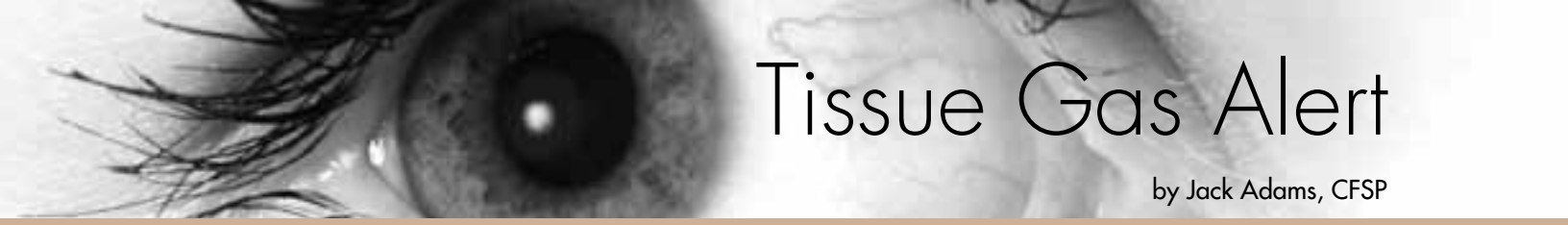

Tissue Gas Alert

by Jack Adams, CFSP

The U.S. Census Bureau reports that the elderly population (65 years and older) has increased 11 fold from 3 million in 1900 to 33 million in 1994. About 1 in 8 people were elderly in 1994 and the Bureau estimates this to increase to 1 in 5 in 2030. The oldest old (85 years and older) are a small but rapidly growing group, comprising of just 1% of the U.S. population in 1994. This oldest of the old segment of the population grew a staggering 274% from 1960 to 1994 compared to a 100% increase for the 65 years old and older group. Overall, the oldest old group is projected to be the fastest growing segment of the elderly in the next century.

People are living longer due to good health care and the advances being made daily in the medical field. New drugs and medical treatments routinely keep patients alive – results that would have been considered medical miracles just a few years ago. Heart surgeries to repair circulation to the heart with stents or artery reconstructions are very common, and bypass surgery to repair heart vessels seems as common today as tonsil removal was years ago. In fact, the National Heart, Lung and Blood Institute tells us that over 500,000 coronary artery bypass grafting surgeries and approximately 1 million balloon or coronary stent procedures are performed in the U.S. each year. If coronary artery disease is detected early enough, a patient could very well live to reach 100 years old because of the treatments now available.

When the body begins to deteriorate, the immune system starts to shut down and many times there are signs of necrotic tissue beginning to develop because of poor circulation. It's not uncommon to make an afternoon removal of a remains that died in the morning and see the beginning stages of decomposition. Abdomens are turning green on bodies dead for a few days and gas is developing even before people die.

The New England Journal of Medicine has reported clostridium infections associated with organ and tissue donations dating back to 1998. The Centers for Disease Control (CDC) began investigating methods used for recovery, processing, and testing of tissue in 2001 following the death of a 23-year-old man after he underwent orthopedic reconstructive surgery. They currently estimate the percentage of contaminated tissue at 0.12% for patients who receive sports medicine tissues such as tendons or menisci. That percentage seems low but the bottom line is that clostridium infections were traced to allograft implantations and the risk involved is real.

Most reputable tissue banks are now following safer testing processes to eliminate the potential of infection from the clostridium bacteria. The challenge is to find methods to sterilize the tissue that doesn't adversely affect the functioning of transplanted tissue while still preventing allograft related infections.

In short, tissue gas is on the rise.

Early Egyptian embalming included removing viscera and brain tissue to slow down swelling and distortion - they recognized that the presence of these organs caused accelerated decomposition. They went so far as to remove the brain which had to be taken out through the nose with specially designed instruments. Today, for the same reasons, bodies embalmed for anatomical research receive additional hypodermic treatment of the brain to ensure adequate preservation and prevention of gas formation.

An embalmer needs to be aware of the consequences of under-embalming because of the effect it could have, or not have, on the existing clostridium perfringens in the body. We all live with this bug - as our immune system breaks down, its presence becomes strengthened and sometimes it is identifiable before death.

Unfortunately, with embalmed bodies most tissue gas is discovered a day or two following the embalming - usually showing its presence through a swollen, distorted eye. This can come the morning of the funeral and can be nothing short of a disaster. The condition is accelerated by under-embalming and not recognizing the neutralizing effects of drugs on the chemicals we use to embalm. If gas is present anywhere in the body, it will almost certainly make its way to the brain because the gas has an affinity for brain tissue.

The gas that is formed in the brain enters the eye through the small opening where the optic artery and vein are located, also known as the foramen. On extreme cases, the eye will be swollen and be purging moist air bubbles. This is very common with drowning victims.

