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Research paper

A Retrospective Study Investigating: Factors associated with mode of arrival and emergency department management for patients with acute stroke

Danny Kinsella[a,b,*], Ian Mosley[c], George Braitberg[d,e]

[a] Alfred Health, Nursing Education, Australia
[b] Sunshine Hospital, Neurology Department, Australia
[c] La Trobe University, School of Nursing & Midwifery, College of Science, Health & Engineering, Australia
[d] University of Melbourne, Department of Medicine, Australia
[e] Royal Melbourne Hospital, Emergency Department, Australia

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ABSTRACT

Background: Presentation by ambulance to the emergency department is critical for stroke patients to receive time dependent treatments. However, little is known of the factors that influence presentation by ambulance.
Methods: Retrospective analysis of all patients with an emergency department medical diagnosis of stroke who presented to one of three Victorian emergency departments over a three-year period (2011–2013). A multivariable model was used to investigate demographic characteristics (including triage assessment category, triage identified as stroke, time to CT, and time to diagnosis within the emergency department) as predictors of arrival by ambulance.
Results: 3548 stroke patients were identified; mean age was 70 years, 53% were males, and 92% had an ischemic stroke. Arrival by ambulance occurred in 71% ($n = 2509$) with arrival by private transport accounting for 29% ($n = 1039$) of patients. Factors significantly associated with arrival by ambulance were older age ($p = <0.001$), being born in Australia ($p = <0.001$), and speaking English in the home ($p = 0.003$). Arrival by ambulance was independently associated with rapid stroke care in the emergency department, arrival within 2 h from symptom onset, attending an advanced stroke service (access to thrombolysis), triaged for stroke, medical assessment within 25 min and referral for CT within 45 min.
Conclusion: In this Australian multicenter study, it was identified that patients who arrived by ambulance received faster acute stroke care within the emergency department. Public health education which targets patients who are younger and from a non-English speaking background is needed as these demographics were not associated with timely arrival by ambulance to the emergency department.

1. Introduction

Stroke is a leading but largely preventable cause of death in Australia and worldwide [1]. Positively, recent years have witnessed considerable advancements in treatment options for patients with stroke [2]. None more so than treatments within the hyper-acute stroke phase (within 6 h from symptom onset), including thrombolysis [3] and endovascular clot retrieval [4]. However, hyper-acute stroke treatments remain highly time-critical [5–7]. Emergency nurses have been shown to positively contribute to patient outcomes for patients presenting with stroke [8,9]. This is achieved by prompt and appropriate triaging of patients [10], activation of 'code stroke' [11], and provision of nursing specific treatments [12].

Rapid presentation by ambulance following the onset of symptoms remains a fundamental requirement for optimizing treatment outcomes in the management of acute stroke [13,14]. Public health campaigns, most notably Face, Arm, Speech, and Time (*FAST*), have assisted the Australian community's recall of stroke symptoms and increased ambulance dispatches for stroke [15]. Other pre-hospital management advancements include; ambulance stroke recognition tools [16] and ambulance pre-hospital stroke notification [17].

* Corresponding author at: Nursing Education, South Block, Alfred Hospital, 55 Commercial Road, Melbourne, Victoria 3004, Australia.
E-mail addresses: d.kinsella@alfred.org.au (D. Kinsella), I.Mosley@latrobe.edu.au (I. Mosley), George.Braditberg@mh.org.au (G. Braitberg).

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Nevertheless, community delays in seeking ambulance assistance continues to limit the implementation of hyper-acute stroke therapies and in turn limits patient outcomes. Little is known of the factors associated with community members arriving to emergency departments by ambulance following stroke symptom onset. Therefore, analysis of factors contributing to delay warrants further investigation [18].

Time critical diagnosis extends beyond hyper-acute treatments, as delay in stroke diagnosis can result in a protracted activation of secondary management such as medication therapy or neurosurgical intervention. Authors of previous studies have reported improved patient outcomes including reduced complications, reduced mortality rates, and faster admission to neuroscience intensive care units [19] and specialist stroke units [20] for patients who receive prompt and timely care in emergency departments.

