HAND SURGERY ON PATIENTS WHO ARE ''HIGH RISK'' FOR BLOOD-BORNE VIRUSES

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There is a risk of transmission of blood-borne viruses (BBV) to health-care workers when performing hand surgery on intravenous drug abusers and other patients known to have BBV. This review summarises methods and procedures that may be employed to help reduce this risk to a minimum. High-risk patients should be identified early and a non-invasive procedure considered. Only experienced staff should scrub and appropriate clothing should be worn. Sharp instrument use should be kept to a minimum and only instrument retraction and suturing should be employed. When possible, wounds should be closed with staples, glue or absorbable sutures. Appropriate steps must be taken to reduce the risk of injuries from sharp bone ends, K-wires and splash exposure during irrigation.

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Blood-borne viruses (BBV) are serious infections and include Hepatitis B virus (HBV), Hepatitis C virus (HCV) and Human Immunodeficiency Virus (HIV). In the UK, the prevalence of infection is thought to be 1 to 2% for HBV and about 1% for HCV (Tansley et al., 2004), with about 53,000 people estimated to be currently living with HIV infection (Health Protection Agency, 2004a).

In the UK, the most important risk factor for BBV is intravenous (IV) drug abuse. It is estimated that about 169,000 people have ever injected drugs in the UK (Jeffery et al., 2002) and that needle and syringe sharing has recently increased, with one in three injectors, when questioned, admitting to this activity recently (Health Protection Agency et al., 2003). The transmission of HBV and HCV continues to increase among IV drug abusers and, in some areas of England and Wales, the prevalence of HCV has risen to 53%, with almost three-fifths of injectors still unaware of their HCV infection (Health Protection Agency et al., 2003).

A report on significant occupational exposure to BBV in health-care workers found that the most common exposures were percutaneous injuries. Exposures most frequently occurred during venepuncture and suturing, and the most common location was the ward, followed by theatre (Health Protection Agency, 2004b). The risk of transmission to a health-care worker from an infected patient following percutaneous exposure, i.e. ''sharps'' or ''needlestick'' injury, has been shown to be around one in three when a source patient is infected with HBV and is ''e'' antigen positive, around one in 30 when the patient is infected with HCV and around one in 300 when the patient is infected with HIV (Department of Health, 1998). In addition to the health risks, there are also implications for work. In the UK, staff are not allowed to perform exposure-prone procedures if they are HIV positive (Department of Health, 2002a), HBV surface antigen positive and ''e'' antigen positive, or ''e'' antigen negative with a high viral load (Department of Health, 2000), or HCV RNA positive (Department of Health, 2002b).

In our unit, we frequently perform hand surgery on patients who are IV drug abusers, some of whom have Hepatitis C. We believe that, in addition to universal precautions (Department of Health, 1998), further precautions should be taken during operations on patients known to be positive for BBV and on IV drug abusers because of the high incidence of HCV in this group. We, therefore, present our management policy for these patients. A table of the main points is included (Table 1).

GENERAL PATIENT MANAGEMENT

It is important to identify high-risk patients as early as possible and, if time allows, counsel them to have blood tests to see if they suffer from BBVs or are carriers. As soon as possible, all health-care staff looking after the patient, especially theatre and ward staff, should be made aware that the patient is high risk. This has obvious potential benefits for the patient and their carers. Staff dealing with such patients should have been immunised against hepatitis B and be aware of local protocols regarding the prevention of BBV transmission and the management of exposure incidents, including HIV post-exposure prophylaxis. The General Medical Council's guidance on Serious Communicable Diseases (1997) describes the essential elements of good standards of practice and care, in relation to the treatment of patients with serious communicable diseases and the responsibilities of doctors who have, or may have, such diseases (http://www.gmc-uk.org/guidance/library/serious_communicable_diseases.asp). Disposable gloves

Table 1—Points to consider when performing hand surgery on patients who are high risk for BBV

General
- Identify high-risk patients
- Would a less-invasive procedure be as effective?
- Inform staff about the patient as early as possible
- Patients position on the operating list

