Correspondence

References


Uptake of solvents from the lungs

Sir,—Any solvent, like any other drug, reaches a steady state concentration (90% of the equilibrium concentration) in any compartment in a time equal to 3-3 times the value of its half life, which may be theoretically estimated from the following formula

\[ T/2 = 1n 2 \times (V \times \lambda_t)/F \]

where \( V \) = volume of the tissue (compartment), \( \lambda_t \) = the tissue/blood partition coefficient of the solvent, and \( F \) = the blood flow to the tissue concerned.

As the enclosed table shows, methyl ethyl ketone (MEK) has a half life of 0-8 minutes, toluene a half life of 1-8 minutes, and n-hexane a half life of 3-2 minutes in the tissues of the vessel rich group. According to these values, n-hexane, which is the least soluble solvent of the three (blood/air partition coefficient = 0-8), can reach a steady state concentration in the tissues of the vessel rich group in about 10 minutes, whereas MEK, which is the most soluble solvent (blood/air partition coefficient = 202), can reach an equilibrium concentration in about three minutes in the same compartment.

If these observations are true then I find it hard to understand the sentence: “Owing to the high solubility of the solvents ... no tissue approached equilibrium with the blood during the experimental exposures...” reported in the editorial: “Uptake of solvents from the lungs” (1985;42:217-8).

The tissues of the vessel rich compartment always approach equilibrium with blood within a few minutes, since its volume is small (6 litres), perfusion is large (5-2 litres/min), and the tissue/blood partition coefficient concerned is generally low (tissue solubility generally no more than 1-10 times blood solubility, apart from fat tissue).1-5

Industrial jobs where exposure to solvents generally occurs do not entail a heavy work load, and, in any case, if this happens the duration of the heavy physical load is relatively short—for instance, 30-60 minutes in a seven to eight hour workshift. If this is true the considerable increase of VA (triplication, quadruplication, or more) that follows the heavy work load can certainly modify the lung uptake, but for a time which is, in practice, only a small fraction of the work shift.

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References


Volume and perfusion of the four tissue groups and distribution coefficients, distribution volumes, and biological half lives of methyl ethyl ketone (MEK), toluene, and n-hexane

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Solvents</th>
<th>Tissue groups</th>
<th>Vessel rich</th>
<th>Muscle</th>
<th>Fat</th>
<th>Vessel poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume in 70 kg person (( V = 1 ))</td>
<td>MEK</td>
<td>6</td>
<td>33</td>
<td>14-5</td>
<td>12-5</td>
<td></td>
</tr>
<tr>
<td>Perfusion (( \text{ml/min} )) (( F ))</td>
<td>MEK</td>
<td>5-25</td>
<td>1-27</td>
<td>0-38</td>
<td>0-1</td>
<td></td>
</tr>
<tr>
<td>Percentage (( % )) of cardiac output</td>
<td>MEK</td>
<td>75%</td>
<td>18-1%</td>
<td>5-4%</td>
<td>1-5%</td>
<td></td>
</tr>
<tr>
<td>Tissue/blood distribution coefficient (( \lambda_t ))</td>
<td>Toluene</td>
<td>1-0</td>
<td>1-2</td>
<td>0-88</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td>n-Hexane</td>
<td>2-3</td>
<td>1-6</td>
<td>82</td>
<td>1-9</td>
<td></td>
</tr>
<tr>
<td>Distribution volume (( V_D = 1 )) ( (V \times \lambda_t = V_D) )</td>
<td>MEK</td>
<td>6-0</td>
<td>39-6</td>
<td>12-8</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toluene</td>
<td>13-8</td>
<td>52-8</td>
<td>1189</td>
<td>23-7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>n-Hexane</td>
<td>24-0</td>
<td>165</td>
<td>1885</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Biological half life (( V_D/F \times 0-693 ))</td>
<td>MEK</td>
<td>0-8 min</td>
<td>21-8 min</td>
<td>23-3 min</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toluene</td>
<td>1-8 min</td>
<td>28-8 min</td>
<td>36-1 H</td>
<td>2-7 H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>n-Hexane</td>
<td>3-2 min</td>
<td>90-0 min</td>
<td>57-4 H</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>
Uptake of solvents from the lungs.

F Brugnone

*Br J Ind Med* 1985 42: 569
doi: 10.1136/oem.42.8.569

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