LETTERS TO THE EDITOR

PHYSIOLOGY, IDIOSYNCRASY AND HEAT STRESS LIMITS
From Lt Col JG Dickinson, RAMC

Sir, Major Martin Bricknell has made many important contributions to the difficult question of Heat Illness in the Services and will doubtless make many more. However, I feel obliged to raise doubts and questions about his latest offering (1), asking whether the results justify the conclusions and whether the right message is being sent to commanders and medics dealing with exercising troops.

First a small detail. The starting core temperatures measured by the IVAC Corecheck aural thermometer all seem rather low. Was the machine set to give equivalent oral temperatures, or is there some other explanation?

Secondly, I question the conclusion that 25°C is the threshold at which CFT is likely to cause a rise in core temperature of more than 0.6°C. Admittedly the whole table of anova analysis is opaque to me, but it is simply used to justify the graph of mean group gain in core temperature against end WBGT shown as Figure 2. This graph is used to estimate the threshold using the “Mark 1 eyeball” technique. However, we see from the table of results that, of 6 groups of soldiers exercising between 19.9 and 22.3°C, no less than 5 groups had a mean temperature gain greater than 0.6°C. The exception was one of the smallest groups and may well have represented a rogue result for technical reasons or as a result of statistical variation. Also the confidence limits are wide and overlapping throughout the analysis. My own eyeball suggests to me that on these data the level at which physiological decompensation may occur could lie at any point above 19°C.

Of course the significance of a rise in temperature of 0.6°C is also open to question. It is well known that athletes quite frequently reach core temperatures of over 40°C without showing any other signs of illness, for example the case of Maron et al (2). The criterion for withdrawing a subject from a heat exercise trial at CHE Farnborough (3) is a core temperature of 38.5°C, which is higher than the mean end temperature in any of the groups studied by Bricknell in Cyprus.

On the other hand, we also know that some soldiers and athletes develop heat illness even when the environmental temperature is quite low. After all, the heat that produces heat illness is endogenous. I have published (4) a table of 9 cases drawn from the literature in which men were severely ill with high core temperatures after exercising in air temperatures varying from only 10.2 to 21°C. Although we know of many predisposing factors for the development of heat illness, they did not seem to apply in these cases and we are left admitting that temperature response to exercise may be idiosyncratic at almost any ambient temperature.

So, thirdly, we should not allow commanders and medics to take away the message “your men are safe from heat illness if the WBGT is below 25°C”, or indeed any other arbitrary point, but rather that vigilance is required in exercising troops in all conditions and that special rules should be applied at higher temperatures and work rates, in high humidity and in clothing of highly insulating properties.

This is a matter of great importance to the Services and my letter is not a “point scoring” exercise. The Defence Medical Services should be giving a clear and consistent message on the issue. Therefore it is suggested that, if this letter is to be published, Major Bricknell should be given the opportunity to answer these points in the same issue of the Journal.

I am etc.

J G DICKINSON

The Duchess of Kent’s Hospital
Horne Road
Catterick Garrison
North Yorks
DL9 4DF

REFERENCES

From Maj MCM Bricknell, RAMC

Sir, I thank the Editor for publishing my reply to Lt Col Dickinson’s letter regarding my recent paper. I agree with the basic thrust of his letter that setting ‘arbitrary’ thresholds for exercise in heat does not guarantee absence of risk from heat illness. However my paper and a review published in this Journal has shown that such thresholds have already been published for use by military forces (1,2). My basic premise is that these thresholds should have some experimental validity and my paper is a suggested methodology for such experiments. The use of the IVAC Corecheck aural thermometer is more fully discussed in another paper awaiting publication in the Journal.

The ANOVA tables demonstrate that there is a statistically significant difference between groups but it does not show which comparisons are significant. It is accepted that the wide overlap of confidence limits for the group mean gains in core temperature graph at Figure 2 limits the conclusions that can be drawn from the graph. It is clear that there is a difference between the group mean
gain in core temperature for end WBGT of 29°C and all other groups except 27.1°C and 21.3°C. The 21.3°C group had a small number of subjects which is reflected in a wide confidence interval. Thus it is suggested that it is certainly unsafe to perform CPT if the end WBGT is greater than 29°C. Deciding a threshold is more difficult. The data would suggest that 27.1°C is unsafe but does not justifiy a threshold below 25°C.

