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Diabetes mellitus and the armed forces

MICHAEL J WORLD

Introduction

With very few exceptions, applicants with diabetes are generally refused a military career in most armed forces in the world. Operational conditions compromising health, welfare and safety rather than any physical impediment are the main reason for this. The small military diabetic population means that meaningful reports can only be generated by the larger armed forces. The majority of military personnel developing diabetes in service are not discharged. Novel approaches to diabetes have been attempted in military aviators. This editorial reviews the reasons for military medical policies in relation to diabetes mellitus and the risk factors (obesity, race, rank and age) for development that could have important consequences for British Forces in the future.

Given that service in the British Armed Forces is currently voluntary, it is sad to have to refuse entry to any willing applicant on medical grounds. In the case of those rejected on the grounds of existing diabetes mellitus, any appeal invariably invokes comparison with some famous diabetic athlete whose ability to win one or more Olympic gold medals has not been impaired by this disease. As will be discussed below, there is more to the decision about fitness to join the armed forces than physical prowess in the scenario of a civilian sporting location with access to full supporting medical facilities. If this article successfully explains why applicants with existing diabetes will generally be rejected, it will be a valuable contribution to furthering understanding between diabetic applicants and the military medical assessors.

The common medical criterion

In general, applicants for military service should have no existing disease dependent on regular medication, even if they can reach the demanding standards of physical ability set by military authorities. All applicants are subjected to a basic but careful medical evaluation and it is unlikely, but not impossible, that extant disease will be missed. In relation to diabetes, data from Sardinia suggest that the prevalence of this disease in potential recruits is increasing. This interesting study found that the prevalence of diabetes in conscripted male army recruits increased by an apparent factor of 29-fold over the years 1936–1973.¹ Obviously, some of



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this could be related to better diagnostic methods but the trend is clear as is the conclusion that increasing numbers of applicants for military service are likely to be found to have diabetes and to be rejected. Military medical standards are strictly enforced in order that the worldwide operational capability of HM Forces is not compromised by human factors. There is also the question of the duty of care to personnel with extant disease that could compromise their ability to survive not only enemy action but also hostile environments. This policy applies to those with diabetes and has been adopted by the majority of armed forces around the world. Only a very few countries do not bar people with diabetes from entering military service. In consequence, there is only a little information about how well they perform after entering military service with existing disease and the two reports that follow are conflicting.

Countries where diabetes is not an automatic bar to a military career

Some countries do not automatically disqualify people with diabetes from entering military service. In Finland, there is military conscription for 6–12 months. Diabetes is not a bar to military service. Of 47 insulin-requiring diabetic personnel serving in a signals unit (where field military demands may be less), 40 (85%) completed their service. Seven individuals (15%) had to interrupt their service because of problems

Abbreviations

| | |
|-------------------|---------------------------------|
| APOD | airport of disembarkment |
| BA | base area |
| BMI | body mass index |
| DMS | defence medical services |
| FEBA | forward edge of the battle area |
| HbA _{1c} | haemoglobin A _{1c} |
| HOMA | homeostasis model assessment |
| IED | improvised explosive devices |
| IGT | impaired glucose tolerance |
| LOC | lines of communication |
| SAM | surface-to-air missiles |

