Wayne State University
Department of Surgery

Hemostasis Skills Module

Hemostasis Skills Module

I. OBJECTIVES

Cognitive:

By the end of this laboratory session participants should…..

1) Understand the importance of maintaining tension on the suture while tying knots or performing suture ligation.

2) Understand the technical differences between free tie/freehand tie, stick tie/ suture ligation/transfixation suture, purse-string suture, drain suture and a figure of 8 suture ligation.

Technical:

By the end of this laboratory session participants should be able to…..

1) Perform a free tie or freehand ligature using your hands
2) Perform a free tie or freehand ligature using an instrument
3) Perform stick tie/suture ligation/transfixation suture ligation
4) Perform a figure of 8 suture ligation
5) Perform a purse-string suture closure
6) Perform two-layer closure of vein

II. ASSUMPTIONS OF PRE-TRAINING SURGICAL SKILLS AND KNOWLEDGE

1. The student should review each of the manuals, CD's and videos listed below in Section III which describe in detail each of the common suture ligature techniques necessary to complete this module.
2. The student should have completed the following surgical skills modules:
    a. Knot Tying
    b. Basic Surgical Instrumentation
    c. Suture & Needle Types
    d. Wound Closure I-Basic

III. PREPARATION

Read the following reviews and be prepared to discuss (required reading):

1. A comprehensive review of topical hemostatic agents – efficacy and recommendations for use: Hardean E. Achneck, Bantayehu Sileshi, Ryan M. Jamiolkowski, David M. Albala, Mark L. Shapiro, and Jeffrey H. Lawson. Annals of Surgery 2010;251(2):217-228.
2. Overview of electrosurgery . Jon Ivar Einarsson, Jon Gould. (www.uptodate.com)
3. Hemostats, sealants and adhesives: components of the surgical toolbox: William D. Spotnitz and Sandra Burks. Transfusion 2008;48:1502-1516.
4. Electrosurgery CE Module (www.valleylabeducation.org)

IV. ANATOMICAL CONSIDERATION

In this module it is expected for the student to understand which anatomic locations and structures dictate the type of suture ligation technique necessary to occlude the anatomic structure.

V. DESCRIPTION OF LABORATORY MODULE

Introduction and Overview

1. The faculty instructor will review the cognitive and technical objectives and provide the rationale for the module.
2. The faculty instructor will familiarize the students with instruments and tools used to perform this module.
3. The faculty instructor will demonstrate all of the technical skill tasks required of the students to complete this module.

Work Station

1. Students are placed around a table.
2. Students will be provided with appropriate practice media. Each student will have access to all instruments listed in Section VII.
3. Students are encouraged to have reviewed the references provided in Section III prior to the module training session.

Skill Tasks

1. Correct performance of free tie/freehand suture ligatures, stick tie/suture ligation/ transfixation suture ligation, , figure of 8 suture ligation, purse string suture placement and two-layer closure of vein.

Performance Evaluation

1. In this module training session the students skills will be evaluated using several different performance assessment tools
    a. Procedural Skills Task Checklist
    b. Time to Completion Assessment
    c. Global Rating Scale

VI. MODULE INSTRUCTION, NARRATIVE DESCRIPTION SKILL DESCRIPTION and TRAINING EXERCISES

Suture ligation is used when it is necessary to create hemostasis by occluding the lumen of a blood vessel or the lumen of a hollow structure to prevent leakage from that structure

Training Exercises

1. Free-hand Tie
    a. Hand
    b. Instrument

2. Stick Tie Suture Ligature / Transfixation Suture Ligature
    a. one point
    b. two point

3. Dissect out vessel from tissue pad. Divide and tie.

4. Tie off larger vessel in continuity.

5. Figure of 8 suture (use suture pads).

6. Purse string suture (use bowel).

7. Running/mattress vein closure (use Penrose drain)

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Free-hand Tie

This type of ligature is performed with a single strand of suture using either hands only or with a long clamp. The technique is used to ligate and occlude the two ends of a vessel, duct, or other structure after it has been cut or transected.

