MIS: Thoracic Surgery

A Continuing Nursing Education Activity

Sponsored By

Pfiedler Enterprises

Sponsored By

Ethicon Endo-Surgery

PART OF THE Johnson & Johnson FAMILY OF COMPANIES

Welcome to

MIS: Thoracic Surgery

(A Continuing Education Self-Study Activity)

CONTINUING EDUCATION INSTRUCTIONS

This educational activity is intended for use as a stand alone self-study activity. We suggest you take the following steps for successful completion:

1. Read the overview and objectives to ensure consistency with your own learning needs and objectives.
2. Review the content of the self-study activity, paying particular attention to those areas that reflect the objectives.
3. Complete the Test Questions and compare your responses with the answers provided.
4. For additional information on an issue or topic, consult the references.
5. To receive credit for this activity complete the evaluation and registration form.
6. A certificate of completion will be available for you to print at the conclusion. Pfiedler Enterprises will maintain a record of your continuing education credits and provide verification, if necessary, for 7 years.

If you have any questions, please call: 720-748-6144.

CONTACT INFORMATION:

Pfiedler Enterprises

2101 S. Blackhawk Street, Suite 220
Aurora, CO 80014-1475
Phone: 720-748-6144
Fax: 720-748-6196
Website: www.pfiedlerenterprises.com

MIS: Thoracic Surgery

(A Continuing Education Self-Study Activity)

OVERVIEW

Historically, surgical intervention has been performed through traditional, open incisions; with the advent of minimally invasive surgery (MIS), procedures across almost all surgical specialties are now being performed through much smaller incisions. Today, this is increasingly the case with thoracic surgery as MIS is fast becoming the norm for many of types of thoracic procedures that were typically performed via large incisions. The recent growth in the use of minimally invasive techniques is due to major improvements in optics for video thorascopes, better instrumentation, and improved anesthesia. Correspondingly, the number of thoracic MIS procedures continues to rise, as this technique offers distinct benefits for the patient over traditional, open thoracotomy. Therefore, it is imperative that the perioperative nurse remains aware of the ever-expanding application of MIS techniques in thoracic surgery in order to maximize benefits for the patient and optimize outcomes. This study guide will provide an overview of current trends in minimally invasive thoracic surgery, beginning with a review of its historical evolution. The indications and contraindications for thoracic MIS procedures will be reviewed. Various video-assisted thoracoscopic surgery (VATS) procedures performed today will be described. The patient benefits associated with minimally invasive thoracic surgery will be presented. Finally, perioperative nursing considerations for patients undergoing thoracic MIS procedures will be discussed.

OBJECTIVES

After completing this continuing nursing education activity, the participant should be able to:

1. Explain the evolution of thoracic MIS techniques.
2. Identify the indications and contraindications for thoracic MIS.
3. Describe the various thoracic MIS procedures available today.
4. Discuss the patient benefits associated with thoracic MIS.
5. Discuss perioperative nursing considerations for patients undergoing thoracic MIS procedures.

INTENDED AUDIENCE

This continuing education activity is intended for use by perioperative registered nurses and surgical technologists who are interested in learning more about thoracic MIS, the associated clinical benefits, and perioperative nursing considerations

CREDIT/CREDIT INFORMATION

State Board Approval for Nurses

Pfiedler Enterprises is a provider approved by the California Board of Registered Nursing, Provider Number CEP14944, for **2.0 contact hour(s)**.

Obtaining full credit for this offering depends upon attendance, regardless of circumstances, from beginning to end. Licensees must provide their license numbers for record keeping purposes.

The certificate of course completion issued at the conclusion of this course must be retained in the participant's records for at least four (4) years as proof of attendance.

AST Credit for Surgical Technologists

This continuing education activity is approved by the Association of Surgical Technologists, Inc. for (**2.0**) CE credits for continuing education in surgical technology.

IACET Credit for Allied Health Professionals

Pfiedler Enterprises has been approved as an Authorized Provider by the International Association for Continuing Education and Training (IACET), 1760 Old Meadow Road, Suite 500, McLean, VA 22102.

CEU STATEMENT

As an IACET Authorized Provider, Pfiedler Enterprises offers CEUs for its programs that qualify under IACET guidelines. Pfiedler Enterprises is authorized by IACET to offer **0.2 CEU (2.0 contact hours)** for this program.

RELEASE AND EXPIRATION DATE

This continuing education activity was planned and provided in accordance with accreditation criteria. This material was originally produced in June 2011 and can no longer be used after June 2013 without being updated; therefore, this continuing education activity expires in June 2013.

DISCLAIMER

Accredited status as a provider refers only to continuing nursing education activities and does not imply endorsement of any products.

SUPPORT

Grant funds for the development of this activity were provided by **Ethicon Endo-Surgery**

PLANNING COMMITTEE

Rose Moss, RN, MN, CNOR — **Larkspur, CO**
Nurse Consultant

Elizabeth Deroian, RN, BA — **Aurora, CO**
Program Manager
Pfiedler Enterprises

Judith Pfister, RN, BSN, MBA — **Aurora, CO**
Program Manager
Pfiedler Enterprises

EXPERT REVIEWERS

Anthony Adams, CST — **Aurora, CO**
Certified Surgical Technologist
University of Colorado Hospital

Julia A. Kneedler, RN, MS, EdD — **Aurora, CO**
Director of Education
Pfiedler Enterprises

DISCLOSURE INFORMATION

All planning committee members, expert reviewers, and authors participating in continuing education activities sponsored by Pfiedler Enterprises are expected to disclose to the audience any real or apparent financial affiliations related to the content of their activities. Detailed disclosure appears below and also will be made verbally prior to those activities with live presentations.

Planning committee members, expert reviewers, authors and faculty information:

1. Have you (or your spouse/partner) had any personal financial relationship in the last 12 months with the manufacturer of the products or services that will be presented in this continuing education activity (planner/reviewer) or in your presentation (speaker/author)?
2. Type of affiliation/financial interest with name of corporate organization.
3. Will your presentation include discussion of any off-label or investigational drug or medical device?

Rose Moss, RN, MN, CNOR

1. No
2. None
3. No

Elizabeth Deroian, RN, BA

1. Yes
2. Employed by company that receives grant funds from **Ethicon Endo-Surgery, Inc.**
3. No

Judith Pfister, RN, BSN, MBA

1. Yes
2. Employed by company that receives grant funds from **Ethicon Endo-Surgery, Inc.**
3. No

Anthony Adams, CST

1. No
2. None
3. No

Julia A. Kneedler, RN, MS, EdD

1. Yes
2. Employed by company that receives grant funds from **Ethicon Endo-Surgery, Inc.**
3. No

PRIVACY AND CONFIDENTIALITY POLICY

Pfiedler Enterprises is committed to protecting your privacy and following industry best practices and regulations regarding continuing education. The information we collect is never shared with other organizations for commercial purposes. Our privacy and confidentiality policy covers the site www.pfiedlerenterprises.com and is effective on March 27, 2008.

To directly access more information on our Privacy and Confidentiality Policy, type the following URL address into your browse: http://www.pfiedlerenterprises.com/Privacypolicy.pdf or View the Privacy and Confidentiality Policy using the following link: http://www.pfiedlerenterprises.com/onlinecourses.htm

In addition to this privacy statement, this Website is compliant with the guidelines for internet-based continuing education programs.

The privacy policy of this website is strictly enforced.

