Abdominal Wall Reconstruction Using Biological Tissue Grafts

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In 1857, Theodore Bilroth, MD, a German-born Austrian surgeon, wrote, 

If we could artificially produce tissue of the density and toughness of fascia and tendon, the secret of the radical cure of the hernia repair would be discovered.1(p39)

For years, surgeons have used a plethora of synthetic meshes for abdominal repair procedures such as herniorrhaphy. Synthetic meshes might be composed of polypropylene, polyester, expanded polytetrafluoroethylene (ePTFE), or a composite that combines two different mesh materials together.

For complex, difficult, abdominal wall repair or reconstruction, however, synthetic meshes have limitations, such as increasing the risk of infection and limitation with the types of materials used. Ideally, prosthetics should

• have good handling characteristics (eg, be stiff versus pliable, be easy to manipulate and place, be easy to cut and shape for correct anatomical fit);
• be resistant to infection;
• be strong enough to prevent graft failure;
• be biocompatible (ie, able to integrate into the host without eliciting a foreign body response, which would encapsulate the implant);
• not limit postimplantation function (eg, the ability of the abdomen to react to tension such as lifting and coughing to prevent reherniation);
• not restrict future access to the abdominal cavity;
• not shrink or degrade over time;
• not transmit infectious disease;
• be easy to manufacture; and
• be cost-effective.2

In the last few years, several new options have become available for surgical repair of difficult-to-resolve abdominal wall defects. The ideal prosthetic has yet to be developed; however, biological mesh is an excellent option for abdominal wall repair. This article will educate perioperative nurses about available biological mesh products and why surgeons are looking to this technology as an option for challenging, complex abdominal wall repair.

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ABSTRACT

Synthetic mesh products have been used to repair abdominal wall defects (eg, hernias) for many years. Biological mesh products are now available as an option when synthetic mesh products are not appropriate. To correctly prepare biological tissue grafts for use in the OR, perioperative nurses must understand the types of grafts available. Biological tissue grafts may be harvested from human, porcine, bovine, or equine hosts and from skin, pericardium, or small intestine submucosa.

Key words: biological tissue grafts, biologics, abdominal wall defects, cross-link, decellularization, hernia, porcine dermis, porcine small intestine submucosa, fetal bovine dermis, human dermis. AORN J 90 (October 2009) 513-520. © AORN, Inc, 2009.
WHY USE BIOLOGICAL TISSUE GRAFTS?

Most perioperative nurses have participated in procedures to repair uncomplicated abdominal wall defects (e.g., inguinal hernias, ventral wall hernias). Many perioperative nurses also have participated in repeat herniorrhaphy procedures for recurrent hernias or more advanced abdominal wall reconstruction procedures using artificial mesh. Synthetic meshes may fail, however, and hernias may reoccur as a result of infection, fistula development, or mesh migration. Hernias also may reoccur if the patient has inherently poor tissue quality as a result of comorbidities and poor wound healing.

Human and porcine acellular dermal matrices, which were introduced in the mid 1990s,3 were initially used to surgically cover burn wounds. Now, biological tissue grafts have come to the forefront as an option for repairing abdominal wall defects. Recurrent hernias or loss of domain are just a couple of cases in which biological tissue grafts are a viable option. Loss of domain (i.e., when the entire abdominal wall has decreased and weakened) can be attributed to factors such as multiple abdominal surgeries or inability to close the abdomen in a timely manner because of abdominal compartment syndrome or infection.

WHAT ARE BIOLOGICAL TISSUE GRAFTS?

Biological tissue grafts are harvested from a variety of tissue. They may be harvested from human, porcine, or bovine dermis (Figure 1). They may be harvested from adult sources or in the case of bovine dermis, may be harvested from a fetus. Some biological tissue grafts come from body parts other than the skin, such as bovine or equine pericardium or porcine small intestine submucosa.

Numerous methods are used to process the biological tissue (i.e., remove all DNA, RNA, and extracellular material) to produce a collagen matrix. Collagen—the fibrous protein of tissue that provides support and gives cells structure—plays a key role in the third and fourth phases of wound healing. In phase three, the proliferative phase, fibroblasts lay down type I collagen during granulation.4 During phase four, new collagen forms, which increases wound tensile strength. Reorientation and organization of collagen and collagen synthesis and degradation create a collagen matrix.4 This collagen matrix allows for tissue ingrowth and revascularization of the patient’s own tissue with the goal of allowing a strong, durable repair leading to a “permanently” repaired defect.

