

Combined Robotic Lobectomy and Adrenalectomy for Lung Cancer and Solitary Adrenal Metastasis

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ABSTRACT

Background and Objectives: Surgical resection of isolated adrenal metastasis in primary lung cancer is associated with improved survival. We report a combined robotic lobectomy and adrenalectomy for resection of a primary lung cancer and metastasis to the adrenal gland.

Methods: A 69-year-old male with a significant smoking history and shortness of breath was found to have a 3-cm left upper lobe mass with an enlarged left adrenal gland measuring 1.5cm. The adrenal gland was biopsied confirming metastatic poorly differentiated carcinoma, likely lung cancer. Computed tomography, positron emission tomography, and mediastinoscopy revealed no evidence of disease outside the adrenal gland.

Results: Following induction chemotherapy, the patient underwent combination robotic lobectomy, lymphadenectomy, and adrenalectomy while in the same lateral decubitus position. Thoracic and urologic oncology teams performed their respective portions of the operation. Overall operative time was 4 hours, and length of hospital stay was 3 days. Estimated blood loss was 150mL with no narcotic requirements beyond the first postoperative day. Final pathology revealed large cell carcinoma of the lung with metastasis to the adrenal. All surgical margins were negative.

Conclusions: Combination robotic lobectomy and adrenalectomy is feasible and can be associated with a short convalescence, minimal pain, and an oncologically sound approach.

Key Words: Robot, Lobectomy, Adrenalectomy, Metastasis.

INTRODUCTION

Metastatic non-small cell lung cancer (NSCLC) is considered incurable with historical median survival of 6 months to 9 months and a 5-year survival of approximately 1% to 2% with some recent improvement with newer medical therapies.¹ However, in patients with oligometastatic disease to the adrenal, standard-of-care resection of a primary lung cancer with a lobectomy or bilobectomy along with removal of the adrenal gland harboring the single metastasis provides an estimated median survival of 2 years to 3 years and a 10% to 26% 5-year survival.²⁻⁴ The adrenal gland is a relatively common site of metastatic spread in primary lung cancer occurring in 10% to 40% of NSCLC patients,⁵ and some are potential candidates for surgical treatment. Identifying surgical candidates involves a thorough evaluation for further metastatic disease outside of the single adrenal gland and the ability to tolerate surgical resection.⁶

Minimally invasive surgical techniques have evolved over the last 2 decades for both lung and adrenal surgery. The video-assisted technique has been thoroughly reviewed, and when basic oncologic principles of lung cancer surgery are adhered to, similar survival rates can be attained with reduced morbidity and improved outcomes.⁷ There are similar findings in laparoscopic resection of the adrenal gland. Prospective case-control research has demonstrated that patients who undergo the laparoscopic technique have an equivalent oncologic result with a nearly 70% reduction in the morbidity and possibly less with greater experience and improved technology.⁸ For patients with synchronous disease, a number of studies have assessed the merits of simultaneous surgical lobectomy with adrenalectomy by open or laparoscopic means.⁹⁻¹² Additionally, recent literature has reported on the feasibility of robot-assisted lobectomy¹⁵⁻¹⁸ and robot-assisted adrenalectomy.²⁰⁻²² As usage of surgical robotic systems by practitioners increases and matures, the indications can similarly expand. More centers are now equipped to perform robotic surgery in different divisions of surgery. We report a combined robot-assisted pulmonary lobectomy and adrenalectomy with the same patient positioning for synchronous biopsy proven primary lung cancer with solitary adrenal metastasis.

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Figure 1. Computed tomography of left lung mass.



Figure 2. Computed tomography of left adrenal mass.