During the operation
- Senior staff and only essential staff should be scrubbed
- Appropriate clothing
  - Double gloving
  - Fluid-resistant mask
  - Face shield
  - Plastic apron
  - Waterproof gown
  - Waterproof boots
- Vigilance and no sudden movements
- Sharp instrument usage should be avoided
- Sharp instruments transferred by a "hands-free" technique
- Instrument retraction only
- Suturing with blunt-tipped needles
- Suturing with "no touch" technique and instrument tie
- Wound closure with staples or glue
- Absorbable suture
- Closed wound drain system

Tendon surgery
- Immobilise tendon
  - Care if using hypodermic needle—use a cap
  - Insert core stitch and hold ends in artery clip

Hand fractures
- Beware sharp bone ends
- Beware sharp K-wires—use a cap

Irrigation
- Beware of splash exposure

should be worn when handling the patient and any spillage of blood or body fluid should be disinfected appropriately.

Serious consideration should also be given to the need for an operation and, where practicable and effective, it is best to choose a non-invasive procedure. Where surgery is necessary, IV drug abusers or patients known to be positive for BBV should be operated on at the end of the operating list, with adequate time provided after for thorough cleaning of theatres to minimise the risk of spread of infection to other patients.

DURING THE OPERATION

General points

When possible, only senior staff should participate in the operation and only essential staff should be scrubbed. Equipment and staff should be minimised in the operating room. We encourage all scrubbed personnel to wear protective headwear, a fluid-resistant surgical mask, a face shield, a plastic apron, a waterproof gown, waterproof footwear and to double glove. Any open skin lesion in the health professional should be dressed with a waterproof dressing. Vigilance is important during the operation and no sudden movements should be made by the surgeon or assistant. During the procedure and at the end, careful attention must be paid to counting and appropriate disposal of all needles and scalpel blades. All contaminated reusable clothing, such as operating loupes and footwear, should be cleaned appropriately. The use of disposable drapes and gowns further reduces the risks associated with cleaning.

Face protection

Transmission of BBV can occur via mucous membranes. The transmission of HCV has been reported following conjunctival splash (Rosen, 1997) and the risk of HIV infection after mucous membrane exposure has been estimated to be between 0.09% and 0.25% (Greene and Akelman, 2004). In a study to assess risk of eye splash, 44% of eye shields were found to be positive for blood, with the surgeon being unaware of the majority of episodes (Marasco and Woods, 1998). We recommend that a face shield should be worn to protect the conjunctivae from splatter and aerosols of blood. These can be worn comfortably over certain designs of operating loupes (Fig 1). Male health-care workers should also consider wearing hoods, rather than caps, to protect freshly shaven cheeks and necks (Department of Health, 1998).

Fig 1 Picture showing a face shield being worn over operating loupes.

Hand protection

No double gloving system will prevent sharp injuries, but it does reduce cutaneous exposure (Cole and Gault, 1989; Greco and Garza, 1995; Marin-Bertolin et al., 1997; Smoot, 1998; Tanner and Parkinson, 2004; Thomas et al., 2001). One study has also suggested that double gloving offers protection against skin contamination in microsurgical procedures (Hentz et al., 2001). A comfortable method of latex double gloving consists of wearing a one half-size larger than the normal inner glove, with a normal glove as the second layer (Smoot, 1998). Wearing indicator gloves allows the wearer to detect perforations to the outer gloves more easily (Tanner and Parkinson, 2004). Most glove perforations go unnoticed (Cole and Gault, 1989; Marin-Bertolin et al., 1997; Thomas et al., 2001) and they increase in proportion to the duration of the operation (Cole and Gault, 1989, Marin-Bertolin et al., 1997). Therefore, gloves should be changed regularly in prolonged surgical procedures. It has been recommended that outer gloves are changed every 2 hours during elective procedures and every hour during trauma surgery (Lemaire and Masson, 2000).

Surgical technique

The use of sharp clips to attach surgical drapes should be avoided as they are known to perforate gloves (Cole and Gault, 1989) and, instead, either blunt clips or disposable drapes incorporating self-adhesive tape should be used.

A pneumatic tourniquet should be used during the procedure as it helps to minimises bleeding and, therefore, the risk of contamination. Thought should be given to the timing of tourniquet release. Some hand surgeons release the tourniquet prior to wound closure while others release the tourniquet as the final step, after wound closure and applying a pressure dressing. The latter may be associated with greater haematoma formation (Himel et al., 1989) but it does reduce the risk of contamination, so should be considered.