Not all biological tissue grafts, however, are created equal. Therefore, many factors should be considered when selecting a biological tissue graft:

- What type of tissue was used to obtain the biological tissue graft?
- How was decellularization performed?
- Was a cross-linking agent added during processing?
- How was the product sterilized?

TISSUE TYPE. There are several sources from which biological tissue grafts are obtained. Several companies use human cadaveric tissue. Companies providing human cadaveric tissue are governed by the American Association of Tissue Banks (AATB). Human cadaveric tissue is not considered a medical device so a US Food and Drug Administration (FDA) 510(k) (i.e., premarket approval) is not required. Cadaveric tissue may come from multiple donors, and the collagen of each donor could vary in its type and degree of elasticity. If more than one piece of the product is needed to repair a defect, the potential for weakness and recurrence of the defect increases, particularly because as people age, collagen is not replaced as often as when they are younger.5 Elastin—a protein similar to...
collagen that is the main component of elastic fibers—decreases with age as well, which may lead to laxity of the implant.6

The disadvantages of using cadaveric tissue include potential for weakness and recurrence of the defect because of the loss of elastin. The advantage to using human tissue (ie, allografts) is that the transplanted tissue comes from a donor of the same species (ie, human); the recipient’s immune system, however, must be suppressed to prevent rejection because the graft is of a different genetic makeup. Porcine and bovine tissues are regulated by the FDA because they are classified as medical devices and, therefore, require a 510(k). Porcine dermis has an architecture very close to that of human tissue, consisting of 97% type I and type III collagen and 3% elastin. Bovine pericardium mimics the characteristics of autologous tissue, is easily accepted by the body, and resists infection. Small intestinal submucosa is a strong extracellular matrix containing collagen; proteoglycans (eg, heparin); glycosaminoglycans (eg, heparin and hyaluronan); glycoproteins (eg, fibronectin); and growth factors. Disadvantages of bovine pericardium and small intestinal submucosa are the limited availability of large size grafts.

DECELLULARIZATION. The decellularization process removes DNA, RNA, and other extracellular material, rendering the tissue acellular. This process varies (ie, physical, chemical, enzymatic) from company to company.

- Physical decellularization involves dissection, agitation, freeze-thawing, sonication, and pressure.
- Chemical decellularization requires the use of detergents, ionic solutions, and acid/base products.
- Gentle enzymatic processing involves a highly specific, very gentle method of dissecting out unwanted tissues and structures while maintaining the three-dimensional structure of the collagen.7

Physical and chemical decellularization processes must be performed carefully because they can destroy the tissue with harsh chemicals and agitation.

COLLAGEN CROSS-LINKING. Cross-linking of the biological material is another step used by some companies (Figure 2). A cross-link is “a covalent linkage [bond] between two polymers [chains] or between different regions of the same polymer.”8 By nature, collagen is cross-linked, which adds to its stability and durability. As people age, the rate of collagen production decreases so collagen is not replaced as frequently. Furthermore, cross-linked collagen becomes more susceptible to collagenase (ie, an enzyme that catalyzes/degrades collagen) and the cross-links become weaker. Thus, as people age, the abdominal wall may become compromised.9 Cross-linking helps a biological tissue graft withstand collagenase degradation, allowing the graft to integrate into the host.9

The types of cross-linking agents and the process of cross-linking play key roles for companies that choose to cross-link their product. Cross-linking has been used for years in biological tissue graft materials. In the past, aldehydes (eg, glutaraldehyde, formaldehyde) were used. Porcine heart valves were cross-linked with glutaraldehyde; however, there was evidence of toxicity and that the amount of the glutaraldehyde exceeded the amount needed, resulting in stenosis and the eventual need to replace the valve.10 Technology has improved...
the performance of these valves, and although companies continue to preserve them with glutaraldehyde, they use a decreased quantity.10

According to Milos Chvapil, MD, PhD, a connective tissue biologist who studied collagen extensively, the most important feature of collagen-derived products is controllable biodegradability (ie, a regulated chemical breakdown of materials).11 Dr Chvapil determined that di-isocyanates (ie, compounds that contain two isocyanate groups) are nontoxic, react with collagen, and become part of the natural cross-link.11 According to Liang et al,12 using the correct amount of agent in the cross-linking process is vital in helping a biological tissue graft withstand collagenase degradation and allowing the graft to integrate into the host. Liang et al12 determined that if a material is “under-cross-linked” it will degrade before ingrowth occurs. If it is “over-cross-linked” the collagen matrix will not allow for ingrowth to occur at all. Choosing the best cross-linking agent and using it in the correct quantities, therefore, helps provide durability and stability in the presence of challenging repairs.

