“Effectiveness, Adaptation, and Health Risks of Embalming Fluids: Just What is the Solution?”

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Who am I?

• Started my career at the Dept of Vet Anatomy in 2001 as a junior technician
• Currently manage the medical and veterinary dissection suites at the University of Bristol in the UK
Who am I?

• Joined the Institute of Anatomical Sciences (IAS) in 2001 and became ‘Secretary’
Brief history of preservation techniques through the ages

- Ancient Egypt 3000BC
- Mummification
Brief history of preservation techniques through the ages

- **Renaissance anatomists - Da Vinci et al**
  - Leonardo da Vinci (1452 - 1519), was probably the first to inject chemicals/wax into the specimens that he dissected and drew.
Brief history of preservation techniques through the ages

• William Harvey (1578–1657) — Harvey was an English physician who was the first to describe accurately how blood was pumped around the body by the heart.

• Dr. Frederick Ruysch (1665-1717) - Danish physician pioneered arterial embalming

• William Hunter (1718–83) - The Scottish anatomist, however, is credited with being the first to report fully on arterial and cavity embalming as a way to preserve bodies for burial.
Brief history of preservation techniques through the ages

• Dr Thomas Holmes (1817-1899) - Generally considered the father of modern embalming.
  • He experimented with preservative chemicals: arsenic, creosote, mercury, turpentine and various forms of alcohol,
  • He reportedly embalmed over 4000 soldiers and officers from the union army during the American Civil War (1861-1865)
Brief history of preservation techniques through the ages

• Discovery of Formaldehyde and its effects.
  • August Wilhelm von Hofmann - In 1867, the science of embalming took a step forward when the preservative chemical formaldehyde was discovered.
  • more effective - and more economical - preservative than previous solutions of oils of turpentine, lavender, rosemary or vermilion which had previously been recommended by William Hunter.
Efficacy of Formaldehyde as a preservative?

- Chemical formula – CH2O
- Formalin?
- Action- how does it work?
- What other chemicals combine with Formalin to produce best preservation?
How Embalming Fluids have changed to meet the requirements of the profession?

• Introduction of different chemicals to give different effects – fixation or flexibility?
  • Soft embalming techniques – Cambridge (cantabrian solution)
  • Theil
  • Use of Fresh/Frozen cadavers in post graduate surgical training courses
Cambridge (cantabrian solution)

• First developed in 1985 by Bari Logan – Reduction in Formalin from 10% to 3% replaced with Methanol.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>g/Kg</th>
<th>ml/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>0315 ETHANOL INDUSTRIAL (99% IMS) (74 OP)</td>
<td>394.650 g</td>
<td>500.000 ml</td>
</tr>
<tr>
<td>0332 FORMALDEHYDE SOLUTION 40% w/v pure</td>
<td>86.347 g</td>
<td>79.000 ml</td>
</tr>
<tr>
<td>2199 POLYETHYLENEGLYCOL 200</td>
<td>84.000 g</td>
<td>75.000 ml</td>
</tr>
<tr>
<td>3360 CITRICIDAL</td>
<td>11.100 g</td>
<td>10.000 ml</td>
</tr>
<tr>
<td>0757 WATER DEIONIZED</td>
<td></td>
<td>336.000 ml</td>
</tr>
</tbody>
</table>

• Results - greater flexibility, good fixation, less harmful fumes

• Still being used today
Theil Solution

Developed in 1992 – Prof W. Thiel, Institute of Anatomy, Karl Franzens University, Graz, Austria.

<table>
<thead>
<tr>
<th></th>
<th>Arterial infusion</th>
<th>Venous infusion</th>
<th>Tank fluid</th>
<th>Moistening fluid</th>
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<tbody>
<tr>
<td>Hot tap water</td>
<td>6.8 ltr</td>
<td>1.45 ltr</td>
<td>1250 ltr</td>
<td>20 ltr</td>
</tr>
<tr>
<td>Boric Acid</td>
<td>250 gr</td>
<td>80 gr</td>
<td>45 kg</td>
<td>600 gr</td>
</tr>
<tr>
<td>Ammonium Nitrate</td>
<td>1680 gr</td>
<td>520 gr</td>
<td>150 kg</td>
<td>-</td>
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<tr>
<td>Postassium Nitrate</td>
<td>420 gr</td>
<td>130 gr</td>
<td>75 kg</td>
<td>-</td>
</tr>
<tr>
<td>Sodium Sulphite</td>
<td>700 gr</td>
<td>190 gr</td>
<td>105 kg</td>
<td>1 kg</td>
</tr>
<tr>
<td>Propylene Glycol</td>
<td>2.5 ltr</td>
<td>780 ml</td>
<td>150 ltr</td>
<td>1 ltr</td>
</tr>
<tr>
<td>Stock II</td>
<td>500 ml</td>
<td>190 ml</td>
<td>30 ltr</td>
<td>200 ml</td>
</tr>
<tr>
<td>Formalin (8.9 %)</td>
<td>2.1 ltr</td>
<td>1.5 ltr</td>
<td>125 ltr</td>
<td>-</td>
</tr>
<tr>
<td>Morpholine</td>
<td>150 ml</td>
<td>110 ml</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Alcohol</td>
<td>1 ltr</td>
<td>1.1 ltr</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total volume [ltr] ca.</td>
<td>12.5</td>
<td>5</td>
<td>1720</td>
<td>22</td>
</tr>
</tbody>
</table>

• low-odour embalming technique
• colour, consistency and transparency of the tissue were very well preserved
• Superb flexibility – comparable with fresh tissue
• Expensive??
Health risks associated with Formaldehyde and Embalming fluids in general – What can be done to address these risks – what does the law allow?

- Law as it stands in EU, UK and USA
- Classification of Formaldehyde
- Proposed changes to classification – HSE, SCOEL IOEL Directives
- Views from the UK Anatomy Sector – PGaPAC response to the HSE
What alternatives to Formaldehyde ‘heavy’ embalming solutions are out there?

- Formalin neutralisation
- Infutrace, Perfect Solution
- Michigan state University, Medical School using Monoethanolamine

1= Before engineering controls
2= After engineering controls
3= After Infutrace
4= After MEA
Conclusions – if any?

Embalming Fluids- just what is the solution?

- So are there any alternative fixatives as effective as Formaldehyde?
- Can we adapt embalming fluids further or have we gone as far as we can?
- Are the solutions we are using as safe as they can be?
Contacts

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THANK YOU