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Treatment of hypoglycaemic diabetics in a prehospital setting is safe

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ABSTRACT

INTRODUCTION: Patients with diabetes suffering from hypoglycaemia may be treated by a Mobile Emergency Care Unit (MECU) and are often released at the scene following treatment. Some of these patients experience secondary hypoglycaemia and require renewed treatment or admission to hospital. The present study was initiated in order to investigate the extent of secondary hypoglycaemia, to evaluate the appropriateness of the current treatment practice, and to provide practical suggestions for the handling of prehospital hypoglycaemia.

METHODS: All MECU runs are registered in a database by the attending physician who states the patients' identity, treatment, outcome and diagnosis. Over a period of four years (1 May 2006-30 April 2010), all missions related to hypoglycaemia were reviewed. Each entry was crossreferenced with the patient's hospital files to detect any recurrent hypoglycaemic episodes within 24 hours from initial contact.

RESULTS: The MECU treated 138 hypoglycaemic cases of whom 50% were released at home following treatment. Four of these patients experienced secondary hypogly-caemia. Two were treated by the MECU and two were admitted through the emergency department without contact to the MECU.

CONCLUSION: The number of patients suffering from secondary hypoglycaemia following treatment by the MECU is acceptable and in line with numbers reported by similar organisations.

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In Denmark, approximately 320,000 people have a diabetes diagnosis [1]. The actual number of affected persons may be 470,000, as many patients with type 2 diabetes are undiagnosed. In all, 10% of these patients are diagnosed with type 1 diabetes. The gender distribution is approximately equal. The mortality of diabetic patients is higher than the mortality of non-diabetic patients and mortality is associated with poor glycaemic control. However, tight glycaemic control increases the risk of clinically significant hypoglycaemia. Hypoglycaemia may be treated by a physician at the scene which may obviate admission to hospital [2, 3]. This medically directed treatment may be accomplished by dispatching a Mobile Emergency Care Unit (MECU) or, according to an Executive Order issued by the Danish Ministry of Health, by a paramedic who may release the patient at the scene following consultation with a physician [4].

The MECU in Odense, Denmark, operates as a part of a two-tiered system in which the MECU supplements an ordinary ambulance manned with two emergency medical technicians. The MECU covers an area of approximately 2,500 square km and serves a population of 250,000-400,000 depending on the time of the day.

In the study period, the MECU was dispatched according to the dispatch criteria mentioned in **Table 1**.

Following each MECU run, patient characteristics (including the patient's Civil Registration System number which identifies the patient) [5], the tentative patient diagnosis and the treatment are entered into the MECU database.

In the study period, paramedics or emergency medical technicians in Denmark were not certified to administer hypertonic glucose solution. In cases in which they arrived to the scene before the MECU, they initiated the treatment via instructions from the physician in charge of the entrepreneur responsible for the ambulance services. This treatment consisted of either sugary drinks given to the conscious patients or intramuscular injection of 1 mg glucagon in unconscious patients. When the MECU arrived at the scene, the treatment strategy was chosen at the discretion of the attending anaesthesiologist. For details, see **Table 2**.

In line herewith, the decision as to whether the patient could be released at home or should be referred to hospital was made at the discretion of the physician manning the MECU. In order to investigate the safety of this treatment, we designed a study based on information from the MECU database.

METHODS

The study was a retrospective, descriptive study approved by the Danish Data Protection Agency (J. No. 2010-41-5098). We searched the MECU database for the patients who had been assigned the diagnoses: *Hypoglycaemia, others* (E161), *Hypoglycaemia without specification* (E162) and *Non-specified, non-complicated diabetes* (E149) registered in the period from 1 May 2006 to 30 April 2010.

ORIGINAL ARTICLE

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Life threatening conditions

Ambulance and Mobile Emergency Care Unit dispatch criteria in the observation period.

Life threatening conditions
Sudden loss of consciousness
Absence of breathing
Noisy or otherwise impaired breathing
Possible life-threatening conditions
Dyspnoea
Severe chest pain
Sudden onset of serious headache
Impaired breathing in infants and children
Suspected serious illness in children or infants
Sudden onset of severe oral or rectal bleeding
Sudden onset of bleeding in pregnant women beyond 20th gestationa
Accidents, implying a risk of life-threatening conditions
Motorway accidents:
On highways
High-velocity car crash
Entrapment
Roll-over
Lorry or bus involved
Motorcycle involved
Pedestrian against car/motorcycle
Other accidents:
Fall from heights
Entrapped persons
Accidents with bleeding victims
Accidents involving horses
Gunshot or stab wounds towards torso, neck, head
Hanging
Drowning
Burns involving face or exceeding 20% (adults) or 10% (infants and children) of body surface area
Accidents involving trains or aeroplanes
Fire implying a risk of damage to people
Chamical avancura
Chemical exposure

Treatment regimen (N = 138).