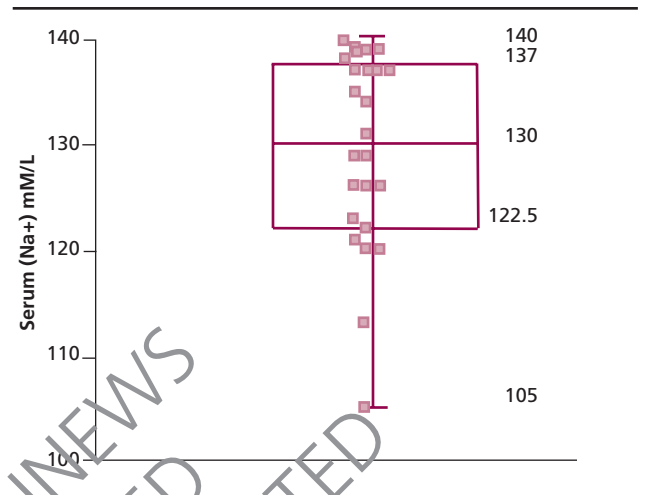
with diabetes. Overall, 16 individuals (33%) reported difficulties related to management of their diabetes in the military environment, five suffering severe hypoglycaemic attacks and one, ketoacidosis. Taking this group as a whole, control (HbA_{1c}) had deteriorated significantly by the end of military service.²

Israel is another country where diabetes is not an automatic bar to military service. In a series of 145 potential recruits with type 1 diabetes, 77 decided to volunteer for army service of which 60 responded to a questionnaire at the end of their military service. Sixty-eight decided not to volunteer and, of these, 44 responded to a questionnaire at a similar time as the group of volunteers. Those who volunteered came from a higher socio-economic group and educational attainment was higher. This may explain their fewer hospital admissions and better control (lower HbA_{1c}) than the civilians.³ This apparently favourable outcome has to be viewed from the perspective of the highly modified nature of the military service permitted. Diabetic applicants were not accepted into combat units. They were excused basic military training. This is often extremely arduous and used elsewhere as a probationary criterion for acceptance into service. Guard duty was not permitted. There was no expectation they would continue working for extended hours. They had to be stationed sufficiently near their homes to permit return after duties and, in fact, 77% of diabetic personnel lived at home. Such conditions are incompatible with services (such as in HM Forces) where the expectation is that all personnel should contribute to worldwide projection of force during at least some of their military career.

Operational structure

Operational strategy will reflect the nature of conflict and will vary in consequence. Such details will inevitably be heavily classified information in relation to current operations. However, the classical operational structure has long been within the public domain, even if it is not that well known. This structure divides operational activity into three locations: the FEBA, LOC and the BA. The FEBA, or enemy

Figure 1. 'Box and whiskers' plot of serum sodium concentrations in a series of 25 soldiers with heat illness without diabetes. Median=130 mM/L. There was attendant encephalopathy due to raised core temperature and hyponatraemia. Deranged blood glucose in a diabetic could be an unnecessary and dangerous complication



contact area, is the location of the potentially most intense military activity.

The DMS do not have the ability to guarantee maintenance of re-supply of individual medicinal requirements at the FEBA. The BA is often co-located with the APOD. Most common medications can be re-supplied here and on the LOC, albeit with some lesser reliability in the latter case. Military medical grading of personnel with disease reflects such re-supply considerations. The greater the distance from the BA, which is usually the location of the field hospital, then the greater the difficulty of casualty extraction. Use of helicopters is ideal for this purpose and to project medical assistance to a forward location. This may not always be possible. Safe deployment of such aircraft depends on air supremacy or at least air superiority. Lack of these or the presence of a significant threat from heat-seeking shoulder-launched portable SAM's makes projection of medical treatment and casualty extraction dependent on road vehicles. The vehicle and occupants then have to face the potential threat not only of enemy air attack but also so-called "friendly fire". Additionally, roadside bombs, also known as IED's, are a perpetual hazard whose sophistication and, therefore, lethality is continually being developed. Current operational reports by news media emphasise the seriousness of this weapon.

It is one thing to ask aircrew or field ambulance personnel to put their lives at risk to save the casualties of enemy action, it is quite another to ask them to do the same for someone who has developed a complication of disease that is known to exist. Even if extraction is successfully accom-

Figure 2. The potential physiological derangements resulting from severe military trauma during resuscitation and life-saving surgery. The monitor shows pulse rate = 75 beats/minute (This is a military tachycardia as most serving personnel have resting pulse rates of 50–55 beats/minute). Blood pressure=44/22. SpO₂ = 100% (on oxygen). ET CO₂ = 4.7 kPa. Concerns about blood glucose and arterial pH in a context of trauma and lactic acidosis would be an unnecessary complication



plished, the international dimension (host nation or co-operating military medical services) has the potential to compromise the standard of care obtained in the UK. This could be critical in the case of diabetic personnel where continuity of care is such an important factor.