CONTACT INFORMATION

If site users have any questions or suggestions regarding our privacy policy, please contact us at:

Phone:	720-748-6144
Email:	tonia@pfiedlerenterprises.com
Postal Address:	2101 S. Blackhawk Street, Suite 220 Aurora, Colorado 80014
Website URL:	http://www.pfiedlerenterprises.com

INTRODUCTION

The use of endoscopic techniques is perhaps the fastest evolving technology in the surgical practice arena, across all surgical specialties; this movement in performing more procedures via minimally invasive techniques is driven by:[1]

- The technological advancements in endoscopic tools to view the operative field;
- The development of less painful procedures;
- Faster surgical recovery times; and
- A decreased length of hospital stay, and consequently, a potential reduction in health-care costs.

Thoracic surgery is one specialty area in which advancements in MIS techniques offer exciting new treatment options for many patients. Minimally invasive thoracic surgery is fast becoming the norm for many types of thoracic procedures at many leading institutions; it has been reported that major medical centers and tertiary hospitals already are undertaking between 40% and 80% of thoracic cases using minimally invasive techniques.[2] Recent growth in the use of minimally invasive techniques, however, is due to major improvements in optics for video thorascopes, better instrumentation, and improved anesthetic techniques. In addition, advances in imaging technology, particularly spiral computed tomography (CT) scans that allow physicians to precisely identify lung nodules, has proven to be a major factor contributing to the increased growth. Correspondingly, the number of thoracic MIS procedures has risen annually over the years, as many surgeons performing them are not only more comfortable with the surgical technique, but also are convinced that these MIS procedures do not compromise patient outcomes.

EVOLUTION OF MINIMALLY INVASIVE THORACIC SURGERY

Despite physicians' desire to visualize the interior of the body organs, the development of endoscopy and minimally invasive surgery was relatively slow. Although they were primitive, the first use of reflective light for inspection of the vagina and uterine cervix is credited to an Arabian physician, Abul Kasim (936-1013).[3] After this initial breakthrough, instrumentation was subsequently developed to examine nasal sinuses and urinary bladders. During this initial era of endoscopy, the primary concern was thermal tissue damage caused by the intense heat emitted by the light sources that were used. As a result, incandescent lighting was eventually incorporated into the tips of certain endoscopes (e.g., cystoscopes and ureteroscopes) that could be cooled by continuous irrigation. Further modifications allowed examination of the nasal sinuses, larynx, bronchus, and sigmoid colon; however, procedures were restricted to endoscope placement in external body orifices. With each generation of surgeons, surgical techniques and devices were continually advanced and refined.

The first endoscopic device used for medical practice to illuminate body cavities was developed in Germany by Philipp Bozzini in 1806.[4] This instrument, considered to be the forerunner of the modern endoscope, consisted of a candle attached to a thin cannula that permitted illumination of body orifices or viscera. Bozzini called this device the Lichtleiter, which means light conductor. It had no magnification or optics and was inserted into the rectum, urethra, or vagina, while the physician looked through the device. At the time, other physicians did not readily accept the device because the visibility was poor and placing the device into orifices was painful for the patient. During the 1800s, however, there were several advances that improved the efficacy of endoscopy. In 1853 a French surgeon, Antonin Jean Desormeaux (1815-1894), was the first to introduce the use of a lens to focus a direct light source, by which a clearer image, as compared to Bozzini's device, was obtained. This enabled the endoscope to be used to visualize structures or remove foreign bodies. Bevan performed the first esophagoscopy procedure in 1868. In 1870, Kussmaul undertook the first esophagogastroscopy in a patient who was a professional sword swallower. The next major advance in the evolution of endoscopy was the introduction of the cystoscope, which had both an illumination source and a working channel. The cytoscope was developed by Maximilian Nitze, a urologist from Berlin, who worked with Beneche, an optician from Berlin, and Leiter, an instrument manufacturer from Vienna; This device consisted of a working channel, a light source, and an optical lens through which light was reflected. However, the entire concept of internal illumination for endoscopy was revolutionized by Thomas Edison's invention of the incandescent light bulb. By 1887, the cystoscope was improved by adding miniature light bulbs at the distal end, thereby improving visualization. This instrument became the basis of modern endoscopy.

The first thoracoscopic procedure was performed in the 1880s.[5] An Italian medical scientist, Carlo Forlanini, published a paper in which he contemplated the feasibility and efficiency of collapsing the lung in order to treat tuberculosis by introducing air into the pleural space and using a scopic aid. He later pioneered this treatment modality for tuberculosis in 1894 by inducing artificial pneumothorax. In 1910, Hans Christian Jacobaeus, a Swedish physician, first introduced the technique of thoracoscopy using a modified cystoscope after learning intracavitary techniques.[6] Jacobaeus was a professor of internal medicine working in a tuberculosis sanitarium in Sweden. Using a local anesthetic and the instrumentation developed by Nitze, Jacobaeus performed the thoracoscopic lysis of pleural adhesions and drainage as an adjunct to collapse therapy. In 1921 Jacobaeus reported an extensive experience with thoracoscopy in the diagnosis of pulmonary and pleural tumors. Jacobaeus is considered to be the father of thoracoscopic surgery because he was the first to describe and perform the procedure of endoscopic exploration of the thorax.

Thoracoscopic procedures were widely performed in Europe during the 1920s; in 1928, a color atlas of thoracoscopically diagnosed intrathoracic lesions was published.[7] During the 1950s, the administration of antibiotic therapy for tuberculosis largely replaced the use of thoracoscopy in the treatment of this disease. Over the next 20 years, thoracoscopy evolved into a diagnostic procedure for the management of pleural effusions, as well as primary and metastatic pleural tumors. Despite its use in Europe however, thoracoscopy was not widely used in the United States until the 1970s, when acceptance of the procedure followed several technical developments. The introduction of fiberoptics and flexible operating scopes attracted interest in the field, and Miller, Hatcher; and Newhouse are credited with reporting the initial experiences, noting that thoracoscopy was a valuable tool in the diagnosis of thoracic disease; with it, unnecessary thoracotomy could often be avoided.[8,9] The flexibility and maneuverability of these new devices led to a dramatic rise in their applications in the fields of gastrointestinal and pulmonary medicine, otolaryngology, urology, and orthopedic, general, and thoracic surgery. The development of endoscopic video cameras and improvement in surgical instrumentation further broadened applications of thoracoscopy. The use of the video camera frees the surgeon's hands, allows assistants to view the procedure, and facilitates maintenance of a sterile field. As a result of these technological advancements, the use of video-assisted thoracoscopic surgery (VATS) has greatly increased. While fewer than 20 years ago, thoracoscopic surgeries were limited to a few diagnostic and therapeutic procedures (e.g., biopsies, management of pneumothorax, treatment of empyema, sympathetic chain ablation, and removal of thoracic foreign bodies), today VATS is widely used in many thoracic surgical procedures.

The newest advancement in the field of thoracic surgery is the use of robots to perform advanced intrathoracic maneuvers thoracoscopically.[10] Recently, the application of robotic surgical technology systems was shown to be technically feasible and safe for resection of selected mediastinal masses. This technology makes it feasible to access remote and difficult-to-reach areas in the thorax, as in thymectomy procedures. Bonatti et al. reported that the use of robotic thoracic surgery has proven safe for heart surgery programs in which a left internal thoracic artery takedown and total endoscopic coronary artery bypass grafting was performed successfully on fifty patients.[11] Researchers speculate that in the near future, most kinds of endoscopic surgeries will be performed with robotic technology, and this will replace traditional surgery not only in the treatment of benign diseases but in malignant diseases as well.