All of this data is based on group mean gains in core temperature. Lt Col Dickinson quite rightly quotes case reports of athletes tolerating core temperatures greater than 40°C and heat casualties occurring at relatively low environmental temperatures. Therefore there is a wide range of physiological tolerance to exercise in the heat. It is not possible to use an environmental measure of heat stress to accurately predict the heat strain on an individual. I believe that it is reasonable to use an experimental model to identify thresholds above which group mean measures of heat strain show the heat load to be unsafe. Indeed my proposed threshold is significantly lower than the previously accepted thresholds published by Minard (3) which had formed the basis of UK military advice. I believe that my advice published in Table 4 emphasises the risk of heat casualties whilst performing physical work.

My research could be substantially improved by using a greater number of subjects and an invasive technique for measuring core temperature. If the study had been undertaken in a heat chamber the exposure to heat could have been better controlled. My paper identified that the study should be repeated for unacclimatised troops and females. This experimental evidence is unlikely to be refined unless further studies are sponsored.

I am etc.

MCM BRICKNELL

23 Para Fd Amb RAMC
Montgomery Lines
Aldershot
Hants
GU11 2AZ

REFERENCES

'TOTAL TRAUMA CARE' - Trauma Care (UK) 1st Biennial Conference
From the Organising Committee of Trauma Care (UK).

Sir, We represent a group of trauma professionals who have recently founded a new organisation - "Trauma Care (UK)" - and we are pleased to announce our inaugural, Biennial Conference entitled 'Total Trauma Care' which will take place at the International Centre in Harrogate, from 25th - 27th November 1997.

The Conference will promote the integration of trauma care by establishing 'Total Trauma Care' and will provide access to relevant advances and current thinking in all aspects of trauma and will allow both local and national professional groups to work together on an equal basis. Professionals attending the Conference will gain an understanding of the whole 'chain of care' concept, with a view to reducing morbidity and mortality associated with trauma. The Conference will demonstrate that the 'chain of care' for the trauma victim begins with accident prevention and should pass smoothly through pre-hospital care; accident and emergency management; operative and ward based treatment; and rehabilitation (both physical and psychological); the final link in the chain being audit.

Trauma Care (UK) as an organisation believes further significant advances will only be made once a philosophy of 'Total Trauma Care' is accepted and becomes the future basis for co-operation between groups and individuals. We intend to provide a base for improvements in patient care and trauma outcome and also for the dissemination of appropriate information and the establishment of continuing educational initiatives. This will be achieved by a Year Book style journal and by biennial conferences. The Conference should appeal to all trauma professionals including: pre-hospital carers and emergency services; emergency doctors and nurses; surgical specialists; physicians and neurologists; anaesthetists and intensivists; radiologists; mental health professionals; physiotherapists and Army medical and nursing personnel.

If your readers require further information and Booking Forms for the 'Total Trauma Care' 1st Bienniel Conference, please telephone or write to the Conference Secretariat at: Index Communications Meeting Services, Crown House, 28 Winchester Road, Romsey, Hampshire, SO51 8AA. Tel: 01794 511331/511332 Fax: 01794 511455.

We are etc.

TRAUMA CARE (UK)

Department of Military Surgery
Royal Defence Medical College
Millbank
London
SW1P 4RJ

TRAUMA MANAGEMENT ON THE BATTLEFIELD: A MODERN APPROACH
From Ftt Lt JR Howell, RAF and Maj BR Singer, RAMC

Sir, We read with interest Lt Col A Hawley's paper on the important issue of trauma management on the battlefield (1) and agree wholeheartedly that the approach of therapeutic minimalism is no longer viable in the current socio-political environment. The author's proposal for the organisation of medical care during a high intensity
conflict, in which manoeuvre warfare is employed, is based on a triad of care; BATLS as soon as possible; surgical resuscitation by forward deployment of Field Surgical Teams (FSTs) for BATLS failure; air evacuation to field hospitals for intensive care. We suggest that the proposed strategy as it stands is flawed for several reasons and will not achieve the stated clinical aim to reduce mortality and morbidity.