CASE REPORT

A 69-year-old Caucasian male with a 60-pack/year history of tobacco use presented with mild shortness of breath. He had no previous thoracic or abdominal surgery. Evaluation with a chest X-ray and subsequent computed tomography (CT) scan of the head/chest/abdomen/pelvis confirmed a 3.1 x 2.6-cm mass (**Figure 1**) in the left upper lobe of the lung with mild mediastinal lymphadenopathy and slight prominence of the left adrenal gland measuring 1.5cm (**Figure 2**). A transbronchial biopsy of the lung lesion revealed poorly differentiated carcinoma. Staining for CK7, CEA, and Ber-EP4 was positive. Staining for CK20, p63, TTF-1, CK5-6, PSA, chromogranin and synaptophysin was negative. Additional staging workup included a fluorodeoxyglucose (FDG)-positron emission tomography (PET)/CT that demonstrated increased uptake in the lung lesion without uptake elsewhere, specifically no evidence of FDG uptake in the adrenal gland.

For evaluation of the mediastinal lymphadenopathy and left adrenal gland, endoscopic ultrasound-guided fine-needle aspiration (FNA) of the nodes was undertaken. No malignancy was found in the lymph nodes; however, the 1.5-cm left adrenal mass was FNA-positive for metastatic carcinoma. Further workup with mediastinoscopy removed 19 lymph nodes that were all benign. The patient elected to proceed with surgical excision and completed one round of induction carboplatin and paclitaxel prior to surgery.

He underwent a robot-assisted left upper lobe lobectomy, lymphadenectomy, and adrenalectomy. The combination robotic procedures were performed by thoracic and urologic oncology teams. The patient was placed in the right lateral decubitus position and was not repositioned for the remainder of the case (**Figure 3**, with port-site locations).

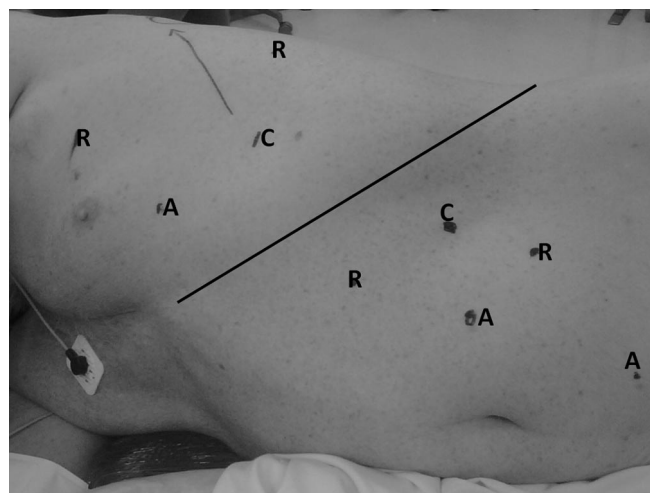


Figure 3. Port Sites for Robotic Left Lobectomy and Adrenalectomy. Lobectomy above the line and adrenalectomy below. C-Camera, R-robotic ports, A-assistant ports.

The thoracic portion commenced first and was performed according to our previously described technique.¹³ The robot was docked over the shoulder, and dissection and removal of lymph nodes was performed in the aortopulmonary (AP) window, beneath the left mainstem bronchus to the subcarinal region, in the posterior mediastinum, paraesophageal, as well as along the pulmonary artery. The mass was found to have significant adjacent inflammatory reaction and involved the area beneath the arch of the aorta, as well as the immediate area around the first branch of the pulmonary artery to the left upper lobe and the left upper lobe bronchus. An endovascular stapler was used to divide the first branch as well as the superior pulmonary vein. Finally, the bifurcation of the bronchus was divided as well as the fissure for the upper lobe using

the endovascular stapler. Frozen section of the surgical margins and lymph nodes were negative. A chest tube and suction drain were left in place.

