

This is the author's final version of the contribution published as:

G. Migliaretti;P. Ciaramitaro;P. Berchiolla;C. Scarinzi;R. Andrini;A. Orlando;G. Faccani. Teleconsulting for minor head injury: the Piedmont experience. JOURNAL OF TELEMEDICINE AND TELECare. 19 pp: 33-35.

DOI: 10.1177/1357633X12474738

The publisher's version is available at:

<http://jtt.rsmjournals.com/cgi/doi/10.1177/1357633X12474738>

When citing, please refer to the published version.

Link to this full text:

<http://hdl.handle.net/2318/127417>

Teleconsulting for minor head injury: the Piedmont experience

Giuseppe Migliaretti*, Palma Ciaramitaro†, Paola Berchiolla*, Cecilia Scarinzi*, Rita Andrini‡, Anna Orlando§ and Giuliano Faccani†

*Department of Public Health and Microbiology, University of Turin, Italy;

†Clinical Neurophysiology Unit, Neurosurgery Division, Health and Science Centre of Turin, Italy;

‡Society for the Regional Information System 'CSI-Piemonte', Turin, Italy;

§Health office, Regional Agency 'Regione Piemonte', Turin, Italy

Summary

We evaluated the benefits of teleconsulting for patients hospitalised with minor head injuries in centres without neurosurgery. In the Piedmont region, 1462 consultation requests were received at specialist centres in 2009, relating to 519 patients with a minor head injury diagnosis (ICD 850 – 854). These were compared with the details of 1895 patients admitted with the same diagnosis during 2009, but for whom no consultations were requested. The mortality risk in the two groups was estimated using logistic regression, after adjusting for the principal confounding factors (sex, age, seriousness of the patient's injury at diagnosis, referral centre). The estimated risk of death for patients for whom no consultation was requested was an odds ratio of 1.32 (95% CI 1.08 to 1.74) compared to those who received a teleconsultation. However, after adjusting for the confounding factors, the risk was not significant (odds ratio ¼ 1.25, 95% CI 0.83 to 1.91). A stratified analysis identified a significant effect for elderly people, aged over 70 years, in whom the odds ratio was 1.14 (95% CI 1.04 to 1.82). The results confirm the benefits of telemedicine, in particular for elderly patients, when teleconsultation is requested in the case of minor head injury.

Introduction

In most European countries, patients who are hospitalised with a head injury are treated in medical centres without neurosurgical units.¹ Until recently, these patients were often transferred to specialist centres for the necessary analyses, and then they were sometimes returned to the centres they had arrived from, with all the risks entailed in these movements. Treatment of patients in specialist centres produces good results,² but little work has described the situation of patients, who present in peripheral centres without neurosurgery.^{1,3} Guidelines for the management of patients with serious head injury in the US and in Europe have been published,^{4,5} but none of these guidelines contain clear indications about transferring patients to specialist centres.

The decision to move a patient to a neurosurgical centre is usually taken after a telephone call,⁶ but in the last few years evaluation of the patient has been made through teleconsulting, which makes it possible to transmit the CT images to the neurosurgeon.⁷

The Project PATATRAC (Piedmont Aosta Valley Axial Tomography Cranial Trauma) began in Piedmont in 1997. It allows the control and monitoring of teleconsultation requests to specialist centres, via a network connecting the regional centres. The aim is to reduce avoidable mortality for minor head injuries. The system records information in a database called Tempore, which has achieved a good level of reliability and completeness of the data, and therefore facilitates research in this field.⁸

The present study aimed to evaluate the benefits of teleconsulting for patients hospitalised with minor head injuries in centres without neurosurgery.

Methods

During 2009, 1462 consultation requests arrived at specialist centres, related to 519 patients with a minor head injury diagnosis (International Classification of Diseases, ICD code 850– 854). The details were recorded in the Tempore database. This information was compared with the details of 1895 patients (SDO patients) admitted with the same diagnosis during 2009, but for whom no consultations were requested. Information about the latter patients was recorded on hospital admission index cards. We considered all clinical and personal data of the two groups.

The benefit of teleconsulting was measured in terms of the patient's mortality risk. The seriousness of the patient's injury was measured using the fifth number of the ICD code. In order to define the best cut-off value in the fifth number of the ICD code that would identify the seriousness of trauma in accordance with the GCS scale, the Receiver Operating Curve (ROC) approach was used.⁹ A ROC analysis plots the true positive (sensitivity) vs false positive (1-specificity) rates. The resulting curve can be analysed to determine at what point (cut-off value) the true positive rate is optimized at a given/desired false positive rate (or vice versa). It was evaluated in comparison to the GCS by Sensitivity, Specificity and Positive Likelihood indicators and their 95% confidence intervals.¹⁰

Using logistic regression models, the mortality risk of Tempore patients was compared to that of SDO patients. The results were calculated as an odds ratio, with 95% confidence intervals (95% CI). The odds ratio was adjusted by the principal confounding factors (sex, age, seriousness of the patient's injury at diagnosis). The statistical analysis was performed using a standard package (STATA 9.0, Stata Corporation, TX, USA).

Results

A total of 1462 consultations were recorded in the Tempore database during the study period. These referred to 462 patients (194 females and 268 males) with a diagnosis of head injury. The majority of the patients were over 70 years old (67% aged over 70 years), with a moderately serious head injury (72% with a Glasgow Coma Score, GCS, over 12).

