Evaluation of acute and chronic pain outcomes after robotic, video-assisted thoracoscopic surgery, or open anatomic pulmonary resection

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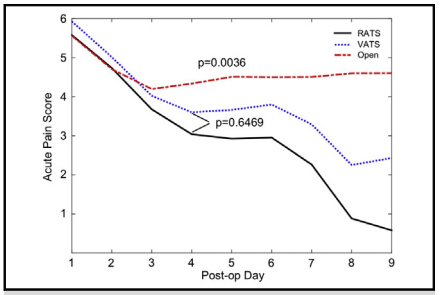
ABSTRACT

Objectives: Although robotic-assisted thoracic surgery (RATS) provides improved dexterity, the effect of RATS on pain compared with video-assisted thoracoscopic surgery (VATS) or open lobectomy is poorly understood. This study evaluated acute and chronic pain following RATS, VATS, and open anatomic pulmonary resection.

Methods: A retrospective review of 498 patients (502 procedures) who underwent RATS (74), VATS (227), and open (201) anatomic pulmonary resection including lobectomy and segmentectomy from 2010 to 2014 was performed to identify factors related to acute and chronic pain. Acute pain scores were analyzed over the first 9 postoperative days. Chronic pain was assessed using the validated PainDETECT survey.

Results: There were no significant differences in acute or chronic pain between RATS and VATS. There was a significant decrease in acute pain for patients with minimally invasive surgery ($P = .0004$). Chronic numbness was significantly higher after open resection (25.5% vs 11.6%; $P = .0269$) but with no difference in other symptoms of chronic pain. Despite no significant difference in pain scores, 69.2% of patients who received RATS felt the approach affected pain versus 44.2% VATS ($P = .0330$). On multivariable analysis, younger age ($P < .0001$), female gender ($P = .0364$), and baseline narcotic use ($P = .0142$) were associated with acute pain, whereas younger age ($P = .0021$) and major complications ($P = .0003$) were associated with chronic numbness in patients who received MIS.

Conclusions: Although minimally invasive approaches resulted in less acute pain and chronic numbness, there were no significant differences between RATS and VATS. In contrast, more RATS patients believed the approach affected their pain, suggesting a difference between reality and perception. (J Thorac Cardiovasc Surg 2017;154:652-9)



Pain scores were significantly higher after open but not between RATS or VATS lobectomy.

Central Message

Although robotics may provide improved dexterity, there were no differences in acute or chronic pain compared with thoracoscopic lobectomy.

Perspective

RATS lobectomy provides improved dexterity and visualization, but the effect of RATS on pain is poorly understood. Although minimally invasive lobectomy resulted in less acute pain and chronic numbness, there were no differences between RATS and thoracoscopic lobectomy. In contrast, more RATS patients believed the approach affected their pain, suggesting a difference between reality and perception.

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Video-assisted thoracoscopic surgery (VATS) is a minimally invasive approach resulting in less tissue trauma, shorter recovery, and improved cosmesis.[1] For early lung cancer, resection is the mainstay of treatment, and VATS lobectomy has become the treatment of choice.[2-4] There is a learning

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Abbreviations and Acronyms

ARDS = acute respiratory distress syndrome
IASP = International Association for the Study of Pain
IV = intravenous
LOS = length of stay
MIS = minimally invasive surgery
PCA = patient-controlled analgesia
PD-Q = PainDETECT questionnaire
POD = postoperative day
RATS = robotic-assisted thoracic surgery
STS = Society of Thoracic Surgeons
VATS = video-assisted thoracoscopic surgery

curve to performing complex thoracoscopic procedures like lobectomy due to reduced tactile sensation.[5] By combining 3-dimensional imaging and increased degrees of freedom, robotic surgery addresses some of these disadvantages.[6,7] Although robotic-assisted thoracic surgery (RATS) may provide advantages in terms of dexterity, one of the disadvantages is a complete lack of tactile feedback, which could lead to tissue damage especially for inexperienced surgeons.[8] Several studies have shown that RATS lobectomy can be performed safely by experienced thoracic surgeons with no significant difference in morbidity or mortality compared with VATS.[9-11]

However, the benefits of RATS compared with VATS lobectomy have not been clearly defined, especially with higher costs and longer operating times.[10,12] One of the proposed advantages of robotic over thoracoscopic procedures is that the robotic arms rotate around a fulcrum point, which theoretically reduces torque on the chest wall decreasing damage to the intercostal nerves and surrounding tissues leading to reduced pain. Although RATS offers certain advantages for the surgeon, the benefits in terms of acute and chronic pain outcomes is less clear.[13-15] This study evaluates postoperative acute and chronic pain outcomes after VATS, RATS, and open lobectomy.

