



# Expanding Encyclopedia Of Mortuary Practices

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Number 641, 2000

## **THE EMBALMING CHEMISTRY OF EDEMA**

### **Part 1**

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*ABSTRACT: Edema and the embalming chemical treatment of edematous cases is discussed. A short review of edema is given along with the traditional accepted treatments for edema. A discussion of edema chemistry and how it relates to embalming theory and practice is covered. Results of lab and field testing of various techniques of edema treatment is analyzed. Shortcomings, misunderstandings and failures of typical embalming treatments is overviewed. The efficacy of aldehyde overload and salt usage is examined. New style chemical embalming treatments are discussed with recommendations to achieve maximum effectiveness in embalming treatment of edema.*

**EDEMA: A QUICK REVIEW.** By whatever name you call it -- dropsy, anasarca, ascites, hydrothorax, hydroperitoneum, and others - edema has and will continue to be a serious problem for embalmers. Edema, of course, is excessive fluid and water retention in the various tissues and areas of the body, all of which contribute to embalming difficulties. In general, edema is typically said to exist when an excess of 10% of fluid is present from the normal moisture content of the body. A normal body moisture content is 55-65% of total body weight. The driving concept of all embalming treatment of edema has been to somehow remove the excess moisture. This has been attempted by injection of strong solutions of formaldehyde to try and create secondary dilution with washing out of edema water and the use of strong salts (almost always Epsom salts) to draw out the excess tissue moisture. Both of these concepts are based on the concept of osmosis.

From basic chemistry, everyone is familiar with osmosis - the driving force for a pressure gradient across a semipermeable membrane. This tension in the various body fluid compartments is measured in osmolarity (the concentration of osmotic active particles present in a fluid expressed as moles/liter of solution). In medical literature, the tonicity or pressures are compared and standardized as mOsm/(milliosmoles per liter). Blood

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plasma has a osmolality (technically, osmoles per kg of diluent) of 275-295 m Osm/kg. Blood serum differs very little with a mOsm/kg of 278-305. Contrast this with the osmolality of human urine with a broad range of dilute to concentrated of 50mOsm/kg to in excess of 1200mOsm/kg. It is this basic chemical pressure gradient that must be overcome for successful embalming of edema cases to occur.

**TRADITIONAL METHODS:** The old standard accepted treatments for edema basically include the following: injection of Epsom salts along with the arterial, injection of strong hypertonic solutions of formaldehyde arterials, utilization of so-called waterless embalming and injection of concentrated humectant along with the arterial solution. Let us examine the efficacy of each of these techniques.

Epsom salts has always been advocated in one form or another since the virtual beginning of formaldehyde arterial embalming in the case of edema. Typically a 10% or greater salt solution would be recommended along with a formaldehyde arterial for injection. The older literature alludes to the fact that a 6.77% solution of Epsom salts duplicates the osmolality of normal tissues -- so a stronger solution than this must be used (hence 10-20%). Through any calculation, I can not derive these numbers from the modern accepted osmolar values of human body fluids. A typical recommendation in the older literature was to just dissolve as much Epsom salts in water as you could - then pour that into the machine and add arterial chemical to make your injection solution. The efficacy of Epsom salts usage is in the eye of the beholder. Some embalmers swear by it's effectiveness, others are convinced that it does not work in most, if not all cases.

The use of very strong formaldehyde arterial concentrations to dehydrate and drastically reduce the moisture content of an edema case is a more widely held view in the embalming profession. The supporting evidence for this methods' success is legion and based on sound embalming chemistry principles. The proven ability of formaldehyde to seriously dehydrate tissues is a constant problem in the embalming of normal cases with all sorts of ameliorative techniques being required (humectants, buffers, lanolin additives, etc.). This disadvantage in normal embalming is used to advantage in the embalming of edema cases.

Waterless embalming has been occasionally advocated in the embalming of edema cases. The basic concept being that injection of less water will help the dehydration effect and minimize the introduction of more water into the tissues during embalming. Unfortunately, waterless embalming is a misnomer -- it is more correctly referred to as "no water added embalming". The water content of modern embalming chemicals is sufficiently high that even using only embalming chemicals minus the dilution water contributes very little to water reduction. In it's recommended embodiment, waterless embalming offers no advantages in the embalming of edema cases other than the advocacy of higher concentrations of formaldehyde, which can be achieved without the technique even being used.

Occasionally, the injection of hyper concentrations of soluble humectants is advocated as an alternative hypertonic injection solution with normal or higher amounts of formaldehyde in the arterial solution. This is sometimes referred to as the "humectant rebound" effect. The theory is that extreme concentrations of humectants will generate the opposite effect of hydration that normally occurs and actually will draw out

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moisture during embalming. Some of the ancient literature even suggests syrups and glycerines for injection along with formaldehyde arterial chemical.

EMBALMING CHEMISTRY AND FIELD TESTS: Our extensive lab and field testing do not confirm the efficacy of several of the traditional embalming treatments for edema. Particularly, in the case of Epsom salt injection, waterless embalming and humectant overload procedures. Epsom salt, is, of course, magnesium sulfate which is a naturally mined mineral salt that is readily soluble in warm water. It's choice for use in embalming, no doubt, stems from it's several medical and pharmacological uses as a general dehydrating salt (for topical use, e.g. foot baths) and a cathartic and anticonvulsant. Despite it's good solubility in water, it does not have a high solubility in concentrated embalming fluids. Also, because it's typically available form is a heptahydrate, only approximately half the actual weight of salt dissolved is active ingredient. When dissolved in pure water, the solution is essentially neutral.

When dissolved in formaldehyde embalming fluid with an acid/base buffer, however, it can override the pH target of the buffer system and alter the pH for better or worse. The reactivity and effectiveness of the formaldehyde or dialdehyde preservative could be changed by the pH variance. When magnesium sulfate is added (at 10-20%) to normal dilutions of embalming solutions and injected there is not a consistent reduction in tissue moisture that is identifiable after embalming. When high concentrations of magnesium sulfate (20-30%) with a small amount of arterial fluid (1/2 to 1/4 the amount for a normal edema case) is injected into edematous areas of a body, no significant reduction in tissue moisture is noted after embalming. Concentrations above these amounts were not used as the solutions were becoming quite viscous and difficult to inject. When magnesium sulfate (10-20%) is injected with a high concentration of formaldehyde (2-3 times normal embalming dilutions) significant reduction in tissue moisture is noted after embalming and tends to increase with time. When no magnesium sulfate is injected and a high concentration of formaldehyde (again 2-3 times normal) is injected, there is a significant reduction in tissue moisture. Qualitatively, there are little noticeable differences between high formaldehyde concentrations and high formaldehyde concentrations with magnesium sulfate as regards total moisture reduction or tissue shrinkage. Lab bench analysis of tissue samples do verify a noticeable but small dehydration effect on large tissue sections and a very noticeable effect on small, thin tissue sections. Obviously, magnesium sulfate has some effect but is not the major factor during embalming unless accompanied by high amounts of formaldehyde as the embalming agent.

CONTINUED: The Embalming Chemistry of Edema  
Champion Expanding Encyclopedia of Mortuary Practices  
Number 642, 2000

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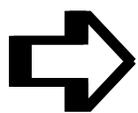
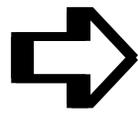
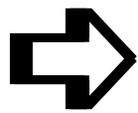
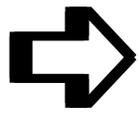
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