The use of MIS techniques for thoracic procedures is expected to grow. Table 1 outlines the volume projections for VATS procedures for 2005 through 2014.[12] Approximately 26,000 thoracoscopies were performed in the United States in 2005; the number of these procedures is expected to increase over the forecast period at a compound annual rate of 5.6% to reach an estimated 43,000 procedures in the year 2014. As noted, the expected increase in lung procedures utilizing MIS techniques is due to improved instrumentation and the broader acceptance of thoracoscopy by chest surgeons.

Table 1 – VATS Procedure Volumes Forecast: 2005 through 2014

Year	Thoracoscopy	Annual Change
2005	26,000	----
2006	27,000	3.9%
2007	28,100	4.1%
2008	29,300	4.3%
2009	30,700	4.8%
2010	32,500	5.9%
2011	34,500	6.2%
2012	36,800	6.7%
2013	38,500	7.3%
2014	43,000	8.9%
Compound Annual Growth Rate (CAGR)	5.6%	----

INDICATIONS AND CONTRAINDICATIONS FOR THORACIC MIS[13]

Today, thoracic MIS is effective as both a diagnostic and therapeutic tool for a variety of thoracic diseases, including complex problems. General indications and contraindications are outlined below; additional indications and contraindications identified for specific thoracic MIS procedures are as follows.

Indications

Diagnostic indications for thoracic MIS include:

- Undiagnosed pleural effusion;
- Indeterminate pulmonary nodule;
- Undiagnosed interstitial lung disease;
- Pulmonary infection in an immunosuppressed patient;
- To define the cell type in known thoracic malignancy;
- To define the extent of a primary thoracic tumor;
- Nodal staging of a primary thoracic tumor;
- Diagnosis of intrathoracic pathology to stage a primary extrathoracic tumor; and
- Evaluation of intrapleural infection.

Therapeutic indications for minimally invasive thoracic procedures include:

- Lung:
    - Spontaneous pnuemothorax.
    - Bullous disease.
    - Lung volume reduction.
    - Persistent parenchymal air leak.
    - Benign pulmonary nodule.
    - Resection of a primary lung tumor (in highly selected cases).
    - Resection of pulmonary metastasis (in highly selected cases).

- Mediastinum:
    - Drainage of pericardial effusion.
    - Excision of bronchogenic or pericardial cyst.
    - Resection of selected primary mediastinal tumors.
    - Esophageal myotomy.
    - Facilitation of transhiatal esophagectomy.
    - Resection of primary esophageal tumors.
    - Thymic resection.
    - Ligation of thoracic duct.

- Pleura:
    - Drainage of an early empyema.
    - Drainage of a multiloculated effusion.
    - Pleurodesis.

Contraindications
Minimally invasive thoracic surgery is contraindicated in the following situations:

- Extensive intrapleural adhesions;
- The inability to sustain single-lung ventilation;
- Extensive involvement of hilar structures;
- Preoperative induction of chemotherapy or chemoradiation; and
- Severe coagulopathy.

MIS THORACIC PROCEDURES AVAILABLE TODAY

As both the numbers and types of thoracic MIS thoracic procedures continue to evolve, the procedures available today are briefly described below.[14]

- Wedge resection – excision of a wedge of the lung that contains the malignant tissues along with a margin of the surrounding healthy tissue. MIS wedge resections are performed for non-small cell lung cancer or pulmonary metastasis; for small (less than 3 cm) peripheral masses; and for patients who are not appropriate candidates for lobectomy (e.g., those with pulmonary hypertension and severe medical illnesses). It is contraindicated in patients with prior ipsilateral thoracic surgery or radiation and in pregnant patients.

- Lobectomy – removal of an entire lobe of a cancerous lung. Most lobectomies can be performed by VATS. A lobectomy performed by VATS should be a standard, anatomic resection, just as the procedure performed through a thoracotomy. The indications for VATS lobectomy include Stage 1 lung cancer; a tumor less than 6 cm in diameter; and benign disease (e.g., bronchiectasis). Relative contraindications include a tumor 5-8 cm in diameter; preoperative irradiation or chemotherapy; sleeve resections; and chest wall invasions. Contraindications are tumors greater than 8 cm in diameter; mediastinal invasion; and surgeon discomfort.

- Pneumonectomy – removal of an entire lung in order to treat cancer. A pneumonectomy can be performed by VATS, and the specimen usually fits through the same size of incision that is used for a VATS-type lobectomy, depending on the size and location of the lesion. In general, a large central tumor is not appropriate for VATS due to involvement of the mediastinal structures. The surgeon must ensure that the tumor is not amenable to a sleeve resection, which may be difficult to determine by the VATS approach. Therefore, rarely is pneumonectomy best handled by VATS.

- Sleeve lobectomy – a lung resection in which a section of bronchus or trachea is removed along with diseased lung tissue after which the proximal and distal ends are anastomosed. Surgeons with excellent video skills can perform a standard sleeve lobectomy by VATS.

- Segmentectomy – removal of a segment of a lobe of the lung that contains malignant tissues. Segmentectomy is an option for small, anatomically well-situated lung cancer. The creation of a segmental fissure and dissecting out the segmental vessels can be done using a thoracoscopic technique.

- Mediastinal and esophageal procedures:
    - Mediastinoscopy. This procedure is an important procedure for staging lung cancer. Video-assisted mediastinoscopy has greatly improved the quality and safety of the procedure. Node dissection can be performed with the standard video mediastinoscope.

- Mediastinal lymph node dissection (right- and left-sided). This is a critical part of any lung cancer procedure. Lymph node dissection should be performed for all types of cancer resections (e.g., wedge, segmentectomy, lobectomy, pneumonectomy) to ensure proper staging and for possible therapeutic benefit. No additional incisions are made for mediastinal lymph node dissection; the procedure uses the existing incisions for the video-assisted lobectomy, which usually precedes node dissection.
- Esophageal mobilization. Mobilization of the esophagus by VATS provides the advantage of a complete cancer operation performed by minimally invasive technique. Although most VATS procedures are performed with the patient in the lateral decubitus position, the prone position offers several advantages for surgery on structures in the posterior mediastinum. For example, in the prone position, lung retraction is not needed because gravity causes the lung to fall out of the way.
- Thymectomy. Using the VATS approach for this procedure is an excellent technique for patients with myasthenia gravis and small (less than 4 cm) thymomas that do not appear to invade other structures.

• Lung volume reduction surgery (LVRS) – a procedure in which nonfunctional lung tissue in emphysema patients is removed, thereby allowing more room in the thoracic cavity for good, relatively healthy tissue, thus improving lung function. In comparison with medical management, LVRS can improve quality of life, pulmonary function, exercise tolerance, and survival for selected patients. Although LVRS can be performed by VATS or a median sternotomy with the same morbidity, mortality, and benefits, the VATS approach costs less and provides faster recovery. Patients who are candidates for LVRS are symptomatic despite maximal medical management including oxygen supplementation, inhalers, and pulmonary rehabilitation. Patients with severe emphysema are deconditioned; rehabilitation reconditions the leg muscles and decreases dyspnea. Patients who are better conditioned are better prepared to cooperate with their postoperative care regimen, such as immediate ambulation and use of incentive spirometer, to reduce respiratory complications. Patients who do not cooperate well or fail at rehabilitation are poor candidates for LVRS. The most important patient selection factor is a heterogeneous pattern of emphysema identified on CT and lung perfusion scanning.