Use of sharp surgical instruments should be avoided when possible. Tissue cutting and dissection should, preferably, be with blunt pointed scissors or with bipolar diathermy. If sharp instruments are being used, they should be handled with particular care and transferred by a ''hands -free'' technique. This means that the sharp instrument is touched by only one person at a time, with no hand-to-hand passing of instruments. This has been shown to reduce the number of operating theatre incidents (percutaneous injuries, contaminations and glove tears) (Stringer et al., 2002). Items should be transferred by being placed in a designated area or container, known as a ''neutral zone''. For example, a kidney dish is used to transfer the item and an announcement is made when a sharp instrument is placed there. It is also important to keep the surgical field clear of unnecessary equipment. Sharp instruments should be returned promptly to the neutral zone. Instruments should be used for the removal of a blade from a scalpel. To reduce the risks even further, disposable scalpels should be used when possible.

When manipulating and retracting tissue, only instruments should be used. Suction is preferable to the practice of dabbing the surgical field manually with gauze. The use of sharp pointed hand-held skin retractors, such as skin hooks, should be avoided when possible and self-retaining retractors used instead. In a study of glove perforation during plastic surgery, where the incident was remembered, the skin hook was the instrument most commonly implicated (Cole and Gault, 1989).

Blunt-tipped needles should be used for suturing when possible, to reduce the risk of percutaneous injury. A ''no touch'' technique of needle passage through tissues should be used, using a needle holder and forceps. It is safer to ''instrument tie'' suture knots. It is also advisable to avoid tying knots with short suture lengths when the needle is still attached, as this may result in a needle puncture of the palm (Smoot, 1998).

If a hypodermic needle is used for tendon immobilisation during tendon repair, its point must be firmly and carefully fixed away from the operation site. It is possible to cap the sharp end with a sterile rubber bung, obtained from a 1-ml syringe (Tzivaridou and De Souza, 2004). Specialised instruments for atraumatic tendon manipulation have been described by Bunnell and Tsuge, but these may not be readily available (Morris and Martin, 1993). A safe and simple method is to insert the core suture stitch into the tendon when it is visible in the wound and then attach an artery clip to the suture end and needle (Tzivaridou and De Souza, 2004). In this way, the artery clip provides the strength needed to overcome the pull of the muscle belly and there is no risk of injury from the suture needle or the hypodermic needle.

In patients with fractures, it must be remembered that bone ends may be sharp and can cause percutaneous injury. If K-wires have been used for fixation, their sharp ends should be capped as soon as possible with, for example, cork or plastic. An alternative is to apply a chiroKlip™, a self-adhesive butterfly shaped aluminium clip over the sharp end (Synerception Ltd website, 2004).

Skin grafts should ideally be harvested with a system where the sharp blade is protected, for example a Humby knife or power-driven dermatome.

Irrigation

When wounds are irrigated to remove foreign material and to reduce bacterial load, care must be taken to avoid splash exposure. In cases of heavy wound contamina-

tion pulsed lavage is frequently used, further increasing the risks of splash exposure due to the higher pressures generated. If such a system is to be used, then methods to decrease the exposure risk need to be adopted. One method is to use an X-ray Cassette cover to provide a translucent closed system (Greene and Akelman, 2004).

Wound closure and dressing

If possible, wound closure is performed with staples or glue. If sutures have to be used, a dissolving suture should be used in preference, to avoid the need for future suture removal. All blood must be cleaned from the patient's skin. Waterproof dressings should be applied and, if a drain is needed, a closed wound system is preferable to an open one.

What to do in case of a percutaneous injury

Every NHS employer must have clearly defined and publicised protocols that should be followed when someone suffers a "sharps" or "needle-stick" injury. These protocols may vary slightly between hospitals, but we have outlined the basic steps that should be taken.

Immediately following any exposure, the skin should be washed liberally with soap and water, without scrubbing. Mucous membranes should be irrigated copiously with water and free bleeding of percutaneous injuries should be encouraged.