Environmental conditions on operations

Wherever possible, terrestrial environmental conditions are not allowed to prevent military operations. Compensation for such conditions such as heat, cold and altitude is always attempted. At one extreme, this will entail appropriate acclimatisation and the other end of the spectrum will entail the use of protective clothing and equipment. The latter, more extreme measures, may preclude administration of oral or parenteral drugs such as those required to treat diabetes. Severe conditions, which are not amenable to artificial manipulation, will always result in some reduction in operational efficiency. Land forces will always endeavour to minimise this by appropriate measures.

In the context of current operations, hot and dry conditions are particularly challenging. They will be encountered and overcome by the majority of personnel with no disease but some will lack the physiological reserve due to variation in genetic constitution (figure 1). Unchallenged in temperate UK, their vulnerability may become apparent in harsh

operational conditions as has been found in Iraq⁴ and Afghanistan. Existing diseases, such as diabetes, with the potential to compromise physiological compensation would put these personnel at increased risk in this situation and reduce their fighting capability. This will be further compromised if there is dependence on the availability of a drug where adequate refrigeration is essential. This storage facility is generally confined to base or hospital locations.

Increased risks related to blood glucose concentration

The previous paragraph alluded to physiological compromise related to the environment. To this must be added the operational risks related to blood glucose concentration. Much as consideration has to be given to civilians with diabetes driving cars, the same considerations have to be given to military personnel when they operate highly dangerous vehicles and equipment, use their personal weapons and handle ammunition. In the military situation, the thresholds to disqualify have to be an order of magnitude lower because of the greater danger involved. Soldiers may sometimes have to resort to field ration packs for days on end. There may be great variation in operational activity. Days of boredom may be terminated by intense action lasting all day and all night for days on end requiring extremes of physiological response dependent on maintenance of blood glucose concentration in the physiological range. Add to this the consequences of injury and it will be readily apparent that diabetes confers a very great disadvantage in field situations (figure 2). The special situation of aviators is considered separately below.

Diseases emergent after joining

In contrast to fresh applicants, those serving personnel that develop disease, including diabetes, often after some years of satisfactory service, are generally not given a military medical discharge if there is chance of redeployment in an appropriate medical category. Often a large public investment will have been made in their training and they will have acquired invaluable operational experience both of which could be put to good use in a reduced or non-operational capacity. However, there will always be a limit to the number of military personnel that can continue to be employed in a medically downgraded role. Each case is evaluated on its merits as was made clear in the official statement on behalf of the British Government in a parliamentary answer by Mr Derek Twigg, Under Secretary of State for Defence and Minister for Veterans at the Ministry of Defence.⁵

Scale of the problem in relation to diabetes: UK

Comparison of the occurrence of diabetes in serving military personnel in the armed forces of different

countries is difficult owing to the variation in denominators employed to measure this. Most reports quote some kind of control group. In Britain, a review of military medical statistics 1978–1988 showed that 1,014 personnel were recorded as being diagnosed diabetic. This was 0.33% of the mean service population at risk (307,785) over these years. One hundred and fifty-one (15%) were officers and 863 (85%) were enlisted personnel. At that time, the prevalence of diagnosed diabetes in the general British population was 750,000 (1.33%) of the total population of about 56 million. One third (250,000) were dependent on insulin.⁶