This type of ligature using <u>hands only</u> is performed in the following manner:

- A hemostatic clamp is placed on end of the target structure to occlude the structure. Make sure the clamp is placed so that the tip is facing upward.
- Once this is performed, direct the clamp downward (tip down) in a vertical position to allow for passage of the suture behind the clamp.
- The suture strand is now passed from one hand to the opposite hand behind the clamp.
- Once the suture is passed behind the clamp bring the tip of the clamp upward and horizontal to its original position (tip up).
- Using the index finger of the hand the suture was passed to the suture is brought under the tip of the clamp and the two suture strands are secured in one hand.
- Once the suture is around the clamp the tip should be rotated slightly away from the surgeon to provide a flat tying surface. Placing a free-hand tie using ones hands is usually performed if enough free space is available behind the clamp.
- Now the two suture strands are crossed and a half-hitch is performed. As the half-hitch is secured to the tissue the clamp is released slowly so the suture can tighten around the tissue appropriately and then the clamp is re-closed on the tissue.
- A second half-hitch is performed in the opposite direction to secure the first square knot. This is then followed by the appropriate number of square knots. Once all knots are completed the clamp is released from the tissue and the suture strands are then cut to an appropriate length (> 5mm).

This type of ligature using an <u>instrument</u> is performed in the following manner:

- A hemostatic clamp is placed on end of the target structure to occlude the structure. Make sure the clamp is placed so that the tip is facing upward.
- Once this is performed, the direct the clamp downward (tip down) in a vertical position to allow for passage of the suture behind the clamp.
- For this technique, one end of the suture strand is attached to a long passing clamp (clamp acts as extension of finger). The passing clamp is

then passed to the opposite hand (rings first) behind the occluded structure and the downward directed hemostatic clamp. At this point one hand is grasping the suture and the opposite hand is grasping the rings of the passing clamp.

- Once the suture/passing clamp are passed behind the hemostatic clamp bring the tip of the hemostatic clamp upward and horizontal to its original position (tip up).
- Bring the tip of the passing clamp underneath the tip of the hemostatic clamp (tip-to-tip), secure the two suture strands in one hand, and release the passing clamp from the suture.
- Once the suture is around the clamp the tip should be rotated slightly away from the surgeon to provide a flat tying surface.
- Now the two suture strands are crossed and a half-hitch is performed. As the half-hitch is secured to the tissue the hemostatic clamp is released slowly so the suture can tighten around the tissue appropriately and then the clamp is closed on the tissue.
- A second half-hitch is performed in the opposite direction to secure the first square knot. This is then followed by the appropriate number of square knots. Once all knots are completed the clamp is released from the tissue and the suture strands are then cut to an appropriate length (> 5mm).

It should be noted that when you are placing your two clamps around the tissue the tips should be facing inwards towards each other if at all possible.

The basic sequence of maneuvers for this technique is: **clamp-clamp-cut-tie-tie.**

Models
1. String (place between clamps on Gore Knot Tying Board)
2. Glove with thumb/fingers filled with fluid or air (knots have to be secured and air tight to prevent leakage of fluid or air from thumb/fingers
3. Tubing (place between clamps on Gore Knot Tying Board)
4. Wet kleenex (to simulate delicate tissue)
5. Thin foam strips (to simulate delicate tissue)
6. Modified foam suture pads with vessels

i. *Use red foam appendages within incisions*
ii. *Use fingertips of glove and pass through foam pads*
iii. *Use of small penrose drain (3mm-5mm) to simulate small vein*