**STERILIZATION.** Several methods are used to terminally sterilize biological tissue grafts. Gamma radiation, ethylene oxide, and hydrogen peroxide plasma are sterilization options. Some cadaveric products are not sterile but are aseptically packaged. The disadvantage of using these cadaveric tissues is that because they are not sterile, the company cannot guarantee the removal of pathogens, which may transmit disease to the recipient. Furthermore, these tissues are processed using antibiotics, which are listed in the product information, but the recipient may be allergic to the antibiotic.

**WHAT BIOLOGICAL TISSUE GRAFTS ARE AVAILABLE TO DATE?**

Many biological tissue grafts are available (Table 1) and choosing a biological tissue graft can be perplexing for a surgeon. Biological grafts differ from one another in regard to available sizes, price, and supporting clinical data. To date, there are no clinical trials comparing each biological tissue graft to the others or showing superiority of one product over the others. Surgeons evaluate available peer-reviewed clinical data and must have realistic expectations of what a product can and cannot do. After considering numerous factors, the surgeon, with the help of company sales representatives, selects a biological mesh that is best for the patient’s specific clinical status.

**HOW ARE BIOLOGICAL TISSUE GRAFTS PREPARED FOR USE IN THE OR?**

Each company has specific directions for preparing its implants. All the implants can be kept on the shelf with the exception of AlloDerm®, which must be refrigerated.6 PermacolTM, Veritas®, XenMatrixTM, and FlexHD™ come hydrated and ready-to-use.13-16 AlloDerm, StratticeTM, SurgiMendTM, CollaMendTM, AlloMax™, and Surgisis® all require rinsing and/or hydration of the implant to varying degrees.6,17-21

The circulating nurse develops a care plan for the patient undergoing abdominal wall reconstruction with a biological tissue graft (Table 2). After the circulating nurse opens the product onto the sterile field and the scrub person rinses and hydrates it according to the manufacturer’s instructions for use, the scrub person must ensure that the mesh remains in saline until it is implanted to prevent dessication (ie, deprivation of moisture by vaporization or evaporation). Dessication of an implant renders it unusable.

Some cadaveric implants have two distinct sides—a dermal side and a basement membrane. The dermal side of the graft must be placed next to more-vascular tissue to allow integration of the implant. The manufacturer’s instructions provide information for determining which side is which. The surgeon orients the graft to differentiate the dermal side from the basement membrane side. Most biological tissue graft companies recommend using a 0 to 2-0 permanent suture (eg, polypropylene) or a long-acting absorbable suture (eg, polydioxanone) on a medium taper needle with either an interrupted or continuous stitch. If the surgeon has difficulty suturing through thicker pieces of the implant, he or she should insert the needle through the pores of the implant or use a reverse-cutting needle, which allows easier suturing without the risk of cutting through the implant.

**WHAT MIGHT THE FUTURE HOLD?**

The ideal biological tissue graft has yet to be developed. The most economical and profcient biological tissue graft would be
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• plentiful and affordable;
• 100% biocompatible;
• resistant to infection;
• able to degrade and be replaced by host tissue, which increases host tissue strength;
• ready to use and have adequate shelf life; and
• capable of restoring normal wound healing in patients who develop hernias, and thereby strengthen the resulting tissue.