Scale of the problem in relation to diabetes: USA

In a one-year study at a single US Army base, 0.18% (58/32,593) males and 0.48% females (43/8,898 – 90% of these were gestational) were prescribed diabetic medications.⁷ As the problem may be hidden, a glucose tolerance test was performed on 625 US soldiers (81% male, 19% female; 54% white, 24% black, 17% Hispanic). Undiagnosed diabetes was found in 0.5%, IGT in 1.8% and impaired fasting glucose in 1%. These rates were 10% of those in the general population as assessed in the National Health and Nutrition Examination Survey III.⁸ This situation appeared to be reassuring by suggesting that careful selection and maintenance of fitness standards were successful. However, a more recent report in US military personnel is worrying. The overall incidence of both types 1 and 2 diabetes in US military personnel (1.9 cases per 1,000 patient-years) has been found to be similar to that in the civilian population (1.6 cases per 1,000 patient-years). This is surprising given the emphasis on maintenance of physical fitness. A case-control study of US military personnel developing type 2 diabetes between January 1997 and August 2000 found that BMI, race and rank (a surrogate for socio-economic status) affected the odds ratios for developing the disease. When compared to those with BMI ≤ 20 kg/m², the odds ratio of those with BMI > 30 kg/m² developing diabetes was 3.0. The odds ratio for development of diabetes in African-Americans was 2.0 compared to whites with Hispanics intermediate (odds ratio=1.6). No differences in BMI were found between races at the commencement of military service. Despite a similar absence of difference in BMI on joining, the odds ratio that junior enlisted personnel (other ranks) would develop diabetes was 4.1. The mean age at diagnosis of diabetes was 35 years and this occurred after an average of 13.6 years of service. While little can be done at present to eliminate genetic factors, it would appear that attention to more stringent implementation of physical fitness and, possibly education, particularly as service personnel become older, might have beneficial health effects.⁹

Racial incidence and its consequences

In an American study it was found that the incidence of diabetes was 1.4 times higher in black (28.4/100,000 person-years) than white personnel (20.2/100,000 person-years) and incidence increased with age more markedly (5-fold) in black personnel than white personnel (3-fold) between the ages of 17–19 and 30–34.¹⁰ Two factors suggest that diabetes will become an increasing problem in British Armed Forces. Firstly, the fall in the proportion of numbers of young potential recruits in the indigenous British population has prompted recruitment from Commonwealth countries where diabetes is more common in older age groups. Secondly, the changing racial demography in British subjects is associated with a relative reduction in the proportion of whites.

Type 1 versus type 2 diabetes

In the British Armed Forces, during the years 1983–1988, 483 personnel were diagnosed with diabetes of which 194 (40%) had type 2 and 289 (60%) had type 1 diabetes.⁶ This proportional split may be misleading. Central statistics depended largely on reports when patients were discharged from military hospitals. Diabetic patients admitted to hospital are, of course, much more likely to have type 1 diabetes. On a background of increased diabetes in the US Navy compared with European controls and in relation to the controversy surrounding the disputed Gulf War syndrome, evidence to support the view that immunisation of US military personnel might increase the prevalence of type 1 diabetes has been presented to the Committee on Government Reform of the US House of Representatives.¹¹

The closure of all military hospitals in the UK in 2001 makes acquisition of military medical statistics absolutely dependent on a robust reporting system at Unit medical centres. This is not currently apparent. In the absence of such a system, it may not be possible to acquire independent British data to determine whether recent operations necessitating immunisation against biological weapons, such as anthrax protective antigen have had an effect on the prevalence of type 1 diabetes in British military personnel.