• Resection of pulmonary blebs and bullae. One of the earliest and most widespread uses for VATS was in the treatment of patients with spontaneous blebs. Bleb resection by VATS has become a standard procedure; however, this method for pleurodesis remains controversial. Studies of treatment of spontaneous pneumothorax have not shown that one method of pleurodesis is more successful than another. Video-assisted resection of bullae is part of LVRS for the treatment of end-stage emphysema.

• Thoracic sympathectomy. Thoracic sympathectomy has been used for the treatment of sympathetic dysfunction since it was first described in the 1940s; with the advent of VATS, the procedure has become more widely applied. VATS provides excellent visual acuity and the potential for doing the procedure more quickly and with fewer complications. Thoracic sympathectomy is indicated for various sympathetic disorders, but it is most commonly performed for hyperhidrosis. Less common indications include reflex sympathetic dystrophy, upper extremity ischemia, Raynaud's disease, debilitating facial blushing, and splanchnicectomy for pancreatic pain.

- First rib resection for thoracic outlet syndrome (TOS). TOS refers to compression of the subclavian vessels or the brachia plexus, or both by the first rib and adjacent structures at the superior aperture of the chest; therefore, treatment of TOS requires resection of the first rib. The most common symptoms are neurologic and are related to compression of the brachial plexus in the distribution of the ulnar nerve. While there are several approaches for TOS, the VATS approach has several advantages. For example, the shoulder does not need to be lifted or held for an extended period of time; the exposure is good; and the cutaneous nerves in the axilla are not disturbed.

- MIS for atrial fibrillation. Due to the technological advances in MIS instrumentation and the increase in surgeons' experience with VATS approaches, surgical ablation for atrial fibrillation can now be successfully performed using minimally invasive techniques.

- Thoracoscopic approach to spinal deformities. The conventional approaches to the spine have been posterolateral, costotransverse, and anterior; to reach the anterior spine, anterior thoracotomy has traditionally been used. There are several problems associated with thoracotomy, such as the long incision, rib resection, significant rib spreading, tissue desiccation, alteration of pulmonary and shoulder girdle function, pain, associated morbidity, and poor cosmesis. The VATS approach presents the spinal surgeon with a minimally invasive option for approaching the anterior vertebral column. The goals of VATS in spine surgery are the same as for thoracotomy in reducing the surgical morbidity associated with open procedures. In addition, the VATS approach has led to many exciting new techniques for the treatment of disc space. Surgical instruments guided through an endoscope are able to gain access to the chest through 15- to 20-mm ports rather than through an 8- to 10-inch long incision required for thoracotomy.

- Diaphragmatic plication. Plication of a paralyzed diaphragm can relieve dyspnea and substantially improve pulmonary function. The procedure is considered to be underused and may be performed by VATS techniques. The diaphragm absorbs the pleural fluid created daily in the pleural space; when the diaphragm is plicated well, there is much less absorptive surface. Postoperatively, the patient may drain a remarkably large amount of fluid through the chest tube.

PATIENT BENEFITS OF THORACIC MIS: A REVIEW OF THE LITERATURE

As with other minimally invasive techniques, VATS offers patients a number of important clinical benefits when compared to open surgical procedures, such as:[15,16]

- VATS is associated with a significantly lower risk (70%) of overall postoperative complications.
- VATS requires only a number of small incisions and causes less physical injury to the patient's body while allowing the surgeon to perform a highly effective procedure.
- Compared with open surgery, which typically requires four to six weeks of recovery time, VATS patients often can return to work and resume other activities as soon as one week after surgery.[17]
- VATS may significantly reduce postoperative pain and need for additional treatment. Research has demonstrated that postoperative pain measured after more than one year was reduced by 61%with VATS versus open surgery. In addition, VATS procedures may significantly reduce the total dosage, duration, and administration of analgesia.
- Delivery of planned adjuvant chemotherapy may be more feasible after VATS compared to open surgery.

Recent research studies have examined the clinical outcomes and patient benefits associated with thoracic MIS techniques; several of these studies are summarized below.

Leshnower et al. performed a retrospective review of 41 patients who underwent pulmonary segmentectomy either through thoracotomy (open group; 26 patients) or by a thoracoscopic approach (VATS group; 15 patients).[18] Both groups were well-matched for age, gender, and preoperative risk factors. Segmentectomy was performed for primary lung cancer in 25 (61%) patients. There was no significant difference in tumor size, number of lymph node stations sampled, or number of lymph nodes removed based upon approach. There was no significant difference in the operative time, but patients undergoing a VATS segmentectomy had significantly reduced chest tube durations and hospital stays. Major complications occurred in 19% of patients in the open group and none in the VATS group. There were two operative deaths (4.8%), both of which occurred in the open group. The authors concluded that VATS segmentectomy is a safe procedure that has fewer complications and a reduced hospital stay when compared with an open segmentectomy. This approach may be the ideal oncologic procedure for patients with small lung cancers (i.e., less than 2 cm) and/or limited cardiopulmonary reserve and significant comorbidities.

Ghosh-Dastidar et al., noting that operating in a day surgery unit has potential benefits including lower risk of cancellation, reduced infection rates, cost effectiveness and increased patient satisfaction, described their experience in routinely performing thoracic surgery in a dedicated day surgery unit in the United Kingdom through prospective data collection over a 27-month period.[19] Following surgery, patients were observed in a recovery area for one hour before transfer back to a short-stay ward. Chest drains, when used, were attached to an ambulatory drainage device designed to be taken home. Ninety-eight patients underwent thoracic surgery in the day surgery unit; sixty (61.2%) patients were male, with a mean age of 53 (17-83) years. Twenty-nine (29.6%) were mediastinal procedures (i.e., the MED group) such as mediastinoscopy/mediastinotomy; 31 (31.6%) were video-assisted thoracoscopic surgery procedures (i.e., the VATS group) such as lung biopsies and pleurodeses; and 38 (38.8%) were a variety of other procedures (i.e., the OTHER group) such as chest wall interventions and sternal wire removal. All patients were assessed postoperatively and were discharged home within four to six hours, if appropriate. No deaths were reported in this review. Out of the group, three (3.1%) patients required admission directly from the day surgery unit and three (3.1%) were admitted late after discharge with problems relating to their surgery. The authors noted that their day surgery program accounted for 12.0% of the total thoracic workload during the time period; they concluded that, as surgeons continually try to fast track increasingly complex procedures, with good patient selection, thoracic surgery can be performed safely and effectively in a day surgery unit.

As noted above, thoracoscopic approaches are being used in the treatment of spine deformities. Chong et al. described their outcomes for adolescent idiopathic scoliosis (AIS) patients treated with VATS plus supplementary minimal incision in the lumbar region for thoracic and lumbar deformity correction and fusion.[20] They reported a case series of a total of thirteen AIS patients requiring fusions of both the thoracic and lumbar regions. Fusion was performed using VATS up to T12 or L1 vertebral level. Lower levels were accessed via a small mini-incision in the lumbar area to gain access to the lumbar spine via the retroperitoneal space. All patients had a minimum followup of one year. In this study, the average number of fused vertebrae was 7.1 levels. The results demonstrated that a significant correction in the angle was obtained at final followup; the instrumented segmental angle in the sagittal plane was relatively well-maintained following surgery, although there was a slight increase. Scoliosis Research Society scores were noted as significantly improved at the final followup. The investigators concluded that the indications for the use of VATS may be extended from patients with localized thoracic scoliosis to those with thoracolumbar scoliosis. Further, by combining the advantages of an anterior approach (short segment fixation) with the VATS technique (cosmetically acceptable scar) and sparing a full diaphragm incision, a satisfactory and significant corrective surgical outcome may be achieved with minimal postoperative scarring.