According to Bellows et al.,7 biological tissue grafts may take one of a number of forms in the future. For instance, customized biological tissue

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**TABLE 1**

Characteristics of Biological Materials for Ventral Hernia Repair

<table>
<thead>
<tr>
<th>Product name</th>
<th>Manufacturer/Regulated by</th>
<th>Tissue source</th>
<th>Decellularization method</th>
<th>Cross-linked</th>
<th>Rehydration required</th>
<th>Sterilization method</th>
<th>Refrigeration required</th>
</tr>
</thead>
<tbody>
<tr>
<td>AlloDerm</td>
<td>LifeCell/American Association of Tissue Banks (AATB)</td>
<td>Human dermis</td>
<td>Ionic (ie, sodium deoxycholate)</td>
<td>No</td>
<td>Yes 10 to 30 minutes</td>
<td>Not sterile</td>
<td>Yes 2-year shelf life</td>
</tr>
<tr>
<td>AlloMax</td>
<td>CR Bard Davol (Tutogen)/AATB</td>
<td>Human dermis</td>
<td>Organic and aqueous solvents</td>
<td>No</td>
<td>Yes 3 minutes</td>
<td>Gamma radiation</td>
<td>No unknown shelf life</td>
</tr>
<tr>
<td>CollaMend</td>
<td>CR Bard Davol/US Food and Drug Administration (FDA)</td>
<td>Porcine dermis</td>
<td>Sodium sulfide, sodium hypochlorite, hydrochloric acid, hydrogen peroxide</td>
<td>Yes† Unknown concentration</td>
<td>Yes 3 minutes</td>
<td>Ethylene oxide</td>
<td>No freeze dried with 3- to 5-year shelf life</td>
</tr>
<tr>
<td>FlexHD</td>
<td>Ethicon/AATB</td>
<td>Human dermis</td>
<td>Ionic</td>
<td>No</td>
<td>No</td>
<td>Not sterile, packaged in 70% alcohol</td>
<td>No unknown shelf life</td>
</tr>
<tr>
<td>Permacol</td>
<td>Covidien/FDA</td>
<td>Porcine dermis</td>
<td>Enzymatic</td>
<td>Yes† 60% concentration</td>
<td>No</td>
<td>Gamma radiation</td>
<td>No 3-year shelf life</td>
</tr>
<tr>
<td>Strattice</td>
<td>LifeCell/FDA</td>
<td>Porcine dermis</td>
<td>Ionic (ie, sodium deoxycholate)</td>
<td>No</td>
<td>Yes 3 minutes</td>
<td>Unknown</td>
<td>No unknown shelf life</td>
</tr>
<tr>
<td>SurgiMend</td>
<td>TEI/FDA</td>
<td>Fetal bovine dermis</td>
<td>Withheld as proprietary</td>
<td>No</td>
<td>Yes</td>
<td>Ethylene oxide</td>
<td>No</td>
</tr>
<tr>
<td>Surgisis Gold (Biodesign)</td>
<td>Cook/FDA</td>
<td>Porcine small intestine submucosa</td>
<td>Peraetic acid</td>
<td>No 4- or 8-layer laminated product</td>
<td>Yes 10 minutes</td>
<td>Ethylene oxide</td>
<td>No 18-month shelf life</td>
</tr>
<tr>
<td>Veritas</td>
<td>Synovis/FDA</td>
<td>Bovine pericardium</td>
<td>Sodium hydroxide, propylene oxide, ethanol</td>
<td>No</td>
<td>No</td>
<td>Unknown</td>
<td>No 3-year shelf life</td>
</tr>
<tr>
<td>XenMatrix</td>
<td>Cr Bard Davol/FDA</td>
<td>Porcine dermis</td>
<td>Withheld as proprietary</td>
<td>No</td>
<td>No</td>
<td>Unknown</td>
<td>No unknown shelf life</td>
</tr>
</tbody>
</table>

* 1-Ethyl-3-(3-dimethylaminopropyl)-carbodiimide (EDC)
† Hexamethylene diisocynate (HDI)

TABLE 2  
Nursing Care Plan for Patients Undergoing Surgical Repair of an Abdominal Wall Defect

