INVITED ARTICLE

HIV INFECTION IN HUMAN BONE

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Bone transplantation is often used for the reconstruction of defects. The best results are achieved with autogenous grafts because they induce no immunological reaction, but allogeneic grafts from bone banks are frequently used to provide an adequate volume of bone (Cookson et al 1988). In Germany, about 470 departments using such banks perform about 71,000 autogenous and about 25,000 allogeneic bone grafts each year (Jerosch et al 1990). In addition some 4,000 bone marrow transplantations are performed each year; a total of 30,000 to date (Bortin and Rimm 1989; Ehninger, Schuler and Schaefer 1991).

Allografting increases the risk of bacterial and viral contamination, particularly with hepatitis virus and human immunodeficiency virus (HIV). It has been shown by co-cultivation that HIV-1 is present not only in lymphocytes but also in bone from HIV-1-infected individuals (Buck et al 1990; Merz et al 1991). In 1988 it was first reported that HIV-1 transmission could occur by bone transplantation (Centers for Disease Control 1988). With the ever-increasing number of bone grafts performed world-wide there is an increasing risk of HIV-1-infection if precautions are not taken to prevent viral transmission (Bortin and Rimm 1989; Buck, Malinin and Brown 1989; Jerosch et al 1990; Ehninger et al 1991).

Guidelines for bone banks have been proposed to minimise the risk of viral infection (Hackenbroch 1990). Provided that a combination of rigorous donor selection, histopathological analysis and laboratory testing is applied, the possibility of HIV-1 infection by transplantation is remote, but if no such precautions are taken the risk has been estimated to be as high as one in 161 (Buck et al 1989).

We have attempted to develop methods to reduce further the risk of transmission of HIV-1 by bone transplantation.

Table I. Detection of HIV-1 in bone by the PCR technique

<table>
<thead>
<tr>
<th>Bone specimen</th>
<th>Amount of bone used for 40 PCR-cycles (µg)</th>
<th>Relative signal intensity*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uninfected</td>
<td>0.5</td>
<td>0.00</td>
</tr>
<tr>
<td>HIV-infected: WR: 4-5</td>
<td>0.4</td>
<td>0.31</td>
</tr>
<tr>
<td>WR: 4-5</td>
<td>0.6</td>
<td>0.52</td>
</tr>
<tr>
<td>WR: 5-6</td>
<td>0.6</td>
<td>0.46</td>
</tr>
<tr>
<td>WR: 6</td>
<td>0.2</td>
<td>0.29</td>
</tr>
<tr>
<td>WR: 6</td>
<td>0.4</td>
<td>0.69</td>
</tr>
<tr>
<td>WR: 6</td>
<td>0.6</td>
<td>0.87</td>
</tr>
<tr>
<td>Positive HIV-1 control (10 µl)</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

* arbitrary units

Inactivation of HIV-1 in bone grafts. We investigated various physical and chemical methods. First, we studied ozone, and showed that it did not inactivate HIV-1 in bone in vitro even in a vacuum (Merz et al 1991; Röder, Müller and Merz 1991a).

We then investigated Cialit ( Hoechst), a solution of otimurate sodium, which has bacteriostatic and antifungal properties and is used for the storage of bone transplants (Cookson et al 1988; Dickson and Inglis 1988). Wilmes, Gürtler and Wolf (1987) reported that a concentration of 0.5 µg/ml of Cialit could inactivate HIV-1. For routine clinical use we employ a concentration of 0.2 µg/ml, but we found no inactivation of HIV-1 either at non-cytotoxic or at higher concentrations (Röder et al 1991c; Röder, Müller and Merz 1991b; Röder et al 1991d). Our findings agree with those of Dickson and Inglis (1988); it appears that Cialit cannot be recommended for the inactivation of HIV-1 in virus-infected bone material.

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Detection of viral genome in the graft. Recently, we have applied the polymerase chain reaction (PCR) technique to test human bone material for the presence of HIV-1 in clinical specimens. DNA was prepared from small specimens of bone taken from uninfected and from HIV-1-infected individuals. After amplification by PCR, aliquots of the reaction mixture were subjected to electrophoresis on agarose gels. To provide a semiquantitative result in terms of the number of HIV-1 copies/10 μl of reaction mixture, we used HIV-1-containing plasmid BH10, adjusted to 10^3 copies/10 μl, as a positive control.

We were able to detect the viral genome in all six samples from HIV-1-infected individuals (Table I). This shows that the PCR technique works well, and is sensitive to HIV-1-genome in bone graft material.

Our conclusions are that neither ozone nor Cialit treatment can inactivate HIV-1 in bone grafts taken from infected persons, but that the PCR technique can be used successfully as a routine screening test to detect HIV-1 genome in bone samples.

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REFERENCES