Flores et al. conducted a comparative analysis of thoracotomy and VATS for lobectomy in the treatment of lung cancer.[21] In this study, all patients who underwent lobectomy for clinical Stage 1A lung cancer were identified from a prospective database in order to evaluate patient characteristics, survival, and complications. From May 2002 to August 2007, 398 patients underwent an attempted VATS lobectomy and 343 underwent thoracotomy. There was one postoperative death in each group. Survival was no different for VATS versus thoracotomy, whereas age, larger tumor size, and higher nodal stage were associated with worse survival. Statistical analysis demonstrated fewer complications for VATS lobectomy, whereas age and tumor size correlated with a greater number of complications. Patients undergoing VATS lobectomy demonstrated a two-day shorter length of stay than patients undergoing thoracotomy. Based on these findings, the authors concluded that VATS lobectomy and thoracotomy demonstrated similar five-year survivals; however, VATS lobectomy was associated with fewer complications and shorter length of hospital stay.

Cattaneo et al. conducted a study to determine if the utilization of video-assisted thoracic surgery (the VATS group) for lobectomy for clinical Stage I non-small cell lung cancer in elderly patients results in fewer complications as compared with lobectomy by thoracotomy (the THOR group).[22] They performed a retrospective, matched case-control study evaluating the perioperative outcomes after lobectomy by VATS versus THOR performed in elderly patients (age 70 years or greater) at a single institution. All complications were graded according to the National Cancer Institute Common Terminology Criteria for Adverse Events. Between May 1, 2002 and December 31, 2005, 333 elderly patients (245 in the THOR group, 88 in the VATS group) underwent lobectomy for clinical Stage I non-small cell lung cancer. After matching based on age, gender, presence of comorbid conditions, and preoperative clinical stage, there were 82 patients in each group; all patients had similar preoperative characteristics. A VATS approach resulted in a significantly lower rate of complications compared with THOR (28% versus 45%,) and a shorter median length of stay (5 days, range of 2 to 20 versus 6 days, range of 2 to 27). No patients undergoing VATS lobectomy had higher than grade 2 complications, whereas 7% of complications in the THOR group were grade 3 or higher. There were no perioperative deaths in the VATS patients, compared with an in-hospital mortality rate of 3.6% (3 of 82 patients) for the THOR patients. The investigators concluded that a VATS approach to lobectomy for clinical Stage I non-small cell lung cancer in the elderly was associated with fewer and overall reduced severity of complications as well as a shorter hospital stay compared with thoracotomy.

Shaw et al. reviewed data on 180 VATS patients who underwent thoracoscopic lobectomy or sublobar anatomic resection at their institution between January 2002 and December 2006.[23] The conversion rate to thoracotomy, complications, length of stay, and duration of chest tube drainage were determined. Similar variables were evaluated for patients older than 80 years of age; those with a forced expiratory volume in one second (FEV1) that was less than 50% predicted; those who had undergone preoperative neoadjuvant therapy; and those who had undergone lung-sparing anatomic resections. Thoracoscopic anatomic lung resection was performed successfully in 166 patients. One of 180 patients (0.6%) died, and 14 patients (9.2%) underwent conversions. The overall median length of stay was four days (range, 1 to 98); the median duration of chest tube drainage was three days (range, 0 to 35 days). The median length of hospital stay and median chest tube duration for the group aged 80 years and older was 5 and 3 days; for the segmental resection group, 4 and 3 days; for the chemotherapy or radiotherapy induction group, 3.5 and 3 days; and for the FEV1 less than 50% group, 5.5 and 4 days, respectively. No patients died in any of these groups. The authors concluded that thoracoscopic lung resection can be performed safely in selected patients aged 80 years and older, in those with marginal pulmonary function, and in those with pathologic response to neoadjuvant therapy.

Butterworth et al. performed a retrospective review of children treated for spontaneous pneumothorax (SP) to determine if, with the advent of VATS, the indications for and surgical treatment of SP in their facility would change.[24] Patients with persistent or recurrent air leaks underwent either limited axillary thoracotomy (LAT) or VATS. The authors evaluated the following outcomes: preoperative SP episodes, thoracostomy tube (TT) days (i.e., patient days with TT in situ, prior to surgery), length of hospital stay (LOS), narcotic use, and freedom from recurrence. Among 31 patients with 19 ipsilateral or contralateral recurrences (61%), 11 were managed nonoperatively. Twenty-six surgeries (13 LAT, 13 VATS) were performed in 20 patients, with 9 undergoing bilateral procedures (3 LAT, 6 VATS). VATS patients were treated earlier, had a diminished narcotic requirement postoperatively, and had a shorter LOS with an equivalent recurrence rate, compared with LAT patients. The absence of contralateral blebs did not predict freedom from SP on the contralateral side in patients undergoing surgery for ipsilateral SP. The investigators concluded that, compared with LAT, VATS causes less pain, has a shorter LOS and encourages earlier surgical treatment (including prophylactic, contralateral treatment) of SP in children.

Atkins et al. conducted a review of prospectively collected data for 77 consecutive segmentectomy patients to compare thoracoscopic segmentectomy (TS) with open segmentectomy (OS).[25] Preoperative, intraoperative, and postoperative variables for patients undergoing TS (48 patients) were compared with those undergoing OS (29 patients). Baseline demographics were similar between the two groups. Indications for pulmonary resection included non-small cell lung cancer (39 patients), metastatic disease (30 patients), and other diagnoses (8 patients). All common segmentectomies were represented in this review. The results demonstrated that no thoracoscopic cases required conversion to open procedures. Operative times, estimated blood loss, and chest tube duration were similar between groups. Outcomes were similar except that hospital length of stay was significantly lower among TS patients (length of stay 6.8 ± 6 days OS versus 4.3 ± 3 days TS). Thirty-day mortality was 6.9% (2 of 29 patients) for the OS group compared with 0% for the TS group. Long-term survival rates were significantly better in the TS group. These authors concluded that thoracoscopic segmentectomy is a safe and feasible procedure, comparing favorably with OS by reducing hospital length of stay. For experienced thoracoscopic surgeons, TS appears to be a sound option for lung-sparing, anatomic pulmonary resections.

PERIOPERATIVE NURSING CONSIDERATIONS IN THORACIC MIS[26]

The patient scheduled for minimally invasive thoracic surgery presents unique challenges for the perioperative nursing staff. If the procedure is being performed electively, the patient usually has a fairly routine perioperative experience. Perioperative nursing considerations are outlined below.

Preadmission Testing

Ideally, the patient scheduled for thoracic MIS is initiated into the health-care system through a preadmission testing program to ensure that he or she is adequately prepared for the procedure. At the time of preadmission testing, the nurse obtains the patient's medical and surgical history and performs a physical examination. The assessment data will assist the nurse in identifying possible postoperative risks, such as the risk for infection or hemorrhage. In addition, the preadmission nurse should instruct and encourage the patient undergoing either a diagnostic or therapeutic thoracic MIS procedure to stop smoking; research has demonstrated that patients who stop smoking several weeks prior to surgery have fewer postoperative complications.[27] The preadmission nurse also instructs the patient on preoperative NPO status (i.e., advises the patient not to eat anything for six hours or drink anything for one-and-one half hours before the procedure).