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Nursing interventions</th>
<th>Interim outcome criteria</th>
<th>Outcome statement</th>
</tr>
</thead>
</table>
| Risk for infection | • Assesses susceptibility for infection.  
• Implements aseptic technique.  
• Classifies the surgical wound.  
• Performs skin preparations.  
• Monitors for signs and symptoms of infection.  
• Protects from cross-contamination.  
• Minimizes the length of the invasive procedure by planning care.  
• Initiates traffic control.  
• Administers prescribed prophylactic treatments.  
• Encourages deep breathing and coughing exercises.  
• Administers care to wound sites.  
• Administers care to invasive device sites.  
• Administers prescribed antibiotic therapy and immunizing agents as ordered.  
• Manages culture specimen collection.  
• Maintains continuous surveillance. | The patient has a clean, primarily closed surgical wound covered with dry, sterile dressing at discharge from the OR. | The patient is free from signs and symptoms of infection. |
| Hypothermia   | • Assesses risk for inadvertent hypothermia.  
• Implements thermoregulation measures by  
  • increasing room temperature as needed,  
  • selecting temperature-regulating devices based on identified patient need, and  
  • administering warmed fluids and solutions as needed.  
• Monitors body temperature.  
• Evaluates response to thermoregulation measures. | The patient’s temperature is greater than 36°C (96.8°F) at the time of discharge from the OR. | The patient is at or returning to normothermia at the conclusion of the immediate postoperative period. |
| Acute pain   | • Identifies cultural and value components related to pain.  
• Assesses pain control using a validated pain scale.  
• Implements pain guidelines.  
• Collaborates in initiating patient-controlled analgesia.  
• Implements alternative methods of pain control.  
• Provides pain management instruction.  
• Evaluates response to pain management interventions and instructions. | The patient and family members verbalize realistic expectations regarding discomfort after surgery. | The patient demonstrates and/or reports adequate pain control throughout the perioperative period. |

The patient participates in management of pain control before and immediately after surgery.  
The patient demonstrates knowledge of pain management.
Surgical Repair of a Complex Abdominal Wall Hernia

What is a hernia?
A hernia is a weakened area in your abdominal wall that may have occurred from excessive straining, heavy lifting, or from age. As the abdominal muscle weakens, the contents of your abdomen (eg, abdominal lining, intestines) may bulge out, forming a sac. The weakened area in the abdominal wall may occur at your umbilicus (belly button), through a previous surgical incision, or in any other area of the abdomen.

What is a complex abdominal wall hernia?
A complex abdominal wall hernia occurs when all or a large portion of the abdominal wall has weakened. This type of hernia may be caused by a previous hernia repair that

- was repaired with a piece of synthetic mesh that became infected or
- increased in size after the previous repair because of another area of weakness in the abdominal wall.

This type of hernia may require use of a biological tissue graft for the surgical repair.

What are the risks of a hernia?
If your intestines or other abdominal contents get trapped in the hernia sac, you may have severe abdominal pain or nausea or vomiting. This can be very serious. Hernias do not get better on their own.

What tests are used to diagnosis a hernia?
Your doctor will examine the area and may have you cough or strain to better see the bulge in your abdominal wall. Your doctor may order an ultrasound or a computed tomography (CT) scan to examine the hernia further.

What are my treatment options?
Surgery is necessary to repair the defect in your abdominal wall. You may have an open hernia repair during which your surgeon makes an incision and pushes the bulging tissues and organs back into your abdomen. The surgeon may use a piece of synthetic (man-made) mesh or biologic (human or animal) tissue to repair the defect.

What is the postoperative care for a complex abdominal wall hernia?
While you are recovering from surgery, you may feel tired or uncomfortable. Your nurse will work with you to evaluate and treat your pain. It is very important to breathe deeply to prevent pneumonia after surgery. Your nurse may give you a breathing device called an incentive spirometer to help you take deep breaths. Also, tell your nurse if you feel sick to your stomach or need to throw up. Your nurse can give you medications to ease the nausea.

What happens after I go home?
Your health care provider will teach you how to care for your incision and how to help decrease pain after surgery. You may go home with a drain in or near your incision. Your nurse will teach you how to care for the drain site before you leave the hospital. You may go home with negative pressure wound therapy (NPWT), which uses a vacuum to remove excessive fluids and decrease pressure around the wound. A nurse may come to your home to help you take care of the NPWT device and change the bandages. It is very important for you to eat a healthy diet and stay active. Your surgeon may tell you to wear an abdominal binder and not lift anything heavier than 10 pounds until you return to the surgeon’s office for a follow-up visit. Call your physician immediately if you experience any of the following postoperative complications:

- swelling or excessive bleeding from the surgical site;
- temperature greater than 101° F (38.3° C);
- excessive, unusual, or foul-smelling drainage;
- nausea or vomiting not relieved with medication; or
- pain that is not relieved with pain medications.

grafts that are individually tailored through stem cell implantation onto the biological matrix may become available. Alternatively, a genetic approach to resolving abdominal wall defects may become possible.