If the tissue makes a "snap-crackle-pop" sound when touched, you have tissue gas. This condition is caused when gas bubbles begin to form in the tissue beneath the skin.

Subcutaneous emphysema: This condition resembles tissue gas because of air being present in the tissue. The difference is that this gas is generally caused by medical treatments such as a tracheotomy, or tapping of the lungs or pleural cavity. If oxygen is given too quickly, the excess goes into the lungs and then tissue. Sometimes medical treatments such as injecting the heart with adrenalin can cause the lung to be punctured, and again air will enter the tissue and cause rapid swelling.Tissue gas is caused by decomposition and subcutaneous emphysema is generally caused by medical treatments.

About 1 in 8 people were elderly in 1994 and the Bureau estimates this to increase to 1 in 5 in 2030. The oldest old (85 years and older) are a small but rapidly growing group.

Suspect Tissue Gas Cases

Embalmers should expect certain cases to have tissue gas present even if it's not visible in the tissue. Some of those are:

Drowning victims: Almost all of these cases will have tissue gas because of the dirty water ingested into the body.

Recent surgeries: Especially surgeries of the abdomen and large, open hernia surgeries. Any surgery of the bowel is always a suspected tissue gas case. Surgical sites can commonly develop gas gangrene while the patient is still alive.

Gunshot wounds: Cases where death occurs because of gunshot wounds can also become contaminated easily. Here again, the embalmer needs to be aware.

Trauma cases: Any cases where death was caused by accidents or violent actions. Invariably these cases are contaminated and exposed to additional clostridium present in soil and the environment.

Suspect tissue gas cases should be treated as actual tissue gas. Aggressive actions can avoid disaster and allow an embalmer to get a good night's sleep. Conscientious embalmers are always taking extra insurance steps to avoid any possible embalming failures.

I like to divide tissue gas into two categories: suspect/beginning tissue gas and advanced tissue gas. In both cases a 16 oz. bottle of Dis-Spray should be added to each gallon of solution. The difference would be in the strength of solution injected in each case. The suspect case, or a case that is showing initial signs of tissue gas, would be injected with a stronger than normal solution with Dis-Spray added. A bottle or two of your "insurance" chemical such as Introfiant would probably be added to kick up the usual strength. You are still treating the tissue and decomposition hasn't set in yet.

Advanced tissue gas can often be visually identified when it appears as though the vessels have reached the skin surface – they can look like a road map. Other visual clues are a green abdomen, areas of skin slip, and air bubbles just below the skin surface. Odors of decomposition and the crepitation sound (that snap-crackle-pop) are also signs of advanced tissue gas. If any of these conditions are present, it would call for a strong solution and I prefer a waterless solution using equal amounts of Metaflow, Rectifiant, and Introfiant plus 16 oz. of Dis-Spray per gallon of solution. The Dis-Spray can deactivate the gas during the initial injection.

Any tissue showing active signs of gas, such as vessels raised to the surface, swelling, crepitation, or skin slip of the tissue, should be hypoed with Basic Dryene after the injection. The phenol in Basic Dryene neutralizes and deactivates the clostridium quickly and is the most powerful weapon to stop tissue gas that I know of. Once a body is well-embalmed it should be checked for any tissue that needs additional hypo work.

Insurance Treatment

Treat the brain: If tissue gas is present in the body, it will very likely travel to the brain. It's impossible to tell how much chemical has reached the brain and because of the difficult nature of these cases, distribution to the brain is often blocked. This is one reason why embalmers who preserve anatomical donation cases treat the brain in addition to the arterial injection.

To treat the brain, a 13 gauge needle can be used to access the cribiform plate. Insert the needle through the nostril and aim it toward the center of the eyes (fig. 1). The needle can be inserted with one other helpful angle and that would be on a plane dissecting the outer boundary of the eyebrow. I have found that 60 cc's of Basic Dryene injected in the brain is enough to be effective. I once injected this chemical into the brain of a drowning victim. This case not only had swollen eyes but it was purging a foamy substance from the eyes. Within 5 minutes of injecting the Basic Dryene the purge stopped and the tissue gas was deactivated.

Channeling with a needle will need to be done to remove gas from tissue. One would use a needle to fan out into tissue similar to the motion of a trocar. After this fanning motion, the embalmer can physically push the gas out of the entry point which becomes the exit for the gas. If the tissue remains reduced, you've eliminated the tissue gas. If the gas returns, the "bug" is still alive and well and will need further hypoing of Basic Dryene to stop its destructive ways. Basic Dryene is the chemical of choice because of the phenol and its fast killing action. This is the most powerful product of its type. At this point I don't care about the bleaching effect; I'm saving the body and the viewing. The embalmer has to declare war and do whatever is necessary to kill the bug and to make sure that the family can view the body. We can always cosmetize discolorations but we can't cosmetize away decomposition.