Preoperative Holding Area

The preoperative nurse admits the patient to the preoperative holding area for surgery and compiles the medical records; the record is then checked for completeness by members of the perioperative team, including current history and physical examination, all laboratory and preoperative testing results, and surgical informed consent; the surgical procedure, patient's NPO status, allergies, and current medications also are verified and confirmed at this time. After placing an IV and starting IV fluids, the nurse administers preoperative antibiotics according to protocol or physician orders. The nurse prepares the surgical site according to surgeon preference, removing hair only if needed for access to the operative site. Upon completion of any other orders from the surgeon or anesthesia care provider, the nurse then instructs the patient on what to expect in the postoperative period and also demonstrates the proper use of incentive spirometer with coughing and deep breathing for postoperative respiratory therapy. The patient also is seen by the anesthesia care provider and surgeon in the holding area.

The circulating nurse also meets the patient in the holding area; after introducing himself/herself to the patient, the nurse identifies the patient verbally and via the wrist identification band. The circulating nurse also reviews the patient's medical record for existing medical conditions that could impact the perioperative period; history and physical examination; laboratory values; allergies; required preoperative antibiotics; signed consent for surgery; and overall completeness of the record. The circulating nurse also assesses the patient for his/her understanding of the procedure, allergies, NPO status, the presence of any implanted devices, and any limitations in movement or skin integrity. The nurse then educates the patient on the intraoperative period and what to expect after being transported to the OR and develops a plan of care (see Table 2 for a sample care plan).

Table 2 – Sample Nursing Care Plan for Patients Undergoing Thoracic MIS Procedures

Nursing Diagnosis	Nursing Interventions	Interim Outcome Measurement	Outcome Statement
Risk of anxiety related to deficient knowledge and stress due to surgery.	• Identifies communication barriers and knowledge level (e.g., expected outcomes, surgical risks, and complications). • Assesses readiness to learn and coping mechanisms. • Explains sequence of events and reinforces teaching about the medical condition or injury and the procedure. • Provides instruction (i.e., oral or written) for the surgical procedure and discharge, including postoperative side effects and activity level. • Evaluates response to instruction.	• The patient verbalizes understanding of the procedure, sequence of events, expected outcomes, and concerns about treatment decisions being discussed. • The patient participates in decision-making.	The patient demonstrates knowledge of the physiological and psychological responses to the surgical procedure.
Risk for injury related to positioning.	• Identifies physical alterations that may affect procedure-specific positioning. • Places the patient in an anatomically correct, lateral decubitus position. • Implements protective measures to prevent tissue injury from thermal, chemical, or mechanical sources. • Uses supplies and equipment with safe parameters. • Evaluates for signs and symptoms of skin and tissue injury.	• The patient's skin remains intact, nonreddened, and free from ecchymosis. • The patient maintains circulation, sensation, and function related to surgical positioning.	The patient is free from signs and symptoms of injury related to positioning.
Risk of infection due to the surgical procedure.	• Assesses skin integrity, sensory impairments, and susceptibility for infection. • Classifies surgical wound (e.g., Class I). • Validates that preoperative antibiotic was administered according to facility policy. • Allows sufficient time for surgical prep solution to dry before the patient is draped. • Minimizes the length of invasive procedure by planning care and obtaining necessary equipment expeditiously. • Monitors the sterile field and perioperative team members to ensure that asepsis is maintained. • Initiates and maintains traffic control. • Dresses wound upon completion of the procedures.	The patient demonstrates dry, nonreddended, nontender wound healing by primary intention.	The patient is free from signs and symptoms of healthcare –associated infection for 30 days after the perioperative procedure.
Risk for unplanned perioperative hypothermia related to the perioperative environment and exposed body surfaces.	• Assesses patient's risk for developing unplanned perioperative hypothermia. • Monitors body temperature throughout the perioperative period. • Implements appropriate thermoregulation measures by placing upper and lower temperature-regulating blankets and using warmed IV and irrigation solutions, when possible. • Evaluates response to thermoregulation measures.	The patient's core body temperature remains within the expected range throughout the perioperative experience.	The patient is at or returning to normothermia at the conclusion of the immediate postoperative period.

Intraoperative Period

As the patient is being prepared in the preoperative holding area, the circulating nurse and scrub person prepare the operating room. The OR setup includes two back tables: one table contains the instruments and supplies needed for the MIS procedure; the other table contains an open thoracotomy setup ready and on stand-by, in case it is necessary to convert the procedure to an open thoracotomy. The scrub person and circulating nurse gather the equipment and open and set up the sterile field. Instrumentation and equipment for thoracic MIS procedures include:[28]

- Video equipment,
- Endoscopes and thoracoports,
- Staplers,
- Thoracic instruments (e.g., lung clamps and retractors) modified for endoscopic use, and
- Various energy modalities for tissue cauterization, including lasers.

All equipment and supplies must be set up and tested to confirm proper functioning; with the intensive amount of technology required for all MIS procedures, this can be a challenging task. Therefore, a new MIS Safety Checklist (a joint effort between the Association of periOperative Registered Nurses [AORN] and the Society of American Gastrointestinal and Endoscopic Surgeons [SAGES]) is being pilot tested at select hospitals across the United States (see Figure 1).[29] This checklist may offer a new tool that can assist the perioperative team in standardizing preoperative preparation in order to provide the best care possible for the patient.

Figure 1 – MIS Safety Checklist

MIS Safety Checklist

1. Pre-Patient Entry

A. Circulating Nurse Duties

Parameter	Actions
Surgeon Preference Card	☐ Reviewed
OR Table Position	☐ Correct orientation and weight capacity
	☐ Bean bag mattress (if indicated)
	☐ Table accessories (eg spreader bars/leg supports/foot board as indicated)
	☐ Positioned for fluoroscopy if indicated
Power sources	☐ Connected and linked to all devices
CO2 insufflator	☐ Check CO2 volume, pressure and flow
	☐ Backup cylinder and accessories (wrench and key) in place Filter for CO2 unit or tubing
Video monitors	☐ Position per procedure
	☐ Test pattern present
Suction/irrigation	☐ Cannister set
	☐ Irrigation and pressure bag available
Alarms	☐ Turned on and audible
Video documentation	☐ Recording media available and operational (DVD, print, etc.)

B. Scrub Person Duties

Parameter	Actions
Reusable instruments	☐ Check movement handles and jaws, all screws present
	☐ Check sealing caps
	☐ Instrument vents closed
	☐ Check cautery insulation
Veress needle	☐ Check plunger/spring action
	☐ Flush needle and stopcock Saline solution available
Hasson cannula	☐ Check valves, plunger, and seals
Trocars/Ports	☐ Check appropriate size/type
	☐ Close stopcocks
Laparoscope	☐ Size and type per preference
	☐ Check lens clarity
	☐ Anti-fog solution or warmed saline for lens cleaning

2. After Patient Entry

Parameter	Actions
Patient position	☐ Secured to OR table, safety strap on
	☐ Pressure sites padded
	☐ Arms out or tucked per procedure
Sequential compression device	☐ On and connected to device
Electrosurgical unit	☐ Ground pad applied
Foot controls	☐ Positioned for surgeon access
Power sources (camera, insufflator, light source, monitors, cautery, ultrasonics, bipolar)	☐ Turned on (on standby)
Miscellaneous	☐ Foley catheter (if indicated)
	☐ Naso- or orogastric tube (bougies if indicated)
Antibiotics	☐ Given as indicated

3. After Prep and Drape

Parameter	Actions
Electrosurgical unit	☐ Cautery cords connected to unit
Monopolar cautery	☐ Tip protected
Ultrasonic or bipolar device	☐ Connected to unit ☐ Activation test performed
Line connections	☐ Camera cord
	☐ Light source (on standby)
	☐ CO2 tubing (connected and flushed)
	☐ Suction/irrigation (suction turned on)
	☐ Smoke evacuation filter connected
Local anesthetic	☐ Syringe labeled and filled with anesthetic of choice needle connected
Fluoroscopy case	☐ Mix and dilute contrast appropriately and label
	☐ Clear tubing, syringe, catheter of air bubbles, label syringes

SAGES

This checklist has been developed by SAGES and AORN to aid operating room personnel in the preparation of equipment and other duties unique to laparoscopic surgery cases. It should not supplant the surgical time out or other hospital-specific patient safety protocols.

