Editorial

Editorial on expanded indications for robotic surgery in stage IIIA non-small cell lung cancer

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The authors present their operative technique of a three-arm robot assisted thoracoscopic lobectomy for locally advanced non-small cell lung cancer (NSCLC) with N2 disease using the da Vinci S system. They utilize 3 small robotic incisions and a utility incision. Cheng *et al.* have a large experience with this technique, having performed over 1,000 lung resections since 2009. This is a modification of the original description put forth by Park *et al.* for a robotic assisted lobectomy, which utilized 2 small incisions and a utility incision (1), and a variation of the four-arm technique described by Veronesi *et al.* (2). Here, the authors state that their technique has the benefit of minimizing the use of unnecessary arms and instruments, use of only 4 incisions (instead of 5 with the four arm technique as has become more common recently), and no need for undocking of the arms to remove specimens.

As the benefits of minimally invasive surgical options for lung cancer become more widely accepted, it is interesting to see the variety of techniques that can be used to safely perform resections in locally advanced patients. We agree that the robotic platform offers the technical advantages of three-dimensional operative viewing and increased flexibility and dexterity of instrumentation over traditional video-assisted thoracoscopic surgery (VATS). Data demonstrating similar lymph node harvest with the robotic technique compared to open surgery and increased compared to VATS have been published (3,4). A recent meta-analysis concluded that robotic anatomic resection had similar 30-day mortality, conversion rate, operative time, hospital stay, days to chest tube removal and number of lymph node stations sampled compared to VATS (5). Furthermore, evidence of the excellent long-term oncologic results of robotic surgery, particularly for N2 disease, is emerging (6,7).

For patients with stage III NSCLC multi-modality treatment with some combination of systemic therapy, radiation, and surgery is often employed. The exact paradigm is nuanced and highly dependent on a multitude of factors, including patient and disease characteristics, local expertise, availability of treatments, and eligibility for potential clinical trials. The current 8th edition of the American Joint Committee on Cancer's (AJCC) tumor (T), node (N) and metastasis (M) staging system classifies locally advanced disease as IIIA, IIIB and IIIC (8). Surgery for stage IIIB (T1-2N3 or T3-4N2) and IIIC (T34N3) disease is not typically recommended (9).

Stage IIIA patients are a select group with either larger tumors and no mediastinal nodal involvement (T4N0, T3-4N1) or smaller tumors with ipsilateral mediastinal nodes involved (T1-2N2). This is a heterogeneous group of patients and treatment plans should be tailored to suit the individual clinical situation (10). For patients without mediastinal nodal involvement, surgery followed by adjuvant systemic therapy is a generally accepted strategy. Those with IIIA disease from N2 involvement can be treated with neoadjuvant systemic therapy (+/– radiation) followed by restaging and surgery, surgery followed by adjuvant chemotherapy (+/– radiation), or definitive chemotherapy and radiation (9). While the optimal approach for these patients has been highly debated, 5-year survival advantages have been demonstrated in surgical patients (42% in patients with persistent N2 disease who had resection *vs.*

17% in patients who completed neoadjuvant chemotherapy and radiation but did not have surgery) (11). In this study, the 5-year survival in the surgery group was 49% in patients with a partial response and 53% in those with a complete response. However, it should be noted that this was a highly select group of patients (non-bulky, non-fixed N2 disease who responded to neoadjuvant therapy) and surgery was by thoracotomy with a muscle flap. Despite these limitations, it highlights that patients with non-bulky, single station disease who respond to neoadjuvant therapy likely have increased survival with surgical resection.

The use of neoadjuvant radiation in addition to chemotherapy prior to surgical resection has also been a heavily debated topic. While the addition of radiation has been shown to result in more frequent downstaging, increased nodal clearance, increased rates of pathologic complete response and increased rates of local control, no improvement in progression free or overall survival was demonstrated in a recent meta-analysis (12). The addition of radiation can potentially lead to adhesions and a more difficult mediastinal lymph node dissection and has been shown to reduce the number of lymph nodes removed at resection compared to neoadjuvant chemotherapy alone (13). Examination of fewer nodes could potentially falsely downstage these patients without improving long-term survival.

In our practice, we have the newer generation Xi system, which reduces docking time and increases versatility of instrumentation through different ports. We utilize a four-arm technique with use of an additional 15 mm assistant port. This allows the benefit of CO_2 insufflation to aide in visualization, depress the diaphragm, and stabilize the mediastinum (14). There are limited requirements for the assistant to change instruments, but he/she maintains the ability to insert ancillary instruments and remove specimens without dedocking a robotic arm. In addition, retraction and tension are controlled by the surgeon and exposure of the operative field is more stable (2,15). The camera is placed in arm 2 for a left-sided resection and in arm 3 for a right-sided resection. We utilize a bipolar grasper in the surgeons left hand, and a mono-polar spatula in the right hand. A tip-up fenestrated grasper is placed in the 3rd arm for retraction. The spatula provides excellent blunt dissection capability and seems to arc less the hook. It is also blunter than the Maryland bipolar dissector. We typically begin with a mediastinal lymph node dissection, which also affords exposure of at least a portion of the bronchial dissection and lobar lymph nodes. The pulmonary artery in the fissure is then dissected as appropriate. The hilar structures are then circumferentially dissected, including all lymph nodes. The vascular structures are then divided, followed by the bronchus. Any remaining lung parenchyma is divided at convenient points to facilitate exposure. Stapler use is at the discretion of the surgeon, and is either a traditional VATS stapler introduced through the assistant port, or the robotic stapler.

At our institution, patients with N2 positive stage IIIA disease meet early with the thoracic surgeons to determine eligibility for resection. A comprehensive workup with history and physical, chest CT scan, PET/CT, brain MRI, and pulmonary function testing is performed in all patients. Smoking cessation is mandatory for consideration of resection, and a referral to our smoking cessation specialists is done if needed. Additional studies, such as cardiac evaluation, quantitative V/Q scan, and cardiopulmonary exercise testing are performed if indicated. Treatment regimens are discussed in a multi-disciplinary setting and potentially resectable patients are treated with induction chemotherapy or immunotherapy on an appropriate clinical trial. Restaging CT and PET/CT following induction therapy are performed, and those who show response, or stable disease, proceed to surgery, more often robotically. Patients who progress with induction systemic therapy or those who are unfit for surgery are treated with definitive concurrent chemotherapy and radiation.

As the authors suggest, as advances in lung cancer treatment and surgery continue to occur, it is important to accurately and methodically evaluate their effectiveness and value. The adoption of new technologies should be rigorously compared to current standards in order to ensure the appropriate dissemination of new techniques and treatments. While erratic use of new therapies can lead to poor patient outcomes, advances will only come with the acceptance of new and innovative ideas. Multi-disciplinary teams with expertise in treating locally advanced lung cancer should work together to determine the appropriateness of surgical resection for these patients and the additional benefit it may provide relative to chemotherapy and/or radiation.

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Footnote

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conflicts of interest to declare.

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