Accompanying risk factors

The presence of other risks to health may increase the risk of development of overt diabetes at a later date with eventual reduction in military deployability and capability. In addition to a higher fasting blood glucose, 9% (185/2045) of French military personnel in the region of Paris had metabolic syndrome. These were older, with higher BMI, heavier smokers, who took less exercise. Possession of increasing numbers of criteria (0–5) for metabolic syndrome were associated with increasing fasting insulin levels and HOMA insulin resistance and microalbuminuria concentration.¹²

Consequences of diagnosis

As mentioned above, once a diagnosis of diabetes, or any other chronic disease, has been made in British serving personnel, everything is done to enable continuing military service wherever possible. Radical changes in occupational activity may be necessary to achieve this and failure may necessitate military medical discharge. In the British services, over a 10-year period, 29% (295/1014) of personnel diagnosed with diabetes were medically discharged.⁶ Even this may be a proportion that is inflated by the potential under-reporting of those developing type 2 diabetes. Before medical discharge, military diabetic patients with a qualifying minimum service will be entitled to resettlement courses to equip them with skills appropriate for civilian life if they do not already possess these. Any pension payable will depend on personal factors such as rank, trade and length of service.

Aviators

This covers both pilots and other aircrew. The nature of the equipment that they operate and the lethality of weapon systems carried in military aircraft requires stringent medical standards to be applied at regular frequent intervals with strict enforcement. The US Air Force takes the same attitude as the RAF: pilots developing diabetes are disqualified.¹³ Other aircrew may continue flying duties subject to careful medical assessment and limitation. Twenty per cent of US army aviators with diabetes and 90% with IGT were retained for flying duties.¹⁴ However, it needs to be remembered that diabetes is just one condition where aviators may be disqualified from flying duties. Others include coronary artery disease, hypertension, back pain and migraine.¹⁵

In the Israeli Air Force, it is not impossible that military pilots with type 1 diabetes might be able to continue to fly. Of five aviators, three were pilots and two were navigators. Orthodox medical advice that the three pilots should be disqualified from flying was overruled by a non-medical authority in two cases. One was a pilot of an F-15 fighter aircraft and the other, a helicopter pilot. Stringent diabetic controls were introduced to minimise the risk of hypoglycaemia and military flying continued without adverse event. The third (cargo) pilot was lost to follow-up. Of the two navigators, one was transferred to ground duties and the other continued flying duties.¹⁶ Subsequently, a novel approach towards retention of aviators recently diagnosed with type 1 diabetes was introduced by the Israeli Air Force. Two aviators were exposed to increasing levels of hypoglycaemia by glucose clamping techniques. A 29-year-old C-130 (Hercules transport aircraft) pilot learned that hypoglycaemia caused paraesthesia and a 28-year-old Apache helicopter pilot developed hunger. Forewarned of

premonitory symptoms, and advised of action to take if these symptoms occurred whilst airborne, both continued military flying without adverse event.¹⁷

Divers

No reports of diabetes in military divers have been found. This may reflect a stringent exclusion of diabetic personnel from military diving.

Treatment

An early report from the British Royal Navy Medical Service concluded that provision of a dedicated diabetic clinic resulted in improved diabetic control, a reduction in episodes of sickness and a consequent improvement of quality of life.¹⁸ In an effort to provide a beneficial educational programme for people with newly diagnosed diabetes in the American military community (both serving and retired), a civilian integrated system was replicated with claimed success. This presumably aimed to conserve the best of civilian-developed management systems whilst preserving the military medical oversight so that compromise of military capability was minimised.¹⁹ However, a subsequent audit of the published clinical practice guidelines for medical surveillance of diabetic patients – most were veterans in this study – in the military treatment system drew the comment that ‘compliance to recommendations was less than anticipated’.²⁰

Conclusion

This report has attempted to give clear details why applicants for military service who have diabetes are excluded by most armed forces around the world. The operating conditions required are very demanding. Costs of training personnel increase with the complexity of equipment they are called to operate. This investment cannot be wasted by special restrictions dependent on medical category. Development of diabetes in serving personnel does not result in the medical discharge of the majority. Practitioners providing care for such patients require the military perspective to maximise continuing safety for all. This has to be the paramount concern.

Disclaimer

The views expressed in this article are those of its author and do not purport to be those of Her Majesty's Government, the Ministry of Defence or its employees.

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