AORN

After the scrub person has set up the sterile back tables, the scrub person and circulating nurse perform the count. When all surgical team members are in the OR, the circulating nurse initiates the surgical time out.

Induction of Anesthesia. The anesthesia care provider and circulating nurse transport the patient to the OR and assist him or her onto the OR bed in the supine position. The anesthesia care provider, with the assistance of the circulating nurse, attaches the blood pressure monitoring cuff, oxygen saturation monitor, and ECG leads. The circulating nurse remains with the patient throughout induction of anesthesia offering assistance to the anesthesia care provider as needed. The circulating nurse then inserts a urinary catheter.

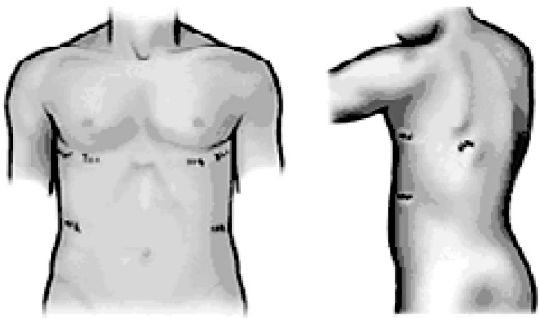
Anesthetic management is similar to that for conventional thoracotomy in terms of using general anesthesia. Double-lumen endotracheal tubes are a safe and helpful tool to allow for separate ventilation of each lung, which provides an excellent view of the internal thoracic cavity as well as an exceptional working field for performing procedures on the pleura, lungs, and mediastinum. This technique does, however, increase the risk of prolonging the procedure time. On the other hand, the use of a single-lumen endotracheal tube in VATS management of patients also has been successful with recurrent pleural effusions and decreased the surgical procedure time.

Positioning and Prepping the Patient. Minimally invasive thoracoscopic surgery requires that the patient be placed in the lateral decubitus position to allow for surgical maneuvering. The surgeon, circulating nurse, and anesthesia care provider work together to turn the patient from the supine position for induction of anesthesia to the lateral decubitus position. The circulating nurse provides the anesthesia care provider with a gel donut for the patient's head; he/she also places two pillows between the patient's legs, ensuring that the lower leg is bent at a 45° angle and the upper leg is straight, and then places padding under pressure points of the lower leg (e.g., the knee, ankle, foot). When the patient is secured in an anatomically correct position, the circulating nurse inflates the bean bag and ensures that the safety strap is secured over the patient's thighs. The circulating nurse then positions and secures the patient's upper arm on a padded, elevated arm board; he/she places an axillary roll under the lower axilla to prevent compression of the brachial plexus. The anesthesia care provider frequently monitors the pulse in the patient's lower arm to monitor for brachial plexus compression. The circulating nurse also applies the electrosurgical unit dispersive pad to the lateral aspect of the patient's upper thigh. The anesthesia care provider and circulating nurse place upper and lower body temperature-regulating blankets on the patient, while ensuring complete access to the operative site.

The circulating nurse preps the patient's skin with an antimicrobial topical skin cleanser from axilla to hip to prepare for the possibility of conversion from a minimally invasive procedure to an open thoracotomy. The scrub person and surgeon then drape the patient.

The Surgical Procedure. The surgeon makes a small incision just large enough for the thoracoscope and then makes two additional incisions similar in size through which the surgeon or first assistant inserts other instruments. This approach allows for triangulation of the instruments, with the camera usually inserted in the central port; the other two port sites are used for biopsy and retraction functions (see Figure 2). In general, the surgeon can perform an exploratory thoracoscopy, as well as a biopsy, with just these three incisions. The surgeon can also place drains or chest tubes into these incisions upon completion of the procedure.

Figure 2 – Thoracic MIS Incisions



Thoracoscopic Incision

Thoracoscopic Incision (side view)

Postoperative Period

Once the procedure is completed, the anesthesia care provider and circulating nurse transport the patient to the postanesthesia care unit (PACU) for observation and recovery. The PACU nurse observes the patient for physiological stability by monitoring and documenting vital signs and the patient's pain level. The PACU nurse frequently auscultates lung sounds; if reduced or diminished breathing sounds, which may indicate a pneumothorax, are noted, he or she notifies the physician. The PACU nurse also assesses the incision site and chest drains for bleeding or oozing. The physician is notified immediately if the patient complains of light-headedness, extreme pain, or difficulty breathing, which may indicate hemothorax or internal bleeding. If no complications arise, the PACU nurse discharges the patient from the PACU to the postoperative surgical unit.

The nurses caring for the patient on the surgical unit monitor for fever developing in the second or third day after the procedure, which may be indicative of infection. In addition, they monitor the incision site for redness, pain, tenderness, or pus discharge, which also may indicate infection. While it is normal for the patient's sputum to be faintly blood-tinged for one to two days postoperatively, heavy or persistent blood in the patient's sputum requires assessment by the surgeon. The surgeon usually removes the sutures seven to fourteen days after the procedure.

SUMMARY

Endoscopic and thoracoscopic surgery has a long, fascinating history. In the last few decades, several technological advances have greatly facilitated the use of endoscopy in the treatment of thoracic and, more recently, spinal lesions. The use of VATS has greatly increased; this growth is expected to continue at a compound annual rate of 5.6% to reach an estimated 43,000 procedures by the year 2014. This expected increase in various procedures utilizing MIS techniques is due to improved instrumentation and the broader acceptance of thoracoscopy by chest surgeons. Today, thoracic MIS is effective as both a diagnostic and therapeutic tool for a variety of diseases and complex problems. As with other minimally invasive techniques, VATS offers patients a number of important clinical benefits when compared to open surgical procedures, such as a significantly lower risk of overall postoperative complications; shorter recovery times; a reduction in postoperative pain, thus decreasing the total dosage, duration and total administration of analgesia; and facilitation of the delivery of planned adjuvant chemotherapy. The perioperative nurse must be aware of the use of VATS as both a diagnostic and therapeutic modality, along with the special patient care considerations. Through this knowledge, the perioperative nurse can assist in the evolution of minimally invasive thoracic surgery as a safe and effective option for patients with a variety of intrathoracic conditions.

