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HEAT EXHAUSTION IN THE EMERGENCY DEPARTMENT: SHOULD NOT BE CONFUSED WITH OTHER FORMS OF HEAT RELATED ILLNESS

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ABSTRACT

Objective: Heat Exhaustion is a common heat related illness presentation seen in Emergency departments in hot and humid areas around the world. Despite being a well-established diagnosis, current literature shows inconsistent understanding of this disorder. In this study we aim to review the different clinical aspects of heat exhaustion.

Methods: In this retrospective study conducted in the emergency department at Hamad General Hospital, Doha-Qatar between May 2013 and September 2014, we reviewed the records of all patients diagnosed with heat exhaustion on discharge.

Results: Three hundred seventy-eight patients were included. Most of them presented in days where the highest ambient temperature (above 40° C) was associated with a relative humidity up to 60%. All patients had a smooth clinical course with no complications before discharge.

Conclusions: Heat Exhaustion is mostly a benign disorder, which should not be considered to overlap with other forms of heat related illnesses. Mild cases can be managed outside emergency departments.

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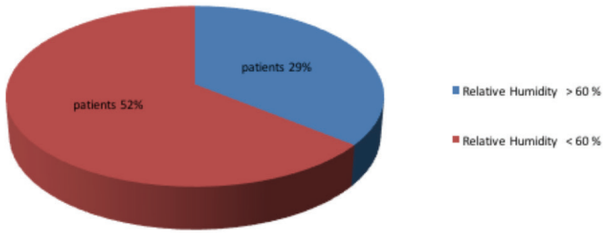
INTRODUCTION

Heat exhaustion is a form of heat related illness. Other forms range from mild conditions such as prickly heat to a potentially fatal condition namely heat stroke. Heat exhaustion falls into the moderate category among clinical spectrum of heat related illness, and is usually self-limited [1]. Heat exhaustion seems to be the most common type of heat related illness [2-4]. It affects millions of patients around the world every year, especially in areas with hot and humid climate [2;5]. Many emergency departments around the world deal with heat exhaustion frequently [4;6] which contributes to crowding at such facilities. Certain regions experience heat waves that result in a large number of cases [7] with a significant clinical burden. Early recognition along with preventive measures, can help in reducing the morbidity associated with heat exhaustion [2], this mandates a better understanding of why heat exhaustion develops. Despite all of that, heat exhaustion is not well studied in general, and most of the available data are retrospective reviews or poorly structured studies [5]. Furthermore, most of the available literature on heat related illness mainly focuses on heat stroke. Authors look into heat exhaustion in different ways. Some authors describe heat exhaustion as an early stage of, or a warning for impending heat stroke [2;8]. Other authors put both heat exhaustion and heat stroke at the same category [9], or suggest some overlap between the two disorders. Heat exhaustion is mostly ill-defined in literature, with absent diagnostic criteria, and inconsistent recommendations of management [10]. This ambiguity invited some authors to call for stop using terms such as heat exhaustion, heat cramps, heat fatigue, and heat syncopy, even to revise the traditional classification of heat related illnesses [11]. In the Middle East, high grades of both ambient temperature and relative humidity are recorded during summer time. However, literature review did not reveal much about heat exhaustion at this part of the world. This study is the first to review the clinical and epidemiological aspects of heat exhaustion in this region. By exploring the different clinical aspects of heat exhaustion, including clinical presentation, response to management and outcome, we aim to shed some light on this specific illness, looking for a better understanding and a better patient's care.

METHODS

We studied the records of all heat related illness patients presented to the Emergency Department (ED) at Hamad General Hospital between May 2013 and September 2014. Inclusion criteria included all patients who were discharge with a diagnosis of heat exhaustion. Patients less than 18 year old were excluded. Ethical approval was obtained from the Medical Research Centre at Hamad Medical Corporation (HMC). Waiver of informed consent for patients' data was requested and obtained. Patients' files were reviewed; collected data included demographic data, pre-hospital management, vital signs, clinical presentation, ED initial assessment, laboratory studies (CBC, electrolytes, renal function test, and liver function test), medications, management plan, and time intervals. Weather data were obtained from the records of Qatar Meteorology Department and Civil Aviation Authority. Data were entered onto spreadsheet, checked for accuracy and reviewed prior to analyses by study investigators using Microsoft Excel®. Data analysed in correlation to demographic and clinical findings.