Any blood exposure incident must be reported promptly and a full record must be prepared and preserved. An exposed health-care worker should be referred urgently to the Occupational Health Service for advice, counselling and treatment. Adequate 24-hour cover must be available, with primary responsibility for this with the Occupational Health Service, with out-of-hours cover usually being provided by the Accident and Emergency (A&E) department. A&E departments should have access to on-call expert advice from consultants in Occupational Health, HIV Disease, Genito-Urinary Medicine, Virology, Microbiology, Infectious Diseases and Public Health (Department of Health, 2004).

The doctor who the health-care worker is referred to needs to try to obtain information from, or about, the source patient concerning possible indicators of BBV infection, including risk factors and results of previous tests for HIV and hepatitis, and medical history suggestive of such infection, including details of past and current antiviral therapy in patients known to be HIV infected. The source patient should be asked to consent to testing for BBV infections. If they are approached in a sensitive manner, consent is rarely withheld (Department of Health, 1998).

Early discussion with the local microbiologist regarding further management is often beneficial as they will also be aware of up-to-date local incidence of BBV, which may be particularly useful in cases where the BBV status of the source cannot be established.

After counselling the health-care worker should be tested for HBsAg and baseline serum stored for an extended period. If the health-care worker develops a BBV infection later, the stored sample can tested to confirm that they were negative prior to the percutaneous exposure.

Any testing must only be performed with the informed consent of the health-care worker and counselling should include discussion about BBV and the risk of transmission through a percutaneous exposure. The test procedure and the implications of a positive result should be discussed and available support and follow-up should be identified.

People considering whether to have an HIV test may need reassurance about any effect this may have on their insurance. The Association of British Insurers has recommended to its members that, for life insurance proposals and proposals for other types of insurance where health or lifestyle questions are asked, they no longer ask whether the applicant has had counselling or a negative test for HIV infection. Insurers are, however, entitled to ask about any positive HIV test result. Existing life insurance policies will not be affected by taking an HIV test, even if the result is positive (Department of Health, 2005).

Hepatitis B

For those who have not been previously immunised by Hepatitis B vaccine, Hepatitis B transmission risk following percutaneous exposure has been shown to be around one in three when a source is infected with HBV and is "e" antigen positive (Department of Health, 1998). Testing for HBsAg gives a baseline and avoids the administration of Hepatitis B vaccine to individuals who will not benefit from it.

HB vaccine is routinely given to health-care workers in the UK. If the health-care worker has received HB vaccine previously, then the course should be completed or a booster considered, after determination of the anti-HBs antibody level and review of previous tests for response to the previous vaccine course. If the health-care worker is known to be a non-responder to the vaccine (anti-HBs <10 miU/ml, 2–4 months post-immunization), they should be offered HBV Immunoglobulin and a vaccine booster should be considered.

In cases where the health-care worker has not had HB vaccine, they should be offered an accelerated HBV vaccine: the first dose at the time of assessment and further doses at 7 and 21 days thereafter. In cases where the source is known, or extremely likely, to be HBsAg positive, then the health-care worker should also be offered HBV Immunoglobulin (HBIG).

The HBV prophylaxis protocol is summarised in Table 2.

Table 2—HBV Prophylaxis (modified from "The Green Book" (Department of Health, 1996)

Status of health-care worker	*Source HBsAg positive/high risk*	*Unknown source/ low risk*
⩽1 dose HB vaccine	Accelerated HB vaccine course and HBIG x1	Accelerated HB vaccine course
⩾2 doses HB vaccine (anti-HBs not known)	One dose of HB vaccine followed by second dose 1 month later	One dose of HB vaccine
Known responder to HB vaccine (anti-HB >10 miU/ml)	Consider vaccine booster	Consider vaccine booster
Known non-responder to HB vaccine (anti-HB <10 miU/ml, 2–4 months post-immunisation)	HBIG x1 and consider vaccine booster	HBIG x1 and consider vaccine booster

Hepatitis C

Hepatitis C transmission risk following percutaneous exposure has been shown to be around one in 30 when the patient is infected with HCV (Department of Health, 1998). There is no effective post-exposure prophylaxis available for HCV. In cases where the source is unknown, the health-care worker should be advised to have a test for anti-HCV at 24 weeks. If the source is HCV positive, then the health-care worker should be offered several other blood tests, including HCV RNA at 6 and 12 weeks and anti-HCV at 12 and 24 weeks, directed at early detection of developing Hepatitis C infection (Ramsay, 1999). Early treatment with interferon and ribavirin appears to be effective in preventing chronic Hepatitis C infection in those in whom early infection is detected (Pearlman, 2004) and NICE has recommended combination therapy with pegylated interferon alpha and ribavirin for the treatment of people aged 18 years and over with moderate to severe chronic hepatitis C (NICE, 2004).

