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Utilisation of emergency medical services for severe hypoglycaemia: An unrecognised health care burden

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ABSTRACT

Aims: Diabetes is associated with several acute, life-threatening complications yet there are limited data on the utilisation of prehospital services for their management. This study aimed to examine the utilisation of emergency medical services (EMS) for prehospital hypoglycaemia, including patient characteristics and factors related to hospital transportation.
Methods: An observational study of patients requiring EMS for hypoglycaemia across Victoria, Australia over three years was conducted. Pre-specified data including patient demographics, comorbidities, examination findings and transport outcomes were obtained. Logistic regression was used to assess factors associated with transportation.
Results: During the study period, 12,411 hypoglycaemia events were attended by paramedics for people with diabetes. The majority were individuals with type 1 diabetes (58.8%), followed by type 2 diabetes (35.2%) and unspecified diabetes type (5.9%). Thirty-eight percent of patients were transported to hospital by EMS following hypoglycaemia. Factors associated with transport by EMS included extremes of age (<15 and >75 years), female gender, type 2 diabetes, event at a nursing home or hospital/community clinic, presence of comorbidities and time of day.
Conclusions: Examination of the utilisation of EMS for hypoglycaemia has identified a previously unquantified need for emergency care for people with diabetes as well as factors related to hospital transportation.

1. Introduction

Diabetes mellitus contributes substantially to the disease burden worldwide, with a global prevalence of an estimated 415 million people (IDF, 2015). In Australia, there are currently an estimated 1.7 million people with diabetes, which is predicted to increase to 3.5 million in the next two decades (Magliano et al., 2009) and, with associated expenditure estimates of $14.6 billion (Lee et al., 2013), this financial burden will be difficult to sustain. In addition to the numerous chronic conditions, diabetes is associated with several acute, life threatening complications including severe hypoglycaemia. Hypoglycaemia, classified as severe when the assistance of another person is required to actively administer carbohydrates, glucagon or take other corrective actions (ADA, 2005), is associated with considerable morbidity and mortality (Cryer et al., 2009; Honkasalo, Elonheimo, & Sane, 2011; Zoungas et al., 2010).

Diabetic complications, such as hypoglycaemia account for 25.6% of avoidable hospitalisations in developed countries, more than any other condition (Glover, Page, Ambrose, & Hetzel, 2007). However, patient reporting of severe hypoglycaemia is incomplete or unreliable (Weitgasser & Lopes, 2014) and little is known about the requirement for prehospital emergency care. International studies reporting utilisation rates (0.6% (Khunti et al., 2013) to 4.7% (Parsaik et al., 2012)) and transport rates (7% (Elwen et al., 2015) to 75% (Holstein,

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Plaschke, Wogel, & Egberts, 2003)) for hypoglycaemia vary widely. Given the growing health and financial burden of diabetes, information on resource use for hypoglycaemia is required to inform potential interventions and measure improvements.

This state-wide, community-based study aims to investigate the utilisation and patterns of demand for prehospital emergency medical services (EMS) for hypoglycaemia in the state of Victoria, Australia, the characteristics of individuals receiving assistance from EMS for hypoglycaemia and the factors associated with EMS transport to hospital following attendance by EMS for hypoglycaemia.

2. Materials and methods

2.1. Study design

A retrospective database review was conducted on all cases of hypoglycaemia attended by the Victorian Ambulance Service, Ambulance Victoria, in the three-year study period between January 1, 2009 and December 31, 2011. All individuals, of any age, who received prehospital emergency medical assistance from Ambulance Victoria during the study period and fulfilling the inclusion criteria of documented diagnosis of diabetes (any type) and/or use of glucose lowering medications and final primary assessment of "hypoglycaemia", as assigned by the attending paramedic, were included. A blood glucose level (BGL) threshold parameter was not specified in the study inclusion criteria, however Ambulance Victoria Clinical Practice Guidelines specify a BGL < 4 mmol/l as the threshold to treat for hypoglycaemia (Ambulance Victoria, 2014a). Monash Health Human Research Ethics committee approved this study.

2.2. Setting

The state of Victoria, Australia had an estimated population of 5.53 million in 2011 (ABS, 2011) and 269,900 residents registered with the *National Diabetes Service Scheme* (NDSS, 2013). Victoria is serviced by a two-tiered prehospital EMS system, Ambulance Victoria, which deploys Advanced Life Support or Intensive Care paramedics to approximately 500,000 emergency cases annually (Ambulance Victoria, 2014b). Every case attended by Ambulance Victoria is recorded by the attending paramedic, using the VACIS®, an electronic patient care record and integrated data warehouse (Cox, Martin, Somaia, & Smith, 2013).