Graph 1: Relation between relative humidity and number of patients

RESULTS

A total of 378 patients with heat exhaustion were included. All patients were involved in outdoor physical activities in hot and humid environment (55 % workers, 36% sports and athletes, and 9% other activities). All were male patients. Mean age was 33 years and ranged from 18-58. Most of the patients presented during August and September, (53 patients in May, 33 patients in June, 71 patients in July, 116 patients in August, and 105 patients in September) **(Table 1)**. One hundred ten 110 (29%) patients presented in days when the relative humidity was > 60 %, and 198 (52%) patients when the highest ambient temperature was > 40°C **(Graph 1)**. On arrival to the Emergency Department, none of the patients found to have a body temperature of 40°C or above. Body temperature ranged from 36.2°C to 39.1°C. The initial systolic blood pressure (SBP) was < 100 mmHg in 13 patients, between 100 mmHg and 110 mmHg in 312 patients, and above 110 mmHg in the rest **(Table 2)**. More than half of the patients, 204 (54%), presented with musculoskeletal symptoms (muscular pain and cramps), 43 (11%) patients with vomiting, and 98 (26%) patients with dizziness **(Table 3)**. In the initial assessment which was done by emergency physicians, 303 (80%) patients were considered to have heat exhaustion, while the rest 75 (20%) patients were suspected to have other diagnosis including: transient ischemic attack, coronary artery syndrome, post ictal status, arrhythmias and intracranial bleeding. Three hundred forty seven 347 (92%) patients received intravenous fluids (normal saline), in 261 (69%) of them, the amount of fluid was > 1 litre. Intravenous paracetamol was prescribed for 76 (20%) patients, 21 (27%) of them were found to have renal impairment later on. 64 (17%) patients received parenteral non-steroidal anti-inflammatory drugs (NSAIDs), 13 (20%) of them were found to have renal impairment. 96 (25%) patients had a white blood cell (WBC) count above 11 x 109 cells.L^{-1}, and 91 (24%) patients had a haematocrit > 45%. 32 (8%) patients developed hyponatremia with a range from 125 to 134 mm.L^{-1}, the rest were within normal. Serum creatinine was mildly elevated in 64 (17%) patients. 60 (16%) of the patients stayed > 4 hours in the hospital for

Month of presentation	Number of patients
May	53 (14%)
June	33 (9%)
July	71 (19%)
August	116 (30%)
September	105 (28%)
Total	378 (100%)

Table 1: Distribution of number of patients per month

Blood presure at presentation	Number of patients
< 100 mm Hg	13 (3%)
100 TO 110 mm Hg	312 (82%)
> 110 mm Hg	53 (14%)
Total	378 (100%)

Table 2: Initial systolic blood pressure in patients

Main presenting symptom	Number of patients
Musculoseletal symptoms	204 (54%)
Dizziness	98 (26%)
Vomiting	43 (11%)
Total	378 (100%)

Table 3: Distribution of main presenting symptoms in patients

further management and observation before discharge. CT head was done for 19 (5%) patients. Eventually, all patients were discharged home after treatment in a good clinical condition.