Therapy	n (%)		
Mono			
IM glucagon	7 (5.1)		
PO glucose	17 (12.3)		
IV glucose	65 (47.1)		
Total	89 (64.5)		
Combined			
IM glucagon + PO glucose	6 (4.3)		
IM glucagon + IV glucose	27 (19.6)		
IV glucose + PO glucose	8 (5.8)		
IM glucagon + PO glucose + IV glucose	6 (4.3)		
Total	47 (34.1)		
Not reported	2 (1.4)		
M = intramuscular: IV = intravenous: PO = neroral			

IM = intramuscular; IV = intravenous; PO = peroral.

TABLE 3

Reasons for admitting patients despite normalization of blood glucose level (N = 69).

Reason	n (%)
Prolonged/repeated hypoglycaemia	4 (5.8)
Patient living alone	3 (4.3)
Patient not fully awake	15 (21.7)
Patient incapable of taking care of oneself	13 (18.8)
Patient generally affected by illness	5 (7.2)
Patient's own request	2 (2.9)
Total	42 (60.9)
Not reported	27 (39.1)

We then searched the patients' medical files for repeated MECU contacts, admissions to hospital, enquiries at the emergency department and out-patient clinics for a period of 30 days following the initial MECU treatment.

Furthermore, we registered any additional information, i.e. type of diabetes, appearing in the case summary. Non-Danish patients were excluded from the study because of difficulty in follow-up. Patients suffering from hypoglycaemia due to other causes than diabetes were excluded.

All data were categorised using Microsoft Office Excel 2007.

Trial registration: not relevant.

RESULTS

A total of 112 hypoglycaemic patients were involved in 142 emergency runs. One patient was excluded as he was not a Danish citizen. In three cases, the cause of hypoglycaemia was not registered in the patient's medical files, but diabetes was ruled out.

The remaining 108 patients (66 men and 42 women) elicited 138 runs. In all, 82 of the 108 patients (75,9%) were insulin-dependent diabetics, whereas 23 (21.3%) were noninsulin-dependent diabetics. In three patients, the type of diabetes was not registered.

In 94 patients, only one contact was registered. Two patients each had two contacts within the observation period. Eight patients were seen three times, whereas four patients each required four visits by the MECU in the observation period.

The median pre-treatment blood-glucose level was 1.9 mmol/l (range: < 0.9-5.9 mmol/l). In 13 cases a pretreatment blood-glucose value was not registered (9.4%). The post-treatment levels ranged 2.7-22.3 mmol/l with a median of 7.9 mmol/l. Post-treatment blood-glucose values were not registered in 59 cases (42.8%). In five cases, neither pre- nor post-treatment measurement was documented.



76.8% of the cases in this study received hypertonic glucose intravenously – either as mono- or combination therapy. Oral glucose or intramuscular glucagon or the two in combination was given in 21.7% of the cases.

As the paramedics' or emergency medical technicians' only option in treatment of unconscious patients was glucagon and they frequently arrived at the scene before the MECU, the largest subgroup in the group that received combined therapy was initially administered glucagon by the paramedic followed by supplementing hypertonic glucose administered by the MECU physician.

In two cases, the treatment regimen was not registered (see Table 2).

In 69 cases (50%), the patient was admitted to hospital despite normalisation of the blood glucose level. The reason for this was only explained in 42 cases (see **Table 3**). In the remaining 69 cases (50%), the patient was released at the scene following treatment. In all, 17 of these patients required healthcare system services in the follow-up period – four patients (5.8%) within 24 hours of their first treatment. Two patients required the MECU services – one was a type 1 diabetic in whom the required daily dose of insulin had not yet been established. The patient was deemed safe to release at the scene after his second hypoglycaemic episode because of a forthcoming appointment at the Department of Endocrinology. The other patient was a type 2 diabetic, who was admitted for three days and treated for dehydration following his second hypoglycaemic episode within 24 hours.

Another two patients, both type 1 diabetes, were admitted to hospital within 24 hours and discharged within a day, see **Figure 1**.

Three of the above-mentioned four patients did not have their blood-glucose level measured after the initial treatment.

The remaining 13 patients were treated in the period from 24 hours to 30 days after initial hypoglycaemia, in which another seven patients were admitted to the hospital because of renewed hypoglycaemia. Two patients were admitted for less than 24 hours, the remaining five patients were admitted for less than a week while an underlying disease was being treated. Three patients contacted the Department of Endocrinology for advice, two to discuss alternations in medication by telephone and one patient was seen at the day-care clinic before a scheduled visit agreed due to the hypoglycaemic episode.