HIV

The risk of acquiring HIV infection following occupational exposure to HIV-infected blood is low, on average about three per 1,000 percutaneous injuries and less than one in 1,000 after mucocutaneous exposure. Where the skin is intact, it has been considered that there is no risk of HIV transmission (Department of Health, 2004). The risk of HIV seroconversion following an occupational percutaneous exposure to HIV-infected blood in health-care workers is higher after exposures involving larger blood volumes, deep injuries, hollow needles, needles that have been used in patient's vein or artery, and devices that are visibly contaminated with blood. Risks are also higher if the source patient has a high viral load and if they suffer from terminal HIV-related illness (Department of Health, 2004).

Table 3—Recommended Drugs for PEP (Department of Health, 2004)

zidovudine 250 mg or 300 mg bd
+
lamivudine 150 mg bd
+
nelfinavir 1250 mg bd (or 750 mg tds)

In cases where the source is unknown, the health-care worker should be advised to have a test for anti-HIV antibody at 3 and 6 months after the incident.

In cases where the source is known to be HIV positive and where a "significant" exposure has occurred, e.g. exposure of mucous membranes or an injury which breaks the skin, post-exposure prophylaxis (PEP) is recommended (Department of Health, 2004).

The recommended drugs for PEP are shown in Table 3 and treatment should normally be continued for 4 weeks. The administration of zidovudine prophylaxis to health-care workers occupationally exposed to HIV was associated with an 80% reduction in the risk for occupationally acquired HIV infection (Department of Health, 2004). Evidence from animal studies indicates that systemic viral dissemination does not occur immediately and that PEP is most likely to be efficacious if started within the hour, although it may still be worth starting PEP even when up to 2 weeks have elapsed since the exposure (Department of Health, 2004). Starter packs containing a 3-day course of PEP should be kept in a number of readily accessible places such as A&E departments. PEP protection is not absolute and it has side-effects such as nausea and vomiting, diarrhoea, malaise, fatigue and headache (Department of Health, 2004). Pregnancy does not preclude the use of PEP and there may be potentially serious interactions with other drugs, so it is best to check with a pharmacist for up-to-date information (Department of Health, 2004). At least 6 months should elapse after cessation of PEP before a negative antibody test can be used to reassure the health-care worker that infection has not occurred. The health-care worker should, therefore, be closely followed up by the Occupational Health Department for such a period and should report any symptoms of concern during this period (Department of Health, 2004).

A health-care worker does not need to avoid performing exposure-prone procedures while pending serological follow-up after occupational exposure. This is because the risk of the health-care worker becoming infected, and the even smaller risk of that infection being transmitted to a patient, is considered to be so small as

not to merit such a restriction. Advice should however be given about safe sex and avoiding blood donation during the follow-up period. In the event that the health-care worker seroconverts and develops established HIV infection, they must cease to perform exposure-prone procedures (Department of Health, 1998).

The NHS Injury Benefits Scheme provides temporary or permanent, benefits for all NHS employees who have suffered loss of earnings because of an injury or disease wholly, or mainly, attributable to their NHS employment. Industrial Injuries Disablement Benefit can also be paid where an employed person contracts viral hepatitis. Although HIV is not a prescribed disease under the Social Security Acts, health-care workers may be able to claim compensation under the Industrial Injuries Disablement Benefit where there has been an accident arising out of and in the course of employment, e.g. a needlestick injury. The Occupational Health Service should provide advice on entitlement to benefits for occupationally acquired infection (Department of Health, 1998). Retirement benefits under the NHS Pension Scheme may be payable when a health-care worker is permanently incapable of performing their duties because of HIV infection (Department of Health, 2005).

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