MATERIAL AND METHODS

Approval from the University of Michigan Institutional Review Board was obtained. Consent was waived for the retrospective review of perioperative pain scores but was obtained when patients completed chronic pain surveys. Consecutive patients who underwent VATS, RATS, and open lobectomy or segmentectomy between February 2010 and June 2014 were included. Patients who underwent chest wall resection or previous ipsilateral thoracic surgery were excluded. Pre-resection mediastinoscopy and diagnostic wedge resection were not considered previous thoracic operations. Pulmonary resections were performed by 7 surgeons. Two surgeons performed all the RATS procedures but used VATS and RATS interchangeably depending on equipment availability with no preference based on size or location of the lesion. Although an open approach was favored for centrally located tumors, this represents the current practice in most thoracic groups.

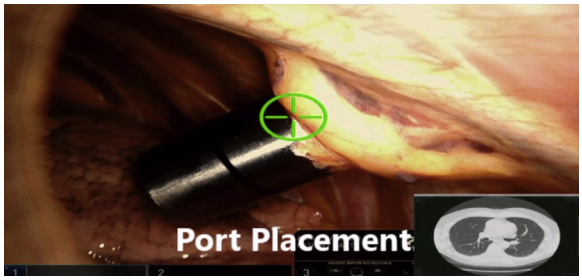
VATS procedures were performed with a 3- or 4-port technique with an access incision less than 5 cm and no rib spreading. A 4-arm technique and an additional 12-mm port for the bedside assistant was used for RATS (Video 1). Posterolateral thoracotomies, generally serratus-sparing, were performed through the fifth interspace after shingling the sixth rib to facilitate rib spreading. All VATS and RATS port sites were infiltrated with 1% lidocaine/0.25% bupivacaine with an intercostal nerve block and postoperative patient-controlled analgesia (PCA) transitioned to oral narcotics. Thoracotomy patients underwent epidural or paraspinous catheter placement supplemented with a PCA when needed.

Data Collection

A retrospective review of 498 patients who underwent 502 lobectomies or segmentectomies, including 74 RATS, 227 VATS, and 201 thoracotomies, was performed to identify factors related to postoperative pain (Table 1). Of these patients, 20 underwent thoracoscopic and 8 open segmentectomies. If a minimally invasive procedure was converted to thoracotomy, the patient was classified as having a thoracotomy. The Society of Thoracic Surgeons (STS) institutional database was queried along with the medical record.

To make the results comparable with other studies, standardized assessment tools were used. For acute (<10 days) postoperative pain, visual pain scores, self-reported by the patient to the nurse, were collected.[16] Focusing on the severity, the maximum pain scores from each postoperative day (POD) were taken from all patients and averaged using a generalized mixed model to create a progression of postoperative pain. Chronic pain is defined by the International Association for the Study of Pain (IASP) as having pain at the site of surgery more than 2 months afterward.[17] Symptoms of chronic pain were assessed using the validated PainDETECT questionnaire (PD-Q), which has been used previously to evaluate post-thoracotomy pain.[18-20] If a patient failed to respond by mail after 2 attempts, up to 2 phone calls were made to administer a phone survey including questions from the PD-Q (Table E1). In the design stage, we specifically selected 11 variables (Tables 2 and 3) to be included in the survey because they were hypothesized to be potentially important factors for comparing surgical groups. In the analysis, we did not adjust for multiple comparisons because we set up a separate hypothesis for each of the 11 variables before we collected the data. Four patients underwent more than 1 lobectomy during different hospitalizations and had their inpatient courses analyzed separately for acute pain but were evaluated once for chronic pain at the time of the study.

Preoperative characteristics, including age, gender, tumor stage, preoperative narcotic use, and smoking status were collected. Major comorbidities included preoperative chemotherapy or radiation, coronary disease, peripheral vascular disease, cerebrovascular disease, pulmonary hypertension, diabetes, creatinine >1.5, dialysis, chronic obstructive pulmonary



VIDEO 1. This brief video demonstrates the port placement and standard techniques used during a robotic-assisted thoracoscopic right upper lobectomy including the use of the robotic stapler and an intercostal nerve block. Video available at: http://www.jtcvsonline.org/article/S0022-5223(17)30216-7/addons.