5]

was assumed to be absent. It is also likely that the study underestimated the total number of head injuries because it did not capture head injuries that occurred in addition to another primary injury.

Fifty percent of patients attending Lakes District Hospital are not local residents and information on medium and long-term outcomes is not contained in the local clinical record. It is therefore not possible to ascertain individual patient outcomes. However, the New Zealand Guidelines are adapted from the Canadian CT Head rule which has been validated in multiple different settings.[5,8] Because practice at Lakes District Hospital is at such variance with these guidelines it is likely that patients with clinically important intracranial injuries are being missed.

The Canadian CT Head rule is over 99% sensitive for minor head injuries requiring neurosurgical intervention and 98% sensitive for all significant intracranial injuries.[5] One Canadian CT Head rule validation study revealed neurosurgical intervention rates of 0.4% (GCS 15 at first assessment) and 1.3% (GCS 13) with clinically important intracranial injury rates of 7.5% (GCS 15) and 24.5% (GCS 13).[8] Twenty percent of patients in the initial validation study were GCS 15 at initial presentation.[5] In comparison, 22.5% of patients in our study cohort remained <GCS 15 at two hours after presentation, suggesting that their head injuries were at least as severe as injuries in the validation study.

Clinically important intracranial injury is defined as any positive CT finding (excluding minimal contusions or haematomas) that would usually require hospital admission and neurosurgical follow-up.[5] Although neurosurgical intervention is not required, studies have shown that these patients have delayed recovery, significant ongoing differences in neurocognitive function and persistent MRI findings compared with patients with normal CT scans.[9–11] Recurrent concussions are associated with delayed resolution of symptoms and long-term effects such as mental health disorders and memory impairment.[12,13] Many patients in the present study may be at risk of recurrent sport or alcohol related head injuries and may have benefitted from risk modification advice or referral to head injury rehabilitation services.

Conclusion

CT scanner in Queenstown

Technological advances have made CT cheaper and easier to provide in rural areas. Services have been successfully introduced into other rural centres with comparable resident populations. These have overcome access disparities without over-servicing.[14,15] Particular features of Queenstown further strengthen the argument for a CT scanner there: its distance from tertiary services, the rapidly growing resident population and the large number of visitors who enjoy the town's high risk adventure sports and party culture.

Rural Health inequalities

This paper provides further evidence that rural New Zealanders have worse access to medical imaging, which has impacts on clinical care.

Rural New Zealanders also experience worse access than urban people to ambulance services, primary care, pharmacies, and mental health services.[16] People living in rural communities in Australia, Canada and the United States have poorer health outcomes than people living in urban areas.[17–19] It is not clear whether these health outcomes are related to environmental differences, health behaviours, or access to medical care, although worse access to medical care for rural people has been also been documented in these countries.[20,21] It has been suggested that New Zealand's urban/rural health disparities may be greater than currently appreciated.[22]

Guideline development

The New Zealand Head Injury Guideline offers an '*alternative management approach for rural centres without access to CT*.'[5] It suggests that only patients with moderate or severe head injuries are immediately imaged, and all others who meet usual criteria for scanning are discussed with a neurosurgical centre. It is unclear if there is evidence to support this alternative approach. It is also our experience that usual advice from the neurosurgical centre is to 'scan according to guidelines'. This is unfortunately often not practical in rural settings.

The current study highlights a gap between the realities of practice in rural New Zealand and current clinical guidelines. The lack of evidence on how best to manage minor head injuries where there is no ready access to CT continues to make the rational management of these patients challenging. It is important to carefully consider all healthcare contexts when guidelines are developed. Relevant research should be encouraged, and rural clinicians should be included on clinical guidelines development committees.

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