Three patients required the MECU services because of recurrent hypoglycaemia within the 30-day follow-up period, after the initial 24 hours. A total of 14 patients were treated by the MECU more than once (2-4 times) due to hypoglycaemia during the four-year period.



A typical prehospital situation.

DISCUSSION

In the present study, we found that only 50% of patients receiving prehospital treatment by the MECU are released following treatment. This is a surprisingly low share given that the practice of treating and releasing the hypoglycaemic patient at the scene following treatment is generally considered acceptable [3].

However, a more recent study concluded that releasing hypoglycaemic patients was only safe in type 1 diabetic patients following structured patient education [6], while another paper concluded that all patients with type 2 diabetes treated with oral antidiabetic agents (OAA) should be admitted to hospital following a hypoglycaemic episode as the evidence that elucidates type 2 diabetes, OAA and hypoglycaemia remains sparse [7]. In that particular paper, a 2-7% risk of secondary hypoglycaemia was described.

Cain et al reported that 75 of 220 patients who suffered from a hypoglycaemic episode required admission to hospital [8], whereas Mattila et al reported that 62 of 69 patients could safely be released at the scene following a hypoglycaemic episode [9].

It is possible that the higher proportion of patients being admitted to hospital is caused by more patients suffering from diabetes type 2 in our material than in other studies [3]. However, the total number of patients suffering from recurrent hypoglycaemia is in line with numbers reported from other institutions with a similar setup [3].

This may be explained by poor compliance with the diabetic treatment instructions in these cases.

In almost one in every ten cases, a pre-treatment

blood glucose level was not obtained before initiation of treatment. Some, but not all of the patients, have been treated by the MECU before, and they are hence known by the prehospital staff as individuals with diabetes. Apart from the few situations where a patient who is known to suffer from diabetes may be uncooperative, measuring and documenting the pre- treatment blood glucose level should be regarded as mandatory in the treatment of patients who are suspected of being hypoglycaemic.

In approximately half the cases, a post-treatment blood glucose level was not measured. It may not be as relevant as the pre-treatment level, since the clinical presentation of the recovering hypoglycaemic patient is obvious. Also, as glucose is distributed in the total water phase of the body, the expected blood glucose value is relatively easy to calculate following treatment.

We found, however, that three in every four patients who suffered a renewed hypoglycaemic episode did not have their blood glucose level measured after the treatment before being released at the scene.

The decision concerning release of the patient at home or upon admission to hospital following treatment of hypoglycaemia is made at the discretion of the physician. The decision is probably influenced by several parameters including the patient's neurological status, the patient's social situation and the patient's response to the treatment. The wide variation in the post-treatment levels of blood glucose indicates that the numeric value itself is an unreliable indicator of the need for admission to hospital. Hence, this value is regarded as less important since the post-treatment value of blood glucose does not necessarily correspond to the patient's improved mental status.

All these individual and unpredictable factors make it difficult to establish clinically useful guidelines.

CONCLUSION

This study demonstrates that anaesthesiologist-administrated prehospital treatment and release is safe. However, based on this retrospective study, we recommend thorough documentation of the pre-treatment blood glucose level; a careful consideration of the medical history, including type of diabetes, duration and extent of the disease; and identification of the triggering cause. Also, before releasing the patient at his or her home, an assessment of the possibility of post-treatment surveillance should be made.

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LITERATURE

- https://sundhedsstyrelsen.dk/da/sundhed/folkesygdomme/diabetes (7 Dec 2014).
- Højfeldt SG, Sørensen LP, Mikkelsen S. Emergency patients receiving anaesthesiologist-based pre-hospital treatment and subsequently released at the scene. Acta Anaest Scand 2014;58:1025-31.
- Anderson S, Høgskilde PD, Wetterslev J et al. Appropriateness of leaving emergency medical service treated hypoglycaemic patients at home: a retrospective study. Acta Anaesthesiol Scand 2002;46:464-68.
- 4. www.retsinformation.dk/Forms/R0710.aspx?id=139180 (7 Dec 2014).
- Pedersen CB. The Danish Civil registration system. Scand J Public Health 2011;39;22-5.
- Holstein A, Plaschke A, Vogel MY et al. Prehospital management of diabetic emergencies – a population-based intervention study. Acta Anaesthesiol Scand 2003;47:610-5.
- Fitzpatrick D, Duncan EAS. Improving post-hypoglycaemic patient safety in the prehospital environment: a systematic review. Emerg Med J 2009;26: 472-8.
- Cain E, Ackroyd-Stolarz S, Alexiadis P et al. Prehospital hypoglycemia: the safety of not transporting treated patients. Prehosp Emerg Care 2003;7: 458-65.
- Mattila EM, Kuisma MJ, Sund KP et al. Out-of-hospital hypoglycaemia is safely and cost-effectively treated by paramedics. Eur J Emerg Med 2004;11:70-4.