In 50% of consultations, the request was completed within 22 min, but in some cases (10%) the consultations took more than 60 min. An analysis of the number of consultations for each patient showed that 10% of the patients needed more than 4 requests (some patients produced more than one request because more details were required in answering the original consultation), and in particular there were 13 patients in whom more than 10 consultations were requested.

The ROC analysis supported the use of the value 4 as the cut-off level for the fifth number of the ICD code to identify in particular moderate trauma (GCS \geq 8). That is, a value smaller than 4 corresponds with a good approximation to a value 8 of the GCS (Specificity \approx 0.93, 95% CI 0.90 to 0.95 and Positive Likelihood \approx 5.48, 95% CI 5.01 to 5.97).

Comparison of the mortality risk between the two groups of patients led to an estimate of the death risk for those patients for whom no consulting was requested: an odds ratio of 1.32 (95% CI 1.08 to 1.74). However, after adjusting for the confounding factors, the risk was not significant (odds ratio \approx 1.25, 95% CI 0.83 to 1.91). A stratified analysis identified a significant effect for elderly people, aged over 70 years, in whom the odds ratio was 1.14 (95% CI 1.04 to 1.82).

The protective effect of consulting was not significant for those patients who arrived in hospital by their own means of transport (odds ratio \approx 1.62, 95% CI 0.91 to 2.86)

Discussion

The present study shows that teleconsulting for head injuries was widely used in regional hospitals and provided substantial benefits. An interesting finding was the different ability to manage patients shown by different regional centres. In particular, some centres needed many requests to manage each patient, and for this reason specific training for operators may be appropriate in future. Also, the high response time in some specialist centres requires further investigation. The results however confirm the benefits of telemedicine, in particular for elderly patients, showing a reduction in risk when teleconsultation is requested. Some other studies have found teleconsulting to be important, particularly to reduce unnecessary patient transfers,¹¹ but at present there is insufficient evidence to identify specific benefits.

Doctor-to-doctor teleconsultation allows the rapid resolution of queries, which would otherwise cause stress for patients and would increase the cost and complexity of their health care.^{12,13} The present study provides a first description of an important technique in the management of patients with head injuries, particularly those hospitalised in peripheral centres, for whom in some cases a useless transfer would have occurred with the consequent associated risks. A further development of the present work will be a detailed analysis of the data made available in the Tempore database, in relation to other diagnoses, including stroke. Obviously the present results are preliminary and require further verification.

References

- ¹ McKeating EG, Andrews PJ, Tocher JJ, Menon DK. The intensive care of severe head injury: a survey of non-neurosurgical centres in the United Kingdom. *Br J Neurosurg* 1998;12:7 –14
- ² Hukkelhoven CW, Steyerberg EW, Farace E, Habbema JD, Marshall LF, Maas AI. Regional differences in patient characteristics, case management, and outcomes in traumatic brain injury: experience from the tirilazad trials. *J Neurosurg* 2002;97:549 – 57
- ³ Guidelines for minor head injured patients' management in adult age. The Study Group on Head Injury of the Italian Society for Neurosurgery.
J Neurosurg Sci 1996;40:11 –5
- ⁴ Bullock R, Chesnut RM, Clifton G, et al. Guidelines for the management of severe head injury. Brain Trauma Foundation. *Eur J Emerg Med* 1996;3:109 –27
- ⁵ Maas AI, Dearden M, Teasdale GM, et al. EBIC-guidelines for management of severe head injury in adults. European Brain Injury Consortium.
Acta Neurochir (Wien) 1997;139:286 –94
- ⁶ Morris K. Assessment and communication of conscious level: an audit of neurosurgical referrals. *Injury* 1993;24:369 –72
- ⁷ Servadei F, Antonelli V, Mastrilli A, Cultrera F, Giuffrida M, Staffa G. Integration of image transmission into a protocol for head injury management: a preliminary report. *Br J Neurosurg* 2002;16:36 –42
- ⁸ Visca A, Faccani G, Massaro F, et al. Clinical and neuroimaging features of severely brain-injured patients treated in a neurosurgical unit compared with patients treated in peripheral non-neurosurgical hospitals. *Br J Neurosurg* 2006;20:82 –6
- ⁹ Nakas CT, Yiannoutsos CT. Ordered multiple-class ROC analysis with continuous measurements. *Stat Med* 2004;23:3437 – 49
- ¹⁰ Altman DG, Machin D, Bryant TN, Gardner MJ (eds). *Statistica Medica, Intervalli di Confidenza nella Ricerca Biomedica*. Torino, Italy: Minerva Medica, 2004
- ¹¹ Jithoo R, Govender PV, Corr P, Nathoo N. Telemedicine and neurosurgery: experience of a regional unit based in South Africa. *J Telemed Telecare* 2003;9:63 –6
- ¹² Houston MS, Myers JD, Levens SP, et al. Clinical consultations using store-and-forward telemedicine technology. *Mayo Clin Proc* 1999;74:764 –9
- ¹³ Paiva T, Coelho H, Araujo MT, et al. Neurological teleconsultation for general practitioners. *J Telemed Telecare* 2001;7:149 –5