GLOSSARY

Bulla	A large blister or vesicle of pathological origin; a thin-walled, sharply-demarcated area of lung destruction.
Bullous Lung Disease	A condition in which there are multiple large bullae associated with a compromise in pulmonary function. It is usually associated with concomitant emphysema, but can be hereditary.
Empyema	The presence of pus in the pleural cavity.
Hemothorax	The effusion of blood into the pleural cavity.
Hyperhidrosis	Excessive or profuse sweating.
Lobectomy	Removal of an entire lobe of a cancerous lung (the left lung has two lobes; the right lung has three).
Lung Volume Reduction Surgery (LVRS)	A procedure whereby nonfunctional lung tissue in emphysema patients is removed, allowing more room in the thoracic cavity for relatively healthy tissue, thereby improving lung function.
Mediastinum	The mass of tissues and organs separating the two pleural sacs, between the sternum in front and the vertebral column behind, containing the heart and its large vessels, trachea, esophagus, thymus, lymph nodes, and other structures and tissues; it is divided into superior and inferior regions, the latter subdivided into anterior, middle, and posterior parts.
Pleural Effusion	The collection of excess fluid in the pleural space.
Pneumonectomy	Removal of an entire lung in order to treat cancer.
Pneumothorax	The collection of air or gas in the chest or pleural space that causes part or all of a lung to collapse.
Segmentectomy	Removal of a segment that contains malignant tissues from a lobe of the lung.
Sleeve Resection	A lung resection in which a section of bronchus or trachea is removed along with diseased lung tissue after which the proximal and distal ends are anastomosed.
Splanchnicectomy	Resection of the splanchnic nerves and usually of the celiac ganglion as well.

Thoracic Outlet Syndrome (TOS)	A collective name for a number of conditions attributed to compression of subclavian vessels or the brachial plexus, or both.
Thymectomy	Removal of the thymus gland.
Wedge Resection	Excision of a wedge of the lung that contains malignant tissues, along with a margin of the surrounding healthy tissue.

REFERENCES/SUGGESTED READINGS

1. Khraim FM. The wider scope of video-assisted thoracoscopic surgery. *AORN Journal.* 2007;85(6):1199-1208.
2. Minimally invasive thoracic surgery taking off. *Healthcare Strategic Management*. Available at: http://goliath.ecnext.com/coms2/gi_0199-500303/Minimally-invasive-thoracic-surgery-taking.html. Accessed January 17, 2011.
3. Ball KA. Surgical modalities. In Rothrock JC, ed. *Alexander's Care of the Patient in Surgery*. 14th ed. St. Louis, MO: Elsevier Mosby; 2011: 205.
4. Das K, Rothberg M. Thoracoscopic surgery: historical perspectives. Available at: http://www.medscape.com/viewarticle/405651. Accessed January 17, 2011.
5. Khraim FM. The wider scope of video-assisted thoracoscopic surgery. *AORN Journal.* 2007;85(6):1199-1208.
6. Das K, Rothberg M. Thoracoscopic surgery: historical perspectives. Available at: http://www.medscape.com/viewarticle/405651. Accessed January 17, 2011.
7. Das K, Rothberg M. Thoracoscopic surgery: historical perspectives. Available at: http://www.medscape.com/viewarticle/405651. Accessed January 17, 2011.
8. Miller JI, Hatcher CR Jr. Thoracoscopy: a useful tool in the diagnosis of thoracic disease. *The Annals of Thoracic Surgery.* 1978;26(1):68-72.
9. Newhouse MT. Thoracoscopy: diagnostic and therapeutic indications. *Pneumologie.* 1989;43(2):48-52.
10. Khraim FM. The wider scope of video-assisted thoracoscopic surgery. *AORN Journal.* 2007;85(6):1199-1208.
11. Bonatti J, Schachner T, Bernecker O, et al. Robotic totally endoscopic coronary artery bypass: program development and learning curve issues. *Journal of Thoracic and Cardiovascular Surgery*. 2004;127:504-510.
12. US Surgical Procedures Volumes #A606. *Medtech Insight*. February 2007.
13. Flores RM, Park B, Rusch V. Video-assisted thoracic surgery. In Souba WW, Fink MP, Jurkovich GJ, et al., eds. *ACS Surgery: Principles and Practice*. 6th ed. Philadelphia, PA: BC Decker, Inc; 2008:404-425.
14. McKenna RJ, Mahtabifard A, Swanson SJ. *Atlas of Minimally Invasive Thoracic Surgery (VATS).* Philadelphia, PA; Elsevier Saunders. 2011.
15. McKenna RJ Jr, Houck WV. New approaches to the minimally invasive treatment of lung cancer. *Current Opinion in Pulmonary Medicine*. 2005;11(4):282-286.
16. Downey RJ, Cheng D, Kernstine K, et al. Video-assisted thoracic surgery for lung cancer resection: a consensus statement of the International Society of Minimally Invasive Cardiothoracic Surgery (ISMICS) 2007. *Innovation: Technology & Techniques in Cardiothoracic & Vascular Surgery*. 2007;2(6):296.

17. University of Pittsburgh Medical Center. Video-assisted thoracic surgery (VATS). Available at: http://www.lungcancer.medicine.pitt.edu/content.asp?id=2086. Accessed February 7, 2011.

18. Leshnower BG, Miller DL, Fernandez FG, Pickens A, Force SD. Video-assisted thoracoscopic surgery segmentectomy: a safe and effective procedure. *Annals of Thoracic Surgery*. 2010;89(5):1571-1576.

19. Ghosh-Dastidar MB, Deshpande RP, Rajagopal K, Andersen D, Marrinan MT. Day surgery unit thoracic surgery: the first UK experience. *European Journal of Cardiothoracic Surgery*. 2010; Oct 30. [Epub ahead of print]

20. Chong HS, Kim HS, Ankur N, Kho PA, et al. Video-assisted thoracoscopic surgery plus lumbar mini-open surgery for adolescent idiopathic scoliosis. *Yonsei Medical Journal*. 2011;52(1):130-6.

21. Flores RM, Park BJ, Dycoco J, et al. Lobectomy by video-assisted thoracic surgery (VATS) versus thoracotomy for lung cancer. *Journal of Thoracic and Cardiovascular Surgery.* 2009;138(1):11-18.

22. Cattaneo SM, Park BJ, Wilton AS, et al. Use of video-assisted thoracic surgery for lobectomy in the elderly results in fewer complications. *Annals of Thoracic Surgery*. 2008;85(1):231-235.

23. Shaw JP, Dembitzer FR, Wisnivesky JP, et al. Video-assisted thoracoscopic lobectomy: state of the art and future directions. *Annals of Thoracic Surgery*. 2008;85(2):S705-709.

24. Butterworth SA, Blair GK, LeBlanc JG, Skarsgard ED. An open and shut case for early VATS treatment of primary spontaneous pneumothorax in children. *Canadian Journal of Surgery*. 2007;50(3):171-174.

25. Atkins BZ, Harpole DH Jr, Mangum JH, Toloza EM, D'Amico TA, Burfeind WR Jr. Pulmonary segmentectomy by thoracotomy or thoracoscopy: reduced hospital length of stay with a minimally-invasive approach. *Annals of Thoracic Surgery.* 2007;84(4):1107-1112.

26. Khraim FM. The wider scope of video-assisted thoracoscopic surgery. *AORN Journal.* 2007;85(6):1199-1208.

27. Moller AM, Villebro N, Pedersen T, Tonnesen H. Effect of preoperative smoking intervention on postoperative complications: a randomized clinical trial. *Lancet.* 2002;359(9301):114-117.

28. Flores RM, Park B, Rusch V. Video-assisted thoracic surgery. In Souba WW, Fink MP, Jurkovich GJ, et al., eds. *ACS Surgery: Principles and Practice*. 6th ed. Philadelphia, PA: BC Decker, Inc; 2008:404-425.

29. Stanton C. Checklist offers improved efficiency for MIS cases. *AORN Connections.* 2011;93(1):C7.

Please close this window and return to the main page to proceed with taking the online test, evaluation and registration.