

Post-Exposure Prophylaxis for Hepatitis B Virus after Exposure to a Person-Borne Improvised Explosive Device

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Abstract

The case of a member of the Australian Defence Force exposed to a person-borne improvised explosive device is presented. Indications for post-exposure prophylaxis against blood-borne viruses in this context are discussed, with specific focus on the 'non-response' to prior hepatitis B vaccination of this individual. This case received post-exposure prophylaxis against hepatitis B only, consisting of hepatitis B immunoglobulin and a course of intradermal vaccine. At six months this member remained free of serological evidence of infection. It is recommended that in the Australian Defence Force hepatitis B non-responder status be formally recorded by way of medical employment classification review, and that consideration be given to occupation groups other than health care workers where there might be benefit in routine testing for seroconversion after a primary course of hepatitis B vaccination.

Conflicts of interest: none declared.

The opinions expressed in this paper are those of the authors and do not necessarily reflect Australian Defence Force policy.

Background

The Australian Defence Force (ADF) has been on operations in Afghanistan since late 2001, and in significantly increased numbers since 2006. An ever-present risk on this operation continues to be that posed by improvised explosive devices (IEDs). In a decade of coalition operations in Afghanistan over 40% of fatalities have been as a result of IEDs¹. This figure is reflected in Australia's experience in this war.

There are several ways in which an IED attack can be carried out. One of these is the person-borne IED (PBIED), colloquially known as a suicide bomber. Physical consequences of exposure to such blasts can include significant exposure to human tissue, from droplets through to penetrating bone fragments (Figure 1). If not fatal, such exposure can represent a risk of transmission of blood-borne viruses (BBV). Braverman et al. described a case report of bone fragments removed from a hepatitis B-negative PBIED victim which tested positive for hepatitis B surface antigen².

The ADF has a program of routine vaccinations provided to all members, and additional vaccinations are administered in anticipation of specific



Figure 1. Axial CT scan of a non-combatant at level of C1. Note bone fragments in L posterior neck, which originated from a suicide bomber in Afghanistan. 130x173mm (300 x 300 DPI)

exposures³. Hepatitis B vaccine is included in the routine vaccinations, and as there are no vaccines available to protect against hepatitis C and HIV, it is thus the only clinically important BBV against which there is presumed protection.

We describe the use of post-exposure prophylaxis (PEP) against hepatitis B virus (HBV) following exposure to a PBIED.

History

A 40 year-old male ADF member was exposed to a PBIED in Southern Afghanistan in early 2012. It was calculated that the suicide bomber was carrying approximately five pounds (~2.3 kg) of home-made explosives (HME), without significant fragmentary additives. The device was detonated without warning inside a building in a civilian area. The ADF member, who was wearing full disruptive pattern camouflage uniform with combat body armour but no helmet or eye protection, was located approximately three metres from the explosion, on the other side of a makeshift plywood wall. The force of the blast blew out the flimsy wall, exposing the member to the source of the blast. The only fatality was the suicide bomber himself.

The member was evacuated to a nearby coalition facility where he had a preliminary medical assessment. He did not require admission and was instructed to follow up in 24 hrs. The member returned to his primary duties in the interim.

Clinical findings

The first presentation by the member to an ADF role 1 medical facility was 27 hrs after the blast.

The member was able to recall the entire event, save for a few moments prior to and immediately after the blast. He was initially dazed and confused, and reported nausea and headache for approximately 24 hrs after the incident. After the blast his uniform, armour, and skin were covered in debris, including small dark flecks of firmly adherent material. He also recalled coughing, spitting, and clearing his eyes of debris for a time after the blast. Given the proximity of the bomber it is conceivable that some of this material contained human remains (HR).

In addition to mucosal exposure, the member also had a 5 cm graze on the neck (containing dried blood), and a 5mm full-thickness cut to the tip of the right middle finger.