Little is known of the extent that demographic characteristics or receiving timely care for acute stroke in the emergency department are associated with arrival by ambulance. For these reasons, clinicians have called for further investigation into this critical area of care [21,22].

1.1. Aim

We sought to examine among patients presenting with stroke factors associated with arrival by ambulance. Specifically, to identify associations between arrival by ambulance and demographic variables and access to clinical service markers (triage assessment category, triage problem identified as stroke, time to medical assessment, time to CT, and time to stroke diagnosis within the emergency department).

2. Materials and methods

2.1. Study design

This study, from a single health network comprising of three hospital campuses, is a retrospective analysis of emergency department medical records for patients with a diagnosis of acute stroke. The study period was 3 years from January 1, 2011 to December 31, 2013.

2.2. Study setting

Monash Health provides acute care services to the south east corridor of Melbourne. Stretching over 28 km from Monash Medical Centre in the south to Dandenong Hospital and then on to Casey Hospital in the south east, the service provides care to a diverse range of communities. The most diverse is the Greater Dandenong local government area with 18% of the population speaking languages other than English. Monash Health has a population catchment of 1.3 million people. The three emergency departments which form Monash Health's emergency service, treat 180,000 people annually. Monash Health's stroke service has overarching uniformity of triage assessment guidelines and protocols for the delivery of stroke care across the three emergency departments. The stroke services within the respective hospitals include a specialist stroke service at Monash Medical Centre which provides a comprehensive stroke unit, stroke thrombolysis, and neurosurgery; Dandenong Hospital which is serviced by a stroke unit; and Casey Hospital which has limited stroke specific services.

2.3. Data collection and variables extracted

Monash Health has a single computer-based emergency department information system. Programs were developed by the investigators to extract all patients with a final medical diagnosis in the emergency department of acute stroke within the study period. The ICD-10-AM (Australian Modification) [23] was used to identify cases for inclusion in the study during the study period. Patients with a final emergency department diagnosis of transient ischemic attack (TIA) were excluded.

Dependent variable:

Mode of arrival to the emergency departments was coded as ambulance or private transport.

Independent variables:

(i) *Demographic characteristics:* Patient variables included age, sex (male or female), country of birth (Australian or other), and language spoken at home (English or other).
(ii) *Clinical service markers:* These included: arrival time within 2 h from symptom onset (this dichotomous variable of 2 h is consistent with other studies that identify rapid hospital presentation patterns following stroke onset [24,25]), triage problem identified as stroke, triage assessment category was performed by emergency nursing staff trained in patient reception and initial patient assessment. Triage category was defined by the Australasian Triage Scale of 1–5 with 1 being most severe and 5 being least severe [9]. Further clinical service markers included time from emergency department door arrival to a medical assessment (minutes), time from emergency department door arrival to CT referral (minutes), and time from emergency department door arrival to stroke diagnosis (minutes).

2.4. Statistical analysis

Descriptive statistics were used to present patient demographics and clinical service markers. Data were analysed using STATA version 12 [26]. Univariable regression analysis was used to identify variables associated with arrival by ambulance. Variables included demographic characteristics and key clinical service markers (triage assessment category, time to medical doctor assessment, time to CT, and time to diagnosis). To address the potential impact of variability within the sample access to specialist stroke services (Monash Medical Centre) was entered as an additional clinical service marker. The Odds Ratio (OR) and 95% Confidence Intervals (CI) were investigated, and a p-value of <0.05 was considered statistically significant. A multivariable model was then developed using backward stepwise elimination for retaining the independent variables. All variables were entered into the model. The least significant variable was removed and the model re-run. This process was repeated until only variables with a p-value of <0.05 were retained.

2.5. Sample size calculation

To determine whether the available sample size was sufficient to address the research questions, the formula provided by Tabachnick and Fidell [27] for multiple regression analysis was used (i.e., $N > 50 + 8m$ where m = number of predictor variables). The number of predictor variables in the present study were $m = 11$, therefore the minimum sample size calculated was $N > 138$.

2.6. Ethics approval

The reported research findings adhere to the National Statement for the Conduct of Human Research by the Australian National Health and Medical Research Council. This study was identified as a 'Quality Assurance Activity' by the Monash Health Human Research

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