Without changing the patient's body position, the robot was redocked over his side. Three robotic ports and 2 assistant ports were placed in the left abdomen for transperitoneal adrenalectomy. Dissection proceeded with takedown of the "white line of Toldt" and mobilization of the splenorenal and splenocolic ligaments. The pancreas, spleen, and splenic vessels were dissected away from the kidney up to the greater curvature of the stomach. The completely mobilized spleen allowed visualization of the adrenal gland and surrounding fat. The gonadal vein was followed to the left renal vein, whereupon the adrenal vein was identified. After ligation of the adrenal vein, a wide resection of the adrenal and upper pole perirenal fat was performed.

Total blood loss was 150mL with a total operative time of 4 hours. The chest tube was removed on postoperative day 1, and the suction drain was removed 2 days later. He did not require any narcotics after postoperative day 1. The postoperative course was otherwise unremarkable, and he was discharged home on postoperative day 3.

Final pathology revealed a poorly differentiated large cell carcinoma of the lung measuring 4.5 x 3.5 x 2.5cm with negative margins and 6 benign lymph nodes; 25 lymph nodes were examined and all were benign. Adrenal pathology demonstrated a 1.5-cm metastatic carcinoma of the lung completely excised. The final pathologic stage was T3N0M1bR0. At 6-month follow-up, the patient had no evidence of disease recurrence.

DISCUSSION

Frequent sites of metastasis for advanced NSCLC include regional lymph nodes, lung, liver, bone, brain, and adrenal glands. In select patients with solitary adrenal involvement, resections of the lung primary and adrenal metastasis have been shown to impact survival. In an early metaanalysis, Beitler et al⁹ showed a moderate survival advantage for resection compared to non-operative therapy. Tanvetyanon¹⁰ found a durable 5-year survival of approximately 26% for patients treated with surgery. Many of the patients in these analyses predated current high-resolution CT scans, positron emission technology, and endoscopic ultrasound methods, potentially suboptimally staging patients by failing to detect metastatic disease outside the

adrenal gland, which would contribute to decreased survival.

Some patients with primary lung cancer will present with synchronous solitary adrenal metastases, while others will be found to have adrenal metastases metachronously. Because a concurrent minimally invasive adrenalectomy adds minimal additional morbidity, in most cases the same setting surgery is recommended when there is synchronous adrenal involvement. If the patient has excessive comorbidities or is unstable, completion adrenalectomy can be deferred. Mediastinoscopy or lymphadenectomy with frozen sections at the time of lung resection may detect positive nodal involvement, which would likely preclude proceeding with adrenalectomy. While ipsilateral adrenal lesions are more straightforward to approach, contralateral lesions could still be approached with patient repositioning. One report has proposed that patients with synchronously presenting metastatic disease, as in the described patient, had a poorer survival compared to metachronously presenting metastases, with no survivors at 2 years in the synchronous group compared to a 38% 5-year survival in the metachronous group.³ The use of induction and adjuvant therapies to improve survival is controversial. Retrospective and prospective research has failed to conclusively demonstrate a survival advantage.¹⁴ Our patient received one course of induction chemotherapy and was noted to have a significant drop in the primary tumor standardized uptake value (SUV). Thus, given that *in vivo* litmus test, we would expect to achieve a survival improvement by administration of adjuvant chemotherapy. Further opportunities to improve survival and response to therapy would include a "personalized medicine" approach and the potential of maintenance chemotherapy.

To our knowledge, no prior literature describes the concurrent robotic resection of lung and adrenal lesions. We have demonstrated that this combined approach is feasible and associated with minimal convalescence and pain with satisfactory short-term pathologic outcomes. There has yet to be a demonstrated benefit of robotics over the laparoscopic approach for either resection. Our institution and respective surgical teams have programmatic focus in the use of robotic technology to perform oncologic resections, as such we attempt to demonstrate surgical efficiency and improved outcomes compared to other minimally invasive literature reports for these patients.