Many of Lt Col Hawley's proposals stem from the work of Mattox and others in Houston (2,3) which proposed abbreviated laparotomy and planned re-operation for critically injured patients. Lt Col Hawley states that this strategy was undertaken when the surgeon was faced with needs which overwhelmed the available resources, a situation which is easily recognisable when considering battlefield conditions. However, according to Mattox et al (2,3) the strategy of abbreviated laparotomy was developed to respond to the critically injured patient who was imminently facing death due to a vicious cycle of hypothermia, acidosis and coagulopathy. Surgery was terminated, not on the grounds of inadequate resources, but on the patient's physiological status. Mattox and co-workers realised that the operating theatre was a hostile environment for the critically injured patient and proposed that surgery be terminated as soon as the patient exhibited signs of impending death. The patient was then transferred to the intensive care unit for vigorous correction of metabolic derangements and coagulopathies. To extrapolate this technique directly to the battlefield environment to be used by FSTs working in a forward position is we believe mistaken on several counts.

The resources required to practice this form of surgery and resuscitation are immense. For example, in the experience of Mattox et al, patients were transfused a mean of 22 units of packed red cells at initial operation, at a mean rate of 11.7 U/hour. In addition they required a mean of 6.3 units of platelets and 4.4 units of fresh frozen plasma. In the event of a mass casualty scenario these requirements would overwhelm all but the most sophisticated of laboratories and we are unable to see how a forward placed mobile FST working in an advanced dressing station would cope even with the demands of one or two patients.

Lt Col Hawley proposes that having undergone surgical resuscitation the patient is transferred to a field hospital, at some distance from the point of surgery, for intensive care. This would subject critically ill postoperative patients to a major transfer at the time when they are least able to withstand it.

In the series reported by Mattox each patient was immediately transferred to the intensive care facility, within the same hospital. It is worth reiterating that surgery was abbreviated because the patients were too sick to continue, and they required immediate intensive care facilities. He states (4) that there must be "a strategy that includes a quick primary operation followed by a prolonged stay in the intensive care unit and planned - or sometimes unplanned - reoperation(s)." In spite of this 51% of patients did not survive to undergo reoperation, with 68% of these patients dying within the first two hours. Overall only 33% of patients survived to leave the hospital with exsanguination accounting for 82% of the deaths. We suggest that attempts to transfer such sick patients to intensive care facilities miles away would be disastrous and would in all probability negate any beneficial effect of the surgical resuscitation.

In conclusion we believe that it is inappropriate to extrapolate the findings of Mattox et al to the situation of the modern battlefield as proposed by Lt Col Hawley. Mattox acknowledged that adoption of the strategy of "damage control" surgery is accompanied by a host of medical and logistic problems. Comparable results cannot be expected from FSTs working in isolation without the co-location of necessary intensive care and laboratory facilities. The "Corridor of Care" from surgery to the intensive care unit needs to be shorter if the patient is to benefit from surgical resuscitation. This will mean that either the surgical team must be co-located with the intensive care at the field hospital, or the intensive care must be brought forward with the surgeon on the battlefield, possibly in the form of mobile units.

It is axiomatic that resuscitation and surgery are undertaken as quickly as possible and we agree that therapeutic nihilism is unacceptable. However, we believe that when necessary, surgical resuscitation should only be undertaken where there are the necessary postoperative resources available. To propose undertaking surgical resuscitation without these resources is to subject dying personnel to an operation with little or no chance of success. We believe that this is unethical.

We are etc
JR HOWELL
BR SINGER

Department of Orthopaedic & Trauma Surgery
Royal Hospital
Gosport
Hants
PO12 2AA

REFERENCES