Stick Tie Suture Ligature or Transfixation Suture Ligature.
A. One Point
B Two point
This suture ligature is performed using a suture and needle. This type of suture ligation is used on deep structures where the placement of an occluding hemostat

is often difficult or when the vessel, duct or structure to be occluded is of large diameter and cannot be occluded with a simple free-hand tie (hand or instrument). These types of suture ligatures are also preferable in those instances when there is no margin for the error and failure to properly occlude a structure would result in catastrophic bleeding or leakage.
The proper method to perform this technique is as follows:

- Following placement of a hemostatic clamp on the tissue (tip up as much as possible) a suture is placed through a part of the target tissue to anchor the suture.
- Following this a single half-hitch is thrown to secure the suture to the tissue.
- The hemostatic clamp is tipped downward and the free end (non-needle end) of the suture is brought behind and around the tissue.
- The hemostatic clamp is repositioned horizontally with its tip facing upward. The two suture strands are then secured with one hand.
- The suture strands are crossed and second half-hitch in thrown in the opposite to form a square knot.
- At this point the appropriate number of additional square knots can be placed to complete the task, or a second pass of the needle/suture through the tissue may be performed (Two point suture ligature) followed by additional square knots being placed.
- This second pass of the needle is done for further anchoring and securing of the suture to the tissue. One-point suture ligatures are used on smaller vessels or tissue structures while two-point suture ligatures are used on larger vessels or when large amounts of tissue are present.

Models
1. suture pads
2. tubing/foam(tubing should sit vertically)

Figure-of-Eight Hemostatic Stitch
This type of suture stitch is used to occlude bleeding vessels that have retracted into muscle or other soft tissue structures. These stitches are sometimes thrown blindly and it is important to avoid going to deep with the needle placement in order to avoid including (and injuring) any other underlying structures encompassed by the stitch placement.

Models

1. *Modified foam suture pads with 'vessels'*
    i. *Use red foam appendages buried within the incisions*
    ii. *Use fingertips of glove and pass through foam pads*
    iii. *Use of small penrose drain (3mm-5mm) to simulate small vein*

Ligation in continuity

This involves ligating a vessel without applying clamps.

- First step is exposure of the vessel to allow for placement of a right angle clamp beneath the vessel to allow for suture ties to be passed under the posterior wall of the vessel at different points along the vessel.
- Two suture ties are then passed between the jaws of the right angle clamp and the vessel is encircled at two areas.
- The sutures are secured to the vessel, occluding the lumen with the appropriate number of properly performed square knots.
- The vessel is then cut or transected between the two suture ties making sure not to cut too close to the suture tie. The suture strands are then cut to an appropriate length (>5mm) to reduce the risk of the tie slipping off of the vessel).

The basic sequence of maneuvers for this technique is: **pass-pass-tie-tie-cut.**

Models

1. Modified foam suture pads with vessels

iv. Use red foam appendages within incisions

v. Use fingertips of glove and pass through foam pads

vi. Use of small penrose drain (3mm-5mm) to simulate small vein

vii. Use multiple clamps (Mosquito, Beckman, Kelley, Crile)

Purse String Suture Stitch

This type of suture stitch is defined by continuous sutures placed around a lumen which are then tightened like a drawstring to produce inversion of the opening. An example of the use of this type of suture stitch would be when performing an appendectomy where the sutures are placed around the stump of the appendix; in the bowel where they are placed to secure the positioning of a stapling device, or in an organ prior to placement of a tube. Another instance occurs in the right atrium where it is critical to hold and secure the cannulation tube during coronary artery bypass.

Models

1. *Use foam suture pad (use a small black mark to create target for stitch)*
2. *Use piece of bowel (create small hole[3mm-5mm] to simulate appendiceal opening)*

2-layer Repair Closure of a Vein

This type of suture closure is used to occlude traumatic and/injured vein branches or to repair larger vein injuries without occluding the vein.