Previous reports have explored various approaches to joint lobectomy and adrenal excision. Combinations of open/VATS lobectomy with open/laparoscopic adrenalectomy for parallel removal of lung cancer and adrenal

metastasis have been used.⁹⁻¹² As an alternative, Hunt et al¹² utilized a technique of single-incision lobectomy with transdiaphragmatic adrenalectomy. The operative time was 1 hour longer and required a double thoracotomy and diaphragm repair.

Over the last decade, robot-assisted lobectomy has been successfully utilized as a minimally invasive alternative. Several institutions have reported on robotic video-assisted thorascopic (VATS) lobectomy,⁷ again with no demonstrable improvement in outcomes compared to outcomes with thorascopic surgery. There are many different means of using robotic instrumentation. Some surgeons use a combination of VATS and robotics, using the robot to perform the mediastinal and hilar lymphadenectomy. Others perform their resections in a similar fashion as to the open thoracotomy technique, approaching the hilar structures through the fissure. Others approach the hilar structures first, either anteriorly for the upper lobes and posteriorly for the lower lobes, taking the fissures last attempting to reduce intraoperative bleeding that occurs when searching for the hilar structures through the fissures and minimizing postoperative airleak by taking the fissures with a single staple line.¹⁵ Melfi et al¹⁶ examined the learning curve of robotic lobectomy and found it to be feasible and safe with benefits generated from the 3-D imaging, dexterity, and degrees of motion of the robotic arms, reduction of tremor, ergonomics and scaling. Several authors^{17,18} have reported on series of robot-assisted lobectomy with similar results. Overall conversion rates to open lobectomy ranged from 13% to 19% with complication rates of 11% to 20%. Operative times were between 209 minutes to 228 minutes, and hospital length of stays ranged from 4 days to 11 days. In a comparison of robotic and open lobectomy, Veronesi et al¹⁷ found equivalent lymph node yields of 17 nodes with reduced length of stay associated with robotic lobectomy (4.5 days versus 6 days).

Similarly, there has been an ongoing surgical trend towards minimally invasive adrenalectomy. For both benign and malignant disease, consideration of the laparoscopic approach as the gold standard has been proposed.¹⁹ Outcomes of robotic adrenalectomy appear comparable to outcomes with laparoscopic adrenalectomy, though randomized control trials have not been performed.^{20,21} Robotic surgery to remove isolated metastatic disease has been previously described for excision of renal cell carcinoma metastasis.²²

The versatility of the da Vinci surgical robotic system has allowed for a number of other urologic combination cases, such as partial nephrectomy or nephroureterectomy, in the same setting as radical prostatectomy.^{23,24} However cross-surgical discipline approaches are much more uncommon. As more surgical fields become accustomed to performing robotic surgery, synergy can be realized from teams working together especially for operations of increased complexity. Robotic port sites can be reused, reconfigured, or closed to create new port sites. The improvements to the da Vinci robot have also made it easier to dock, undock, and redock.

Masses of the adrenal gland presenting in conjunction with lung carcinoma, like all adrenal lesions, may represent benign, functional, or malignant lesions. Chen et al²⁵ described synchronous treatment of a primary non-small cell lung cancer and ipsilateral pheochromocytoma. This illustrates the importance of a complete workup, preferably with tissue diagnosis before embarking on surgical intervention. Comprehensive imaging before surgery is imperative to rule out other gross sites of distant disease. Through thorough imaging using CT and PET/CT with lymph node biopsies confirming disease confined to the adrenal gland, we could be fairly confident that surgical excision of the adrenal could be reasonably approached and be of benefit.

CONCLUSION

In the present clinical scenario, addressing and removing of the primary lung tumor with the adrenal gland all performed robotically can be completed with remarkably rapid patient recovery. Operative times were similar to those reported for robotic lobectomy with a length of stay of only 3 days, minimal blood loss and no narcotic pain medicine requirements beyond the first postoperative day. Presently the patient has no evidence of gross disease. This approach may be an option even for patients undergoing surgery for palliative indications, because a robotic operation may offer a less demanding and faster recovery.

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