2.3. Variables

Pre-specified, de-identified data related to both EMS operational processes (location, date and time of attendance) and patient characteristics (gender, age, location type, type of diabetes, pre-existing medical history, examination findings and EMS transport outcomes) were extracted.

2.4. Operational process variables

Total emergency caseload for the three year period was derived by addition of the annual emergency caseload reported in serial Ambulance Victoria Annual reports (Ambulance Victoria (2009, 2010, 2011)) for the same period. Location of the EMS attendance was classified as "metropolitan" or "regional" according to the Australian Department of Immigration postcode classification (Australian Government, 2013). The time of the emergency call was grouped into four 6 h time periods; 0000 to <0600 h, 0600 to <1200 h, 1200 to <1800 h and 1800 to <2400 h as reported by previous studies (Heller, Amiel, & Mansell, 1999) (Socransky, Pirrallo, & Rubin, 1998).

2.5. Patient-related variables

Scene type, recorded by paramedics, was classified as: private residence, public place, nursing home/supported accommodation or hospital/community clinic. Diabetes type, based on patient/known bystander report, was classified as type 1 diabetes; type 2 diabetes treated with insulin; type 2 diabetes (not treated with insulin); or unspecified diabetes type. Past medical history was based on self- or family-reports and recorded by paramedics. A selection of comorbidities considered to be commonly associated with diabetes and/or utilisation of prehospital EMS was analysed and included renal disease, coronary disease, hypertension, stroke, concurrent infection and anxiety/depression. Initial and final examination findings as recorded by the paramedics included Glasgow Coma Score (GCS), Blood Glucose Level (BGL), Systolic Blood Pressure (SBP) and respiratory rate. Glucometry was performed by paramedics using capillary blood samples and point of care glucometers (Freestyle Optium ®, Abbott Laboratories, England) with a valid range of 1.1 mmol/L to 27.8 mmol/L, where values below and above this range are displayed and recorded as "low" or "high" respectively.

2.6. EMS attendance outcome variables

The outcome of EMS attendance was binary: patient transport to hospital with EMS or not transported to hospital with EMS. If attendance did not lead to transport to hospital with EMS, the reason, as recorded by paramedics was classified as 1) patient refused transport, 2) transport was deemed unnecessary, 3) patient to follow up with local medical officer or attend hospital by private means or 4) other (including "dead on arrival" and "died at scene").

2.7. Statistical analysis

To examine factors related to patterns of demand and patient characteristics, categorical variables were reported as percentages and differences between subgroups analysed using χ^2 test. Continuous variables were summarised as means with standard deviations and subgroup analysis performed using ANOVA when data were normally distributed or as medians with interquartile ranges and subgroup analysis performed using Mann–Whitney U when data were non-normally distributed. Annual and seasonal event rates of hypoglycaemia attended by EMS were calculated. Event rates were also calculated for both "metropolitan" and "regional" and adjusted by regional population density (per capita requests for EMS care). To examine factors associated with transport to hospital with EMS, logistic regression models were used in a 2-step approach. In the first step, crude models were calculated. The selection of variables was based on identifying all clinical variables of suspected importance for the outcome of interest (and/or exhibiting a p value of less than 0.05). In the second step, models were adjusted for all covariates identified to yield a p-value <0.05 in the univariable analysis except the covariate of interest. A two-sided significance level of 0.05 was considered statistically significant for all hypothesis tests. All analyses were performed using Stata software version 12.1 (StataCorp, Texas, USA).

3. Results

Between January 2009 and December 2011, Ambulance Victoria responded to 13,103 cases of hypoglycaemia, accounting for approximately 1% of the annual emergency caseload. Of these, 692 cases were excluded due to insufficient detail regarding diagnosis of diabetes, leaving 12,411 cases for the analysis. The average number of attendances per year was 15.32 events per 1000 Victorians with diabetes. There were a greater number of attendances during summer as compared to spring ($p = 0.02$), autumn and winter ($p < 0.001$). The rate of attendance, adjusted by regional population density (per capita requests for EMS care), was similar in metropolitan compared to regional locations ($p = 0.18$).

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