Editor’s notes: AlloDerm is a registered trademark and Strattice is a trademark of LifeCell, Branchburg, NJ. AlloMax, CollaMend, and XenMatrix are trademarks of CR Bard/Davol, Warwick, RI. FlexHD is a trademark of Ethicon, Somerville, NJ. Permacol is a trademark of Cogidien, Mansfield, MA. SurgiMend is a trademark of TEI, Boston, MA. Surgisis is a registered trademark of Cook, Bloomington, IN. Veritas is a registered trademark of Synovis, St Paul, MN.

Publication of this article does not imply AORN endorsement of specific products. Not all available biological tissue graft products are mentioned in this article.

REFERENCES

Patricia Brown, RN, BSN, was the western region clinical specialist for Permacol with Cogidien, Mansfield, MA, at the time this article was written. Ms Brown has declared that her employment at Cogidien could be perceived as a potential conflict of interest in publishing this article.
1. An ideal prosthetic for repair of an abdominal wall defect should
   1. be easy to manufacture and cost-effective.
   2. be resistant to infection and not transmit infectious disease.
   3. be strong enough to prevent graft failure.
   4. have good handling characteristics.
   5. not restrict future access to the abdominal cavity.
   a. 2 and 3
   b. 1, 4, and 5
   c. 2, 3, 4, and 5
   d. 1, 2, 3, and 4

2. A hernia repaired with a synthetic mesh may reoccur if
   1. a fistula develops.
   2. an infection develops.
   3. the mesh migrates.
   4. the synthetic mesh fails.
   a. 1 and 3
   b. 2 and 4
   c. 2, 3, and 4
   d. 1, 2, 3, and 4

3. Biological tissue grafts can be harvested from a variety of sources such as
   1. equine pericardium.
   2. fetal human dermis.
   3. bovine dermis.
   4. porcine small intestine submucosa.
   a. 1 and 3
   b. 2 and 4
   c. 1, 3, and 4
   d. 1, 2, 3, and 4

4. Collagen matrix helps to permanently repair an abdominal wall defect.
   a. true
   b. false

5. Methods of decellularization include
   1. chemical processing.
   2. electrophoresis.
   3. gentle enzymatic processing.
4. physical processing.
   a. 1 and 3
   b. 2 and 4
   c. 1, 3, and 4
   d. 1, 2, 3, and 4

6. Cross-linking is a process that
   a. involves dissecting out unwanted tissues and structures.
   b. is a required step for all companies that process biological tissue grafts.
   c. helps a biological tissue graft withstand collagenase degradation, allowing the graft to integrate into the host.
   d. removes DNA, RNA, and other extracellular material.

7. Controllable biodegradability, the most important feature of cross-linked collagen-derived products, is
   a. available in all biologics.
   b. a regulated chemical breakdown of materials.
   c. not determined by the amount of cross-linking agent used.

8. Methods used to terminally sterilize biological tissue grafts include
   1. ethylene oxide.
   2. hydrogen peroxide plasma.

9. After the circulating nurse opens the product onto the sterile field and the scrub person rinses and hydrates it, the scrub person must ensure that the mesh remains in saline until it is implanted to prevent
   a. emulsification.
   b. dessication.
   c. germination.
   d. crystallization.

10. The circulating nurse should be prepared to provide the surgeon with suture to secure the implant; most biological tissue graft companies recommend using a
    a. 1 to 0 long-acting absorbable suture on a large taper-cut needle.
    b. 0 to 2-0 permanent suture or long-acting absorbable suture on a medium taper needle.
    c. 2-0 to 3-0 absorbable suture on a small cutting needle.
    d. 3-0 to 4-0 permanent suture on a large taper needle.
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PURPOSE/GOAL
To educate perioperative nurses about using biological tissue grafts to reconstruct abdominal wall defects.

OBJECTIVES
To what extent were the following objectives of this continuing education program achieved?
1. Identify characteristics of an ideal prosthetic.
2. Explain why a hernia repaired with a synthetic mesh may reoccur.
3. List sources from which biological tissue grafts may be harvested.
4. Explain the role of collagen in regard to the use of biological tissue grafts.
5. Describe how biological tissue grafts are processed.
6. Discuss perioperative nursing care of the patient undergoing abdominal wall reconstruction with a biological tissue graft.

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10. did the objectives relate to the overall purpose/goal?

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12. were they easy to understand?
13. did they address important points?

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