The member had evidence of a full primary course of ADT vaccination in 1991, a booster in 2001, and an adult dT_a booster (Boostrix[®], GSK) administered

in 2011. There was also evidence of a full primary course of hepatitis B vaccine (Engerix-B Adult[®], GSK) in 1991. It was noted that there were subsequent doses administered in 1997 and 2003, but there were no anti-HBs titres in the deployed volume of the unit medical record (UMR), the medical record available to the treating medical officer in Afghanistan. Through contact with the member's ADF health centre in Australia, we were able to determine that an anti-HBs titre of 0.1 mIU/mL had been recorded in late 2002. Thus it is possible that the 4th and 5th doses of HBV vaccine were administered because of an absence of evidence for prior seroconversion. As a result, it was deemed that the member may still not have protective antibodies at this presentation.

Management

Post-exposure prophylaxis advice was sought via telephone from an infectious diseases physician in Australia.

The risk of contracting HIV in such an exposure incident from a source of unknown status was deemed to be very low. Post-exposure prophylaxis with zidovudine and lamivudine (Combivir[®], GSK) was offered, but declined by the member after a discussion about the risk of contracting HIV, and the risks and benefits of treatment.

The risk of contracting HBV was considered to be significantly higher. Whilst prevalence data for blood-borne viruses in Afghanistan are scarce, it is apparent that the prevalence of HBV is significantly higher than HIV, in the range of 1.5 – 12.3 %, depending on the population studied⁴⁻⁹. Hepatitis B is also far more infectious than HIV^{10,11}. For these reasons the member consented to HBV post-exposure prophylaxis. Hepatitis B immunoglobulin (HyperHEP B[®], Talecris), at a dose of 1100 IU, was administered intramuscularly 33 hours after the blast. It was not possible to wait for a baseline anti-HBs titre, as this had to be performed in Germany, with a one-to-two week turn-around. In addition to the HBIG, an accelerated course of intradermal HBV vaccine (Engerix-B Adult[®], GSK) was commenced because of the presumption that the member was a HBV vaccine 'non-responder'.

Outcome

The member had serology performed for HIV, HBV, and HCV at baseline, one, three, and six months.

Because of overnight laboratory closure, baseline bloods were not drawn until the day after administration of HBIG. This is likely to have contributed to the baseline anti-HBs titre of 72.6

mIU/mL. Negative baseline serology was returned for HIV, HCV, and HBsAg.

Anti-HBs was 244.2 mIU/mL, 156.8 mIU/mL, and 40 mIU/mL at one, three, and six months respectively (while the six-month test was performed at a different laboratory to the first three, the trend supports the suspicion of persisting non-responder status). Tests for HBsAg, and HIV and HCV antibodies were all negative at three and six months.

Discussion

Management of BBV post-exposure prophylaxis in any setting can be very complex. The comprehension of risk can be a challenge at the best of times, yet at a time of significant anxiety the patient, with the doctor's assistance, is required to assimilate complex epidemiology, modes of transmission, and efficacy of treatment all in a short period of time. Ultimately the decision to receive prophylaxis is a personal one, but guidelines can be helpful. The Centers for Disease Control and Prevention (CDC) in the United States have produced a guideline on BBV post-exposure prophylaxis in blast incidents by adapting existing recommendations for occupational and non-occupational exposures to blast mechanisms¹². These guidelines were referred to in the management of this case (Table 1). The member was considered to have at least a category 2 exposure on the CDC scale.