Plan B for entering the brain: there may be a case that has advanced arthritis and the normally soft cribiform has calcified making it very tough to enter. You can enter the brain by inserting a 19 gauge needle into the outside border of the eyeball and aim it on an angle behind the eye and in the center. You may be able to visualize a triangular form on the inferior surface of the eye with muscle tissue on the side holding the eyeball in place. This area will be where you'll find a foramen opening that allows the optic nerve and artery to pass.

(fig. 1)

• Accessing the brain through the cribiform to treat with Basic Dryene.

Tissue banks are now following safer testing processes to eliminate the potential of infection from the clostridium bacteria. The challenge is to find methods to sterilize the tissue that doesn't adversely affect the functioning of transplanted tissue.

Most tissue gas is discovered a day or two following the embalming - usually showing its presence through a swollen, distorted eye. The condition is accelerated by under-embalming and not recognizing the neutralizing effects of drugs on the chemicals we use to embalm.

The embalmer has to declare war and do whatever is necessary to kill the bug and to make sure that the family can view the body. We can always cosmetize discolorations but we can't cosmetize away decomposition.

This is the foramen or entrance that the gas uses to enter and swell the eye following an embalming that was done after underestimating the condition of a body. By briefly probing this area behind the eye, you'll find the foramen and pass the needle into the brain. Once you've entered the brain, you can attach a syringe to the luer lock and inject approximately 30cc's of Basic Dryene. This process would be repeated on the other side with an additional 30cc's being injected into the brain entering through the other foramen behind the eye. I have increased the amount of Basic Dryene to 60cc on difficult or advanced tissue gas cases. Suspect cases can be treated with 30 cc's total or 15 cc's per eye foramen.

OK – Is there anything else we can do? Is there anything that could give us some more insurance or prevent further problems on this tough case? Is there something that I haven't done that would allow me to get a better night's sleep? Embalmers - sleep is a good thing! Embalmers who have done their best and have done everything they can think of on a difficult case, can sleep. So - let's take another look.

The facial tissue seems firm and well-embalmed and we've treated the brain. What other precautions could we take to prevent mishaps? I like to use a 15 gauge 6" needle and inject Basic Dryene from the side of the neck to the front of the neck just above the clavicle. This same needle entry on the side of the neck and near its base can be used to inject toward the back of the neck. One entry can be used to inject a ring of chemical to half of the neck *(fig. 2)*. The other side of the neck can be

(fig. 2)

• Blocking off gas at neck with Basic Dryene

similarly treated using one point of injection to reach the lower front and back part of the neck. By injecting this area with Basic Dryene, we can create a barrier that won't allow the bug to crossover. Even though the face may seem to be well-embalmed, tissue gas has been known to travel into unexpected places. On severe cases, we can inject a wider and thicker barrier into deeper tissue of the neck.

Jack is Dodge's busiest embalming educator and lecturer. Along with working for Dodge as a sales representative in northern Illinois, he is an Embalming Lab Instructor at Worsham College.

Jack Adams, CFSP

Because the head is the most important body part we're dealing with, this barrier will insure the face won't be one of these unexpected gas routes and a clostridium nesting zone. That's major stuff!

Let's see, we've treated the brain and put a barrier around the neck to prevent any active bug access to the facial tissue from the trunk. One other important viewing part would be the hands. Here again, an active gas that wasn't totally neutralized could travel from the chest or shoulder and wind up in the hand that we thought to be embalmed. A new barrier is needed above the wrist. This can be done in a similar way to the neck injections by using two entry points, one on the superior and one on the inferior side of the forearm above the wrist *(fig. 3)*. A ring or barrier around the full arm is formed and I can tell you from experience that this works and it will protect any spread of tissue gas to the hands.

(fig. 3)

• Hand entry points to block off gas with Basic Dryene

Now you've injected the body specifically to battle the clostridium and your treatment of the brain will prevent any tissue gas from entering into the eyes through the foramen. The barriers or blockades around the neck and forearms will prevent any clostridium spreading to the hands or face.

For the cavity treatment, I'd use a strong chemical such as PermaCav 50. Reaspirating is always a good idea with gas cases. If gas is present during reaspiration or the tissue is spongy, Basic Dryene can be added to the cavity to insure the gas is deactivated within the cavities.

As I previously mentioned, any gas remaining in viewable tissue should be removed by channeling in a fan-like motion with a 15 or 13 gauge needle. The gas can be physically removed through the entry point by massaging it out. This is the same procedure used for removing excess fluid from tissue. Kalon Massage Cream should be applied to the skin and any wrinkles that may develop can be ironed out using a Tissue Reducer. It is best to do this process directly after the embalming to prevent fixated wrinkles the following day. Incisions can remain open and used for removing gas from tissue.

Following all tissue gas cases, instruments must be disinfected and sterilized in order to avoid contamination of other cases. I recommend DSD for this decontamination process. Other equipment such as tables or cots should also be disinfected.

No matter what happens from this point on, you'll be able to sleep because you've done your best to help the family say goodbye.