- A vascular clamp (Satinsky vascular clamp) is often used to partially occlude a damaged vein. This allows for repair while maintaining flow in the vessel beneath the partially occluding vascular clamp.
- Once the clamp is in place the 2-layer closure repair is started. The first layer stitch placed is a running horizontal mattress stitch with the suture placed immediately above the jaws of the partially occluding clamp.
- One the horizontal mattress reaches the opposite side of the clamp a second layer stitch is performed using a running continuous stitch.
- The running continuous stitch is placed just above the horizontal mattress stitch layer and is ran back in the opposite direction towards the starting point of the horizontal mattress stitch. Once this cve
- When the running continuous stitch reaches the other suture strand the partially occluding vascular clamp is then released and the two suture strands are tied and secured with appropriate number of square knots.

Model

1. *Use a larger penrose drain 8mm-10mm (simulates common femoral vein).*
2. *Use 5-0/6-0 prolene or CV-5/CV-6 PTFE double needle suture.*

Securing sutures stitches for drains

This type of suture stitch is used to secure drainage tubes either to the wall of organs being drained, peritoneum and fascia or skin. Drainage tubes are placed in hollow organs, bladder, and chest cavity or into the peritoneal cavity. These tubes need to be secure to allow for adequate drainage and optimal function of the organ or area being drained.

- Sutures may be placed around the circumference of the drain at 12, 3, 6, and 9 o'clock positions or a simple u-stitch is placed and secured directly to the drain and the skin.
- A simple U-stitch suture may be placed around the drain tube and secured directly to the drain and the skin
- Another technique is where a simple suture stitch is placed immediately adjacent to the drainage tube and several square knots are tied down to the skin. The two suture strands are then wrapped twice around the tube in opposite directions and tightly secured to the tube.
- Regardless of what type of suture technique is used to secure the drain, once the drain is removed the suture strands are tied together to close the skin at the drain site.
- Typically when a drainage tube is being anchored to the skin non-absorbable sutures should be used.

Model

1. *Foam suture pad and drain tubing (tubing should be vertical through the foam pad)*
2. *Pork bellies or thick foam pads with rubber drain tubing (tubing should be vertical through the foam pad)*

VII. Common Suture Ligation and Incision Creation and Closure Errors

1. Suture ligation. The major error that occurs with this type of knot is when students and residents ask the first assistant to release the occluding clamp before they complete first square knot and secure the tissue pedicle. This error often results in a misplaced knot and a knot which is loose, non-occluding and more often than not slips off of the tissue pedicle at the slightest movement. Another relatively common error that occurs is when students and residents place excessive pulling tension on the suture while they are attempting to tie square knots and ligate the tissue pedicle. This excessive pulling of the suture by the student or resident tying the knots can result in the suture becoming displaced and may result in inadequate occlusive ligation of the pedicle or complete loss of the suture ligature around the tissue pedicle. It is important to perform the "three-point technique" of tying knots when ligating blood vessels or other structures which may leak fluid. In this technique it is important for the surgeon's hands to line up in a straight line with the vessel or structure being ligated. Failure to do so may result in excess traction against the vessel. In tying deep bleeding or leaking points, this traction tears the vessel or structure at the point of ligature and exacerbates bleeding and leaking.

VIII. EQUIPMENT REQUIREMENTS and MATERIALS NEEDED

Gloves
Foam pad
Plastic or rubber drain tubes
Suture skin pad
Pork bellies
3mm-4mm penrose drain (small)
5mm polyester vascular graft (W.L. Gore)
Double Layer Simulated Bowel: 20mm OD or 30mm OD x 200mm
#15 scalpel blades
#3 knife handle
5" or 7" needle drivers
3-0/4-0 braided silk suture
3-0/4-0 monofilament Ethilon, Prolene, PDS sutures and ties
5-0/6-0 Prolene sutures
Toothed forceps (Rat tooth)

Adson forceps with teeth
Debakey forceps
Tissue forceps without teeth
Mosquito clamp
Kelley hemostat clamp
Beckman clamp
Right angle clamp
Suture scissors