It is widely reported that approximately 5-15 % of healthy immunocompetent individuals do not raise an adequate antibody response,^{14,15} and that this is positively correlated with age.¹⁶ The product information for the ADF recombinant vaccines, Engerix[®]-B (GSK) and Twinrix[®] (GSK), state that non-response is as low as 4 % and 0.7 %, respectively, after a correctly administered primary course.^{17,18} Such non-response can persist despite multiple additional doses of vaccine, so vaccination in high-risk groups may need to be tailored to the individual.¹⁹ The National Health and Medical Research Council (NHMRC) recommends testing for anti-HBs titres only in people with impaired immunity or with increased occupational risk, for example healthcare workers¹⁵, so it is unusual to have a titre performed on a military member who is not a healthcare worker. Such post-vaccination testing should be performed one to two months after the final dose of vaccine and if the anti-HBs titre is found to be > 10 mIU/mL in an immunocompetent person they can be assumed to have long-term protection and therefore not require any further testing²⁰.

The management of people who are identified as not having seroconverted after a primary course of HBV vaccine is varied. The NHMRC recommends a fourth double dose or a further three doses at monthly intervals.¹⁵ Another option, as in this case, is a course of intradermal vaccination using one quarter

Table 1. Post-exposure recommendations in the setting of blast, and with unknown vaccination status. Adapted from CDC12 with permission.

Risk category	HIV	HBV	HCV	Tetanus
Cat. 1 Penetrating injuries or non-intact skin exposures	Generally no action	Intervene	Consider testing	Intervene
Cat. 2 Mucous membrane exposures	Generally no action	Intervene	Generally no action	No action
Cat. 3 Superficial exposure of intact skin	No action	No action	No action	No action

In this case an assumption was made that the member was not immune to HBV. This was because of a negative anti-HBs titre before his fifth and final HBV vaccination in 2003 (though it is worth noting that some people who mount an effective humoral response early after vaccination no longer have measurable antibodies when retested at least one year later¹³, causing some to question the use of antibody levels as a measure of protection). People who fail to raise an effective early humoral response to HBV vaccination, defined as an anti-HBs titre < 10 mIU/mL, are often termed 'non-responders'.

of the usual adult dose (5 mcg in 0.25 mL). This has been shown to seroconvert approximately 90% of healthcare workers who were non-responders to a primary intramuscular course of vaccine,^{21,22} though long-term data are lacking for both this and the additional intramuscular dose approaches.²⁰

This case raises a few important questions regarding HBV vaccination in military members. Whilst the vaccine is routinely administered in the military, and is a requirement for deployment on operations, only healthcare workers have their anti-HBs levels checked. That said, it is hard to make a case for

population serological testing on the basis of this one exposure. Is it possible to define a sub-group of the military who should have serological testing, in addition to healthcare workers? Are all combat corps of the Army an appropriate group? What about those who are most likely to be exposed to injured enemy and human remains, for example special forces? What about those who are likely to conduct cache searches (unpublished data reveal a number of needle-stick injuries necessitating PEP in this context)? Can certain operations be anticipated to harbour greater risk, necessitating pre-deployment serological testing of an appropriate sub-group? In the context of current operations the authors suggest that, as a minimum, consideration should be given to pre-deployment anti-HBs testing of special forces elements, including their engineering support. Operational health advisors may identify other at-risk groups that should also be tested.

It is not known why this member had HBV serology performed after four doses of vaccine. However, once a person is identified as a non-responder, it is recommended by the authors that an attempt is made to induce seroconversion with further vaccine doses, using one of the techniques described above. If the person is a persistent non-responder, they should be carefully counselled about the implications of this, including education about high risk exposures, and the requirement for HBIG in the case of exposure.²³ For military members, non-responder status should

be clearly recorded, ideally by Medical Employment Classification review, so that this is immediately apparent when managing a potential post-exposure prophylaxis case. Access in the deployed environment to serological testing, HBIG, and vaccine, may need to be considered prior to deployment. Appropriate first aid measures after contact with potentially contaminated materials should also be included as part of pre-deployment medical training, if not ADF-wide annual first aid training.

Hepatitis B is a serious but preventable illness. As long as military operations are conducted in regions where its occurrence is relatively high, and where access to a laboratory for performance of early anti-HBs titres is not available, consideration needs to be given as to how to manage the risk in the small but significant number of vaccine non-responders.

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