DISCUSSION

Hamad General Hospital is the main tertiary care – referral hospital in Qatar, with a 200 bed ED and up to 400,000 annual attendances. The warm season in Qatar extends from May to September. Ambient temperature and relative humidity reach maximum round the year during these months. Weather records show that the average temperature in summer months is around 40° C. And the relative humidity in August and September is higher than any other summer months. In this study we reviewed 378 cases of heat exhaustion, who presented to the ED at Hamad General Hospital over 16 months (May 2013 to September 2014). Majority of our patients presented in August and September, where the recorded temperature and relative humidity were > 41°C and > 60 % respectively. In the other summer months (where less number of heat exhaustion cases presented), the highest recorded temperature was > 41°C most of the time, but the average recorded humidity was < 60 %. This suggests a direct relation between occurrence of heat exhaustion and relative humidity during summer months. The combination of high humidity and high ambient temperature has a major role in inducing heat exhaustion. Sweating is the main mechanism with which the body dissipates heat, basically this happens when sweat evaporates off the skin. High humidity decreases the efficiency of cooling by decreasing the evaporation from the skin surface [10;12]. This leads to failure of cooling the body [13]. Further, the body responds by more sweating. Excessive sweating leads to loss of water and sodium from the body [14-16]. Eccrine sweat glands may produce up to two liters of sweat per hour [17]. In the presence of elevated body temperature and excessive sweating, heat exhaustion develops when the loss is not compensated with appropriate fluids intake. Furthermore, patients with heat exhaustion can develop hyponatremia if the oral intake was mainly free water, and laboratory findings may reflect dehydration [18-20]. This can be responsible for most of the clinical manifestations of heat exhaustion. At this stage, most of the patients develop symptoms which mandate interruption of the physical activities and moving to other places. This happens before the body core temperature builds up to 40°C, hence it should not be confused with heat stroke, where both a core temperature greater than 40°C and central nervous system dysfunctions are the whole mark. It is very unlikely that heat exhaustion (where there main problem is fluid and sodium loss) will progress to heat stroke. That is also consistent with the fact that the severity of most of heat exhaustion cases are mild to moderate, and can be easily treated in the emergency department with excellent outcome [5]. In our study, none of our patients found to have a body temperature > 39.1°C, and in all cases body temperature ranged between 36.2°C and 39.1°C. Patients with heat stroke may present to the emergency department with a core temperature < 40°C, but they will still show manifestations of central nervous system dysfunction, which was not the case in any of our patients. Furthermore, the systolic blood pressure was found to be low or at the lower side in most of our patients, which indicates that they have lost significant amount of their body fluids. That is supported by the findings from previous studies, which showed that in hot-humid climate, the amount of sweat can reach up to three litres per hour [21;22]. Patients with heat exhaustion present with a variety of nonspecific signs and symptoms, including fatigue, headache, profuse sweating, nausea, vomiting, tachycardia, muscular cramps, syncope, dehydration, and rarely signs of circulatory collapse in severe cases. Body temperature can be elevated but not > 40°C [18]. All of our patients were found to have at least three clinical findings from the mentioned list. This suggest that heat exhaustion should be anticipated in patients present with at least two of the signs and symptoms mentioned earlier, especially when the hot weather is associated with humidity > 60%. Patients present with a single manifestation (for example muscular cramp), may not be considered to have heat exhaustion. Most of our patients had musculoskeletal symptoms (muscular cramps, pain, etc.) and other general symptoms as well. Such symptoms make it difficult (if not impossible) to continue physical activities in the same environment, and require moving to another area and/or seeking medical care. As expected, some patients were found to have hyponatremia. Other patients found to have elevated renal parameters, mostly due to dehydration. Both findings support the above discussion. The general nature of the clinical presentation in heat exhaustion, and the absence of diagnostic test, both can be misleading to the treating physician if not associated with a clear suggestive history. The vast majority of our patients presented with a constellation of signs and symptoms which are mostly general and none specific. This type of presentation can be a real challenge to the emergency physician who finds himself dealing with an impaired patient with a poor history. This could be the reason behind having 75 (20%) patients initially diagnosed with other conditions rather that heat exhaustion, but ultimately reached to the correct diagnosis after repeated assessment. Treatment of heat exhaustion consists mainly of moving the patient to rest indoor or under a shaded area, and replacement of fluids [2;23]. Once stabilized, the patient can be discharged safely with instructions on prevention [18]. Antipyretics have no role in the treatment of heat exhaustion [18]. In mild cases, the management can be carried out with rest and oral rehydration without the need to transport the patient to the ED. For more symptomatic patients, the management in ED includes isotonic saline as the preferred type of intravenous fluid. Hypertonic saline should be considered in symptomatic hyponatrimea.

Hypotonic saline has no role in the initial management of heat exhaustion and even can be harmful [2]. Most of our patients received intravenous fluids (normal saline) in the emergency department. In 31% of the cases the amount of saline administered was < one litre, which indicates mild conditions and rapid response to treatment. Patients with heat exhaustion are expected to improve and show signs of recovery, after two to three hours of starting the management, this counts from the time the patient is removed from the affecting environment [2]. That was the case in the majority of our patients. None of the patients required escalation of the management towards active cooling or other treatment modalities, as they all responded very well to the treatment with rest and fluids. None of our patients progressed to heat stroke. The above supports what some author's clearly stated that there is no role for active cooling in the management of heat exhaustion [18;24]. That is in contrary to other opinions which suggest that heat exhaustion may develop into heat stroke if not recognised and treated appropriately [1] or suggest to proceed for management as heat stroke (including cooling) if the patient did not improve [24]. Upon discharge, our patients were instructed on how to prevent and recognize early signs of heat exhaustion. Instructions included avoiding excessive physical activities during hot and humid weather, maintaining a good hydration status with avoidance of hypotonic drinks, wearing light clothing, and watching for any alarming symptoms for heat exhaustion [2;25]. This study is limited by the unavailability of some clinical data due to the retrospective design. In conclusion, heat exhaustion is a well distinguished type of heat related illness, which does not overlap with heat stroke. In the absent of neurological manifestations and core temperature above 40, patient presents with two or more heat related signs and symptoms should be considered to have heat exhaustion. High index of suspicion is required when a hot weather is associated with relative humidity > 60%.

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