resection, multifocal disease, induction therapy, distant metastases, large cell cancer, and adenosquamous cancer were all excluded. Although this limited the generalizability of these results, it has enhanced the validity by reducing the heterogeneity in the study population.

CONCLUSIONS

The focus of the present study was on the distance from the primary tumor to the closest margin in wedge resection. Crucially, we could not report on the differential effect that the margin distance might have for tumors of different sizes because we did not have enough power to detect the effect. However, we did not restrict the results to a specific postulated margin-to-tumor size ratio but, rather, quantified the effect of the margin distance, in general, on the risk of recurrence. We found that an increasing margin distance yielded decreased local recurrence rates for a margin distance of ≤15 mm, regardless of the tumor size when the tumors were ≤2 cm. Thus, we can decrease the risk of local recurrence during wedge resection of small NSCLC if we can achieve an adequate (≤15 mm) margin distance. Although we believe our results speak to the potential benefits associated with a resection margin of ≤15 mm, they cannot specify the ideal margin distance for small tumor size. Our results suggest that an important avenue for future work will be to gather more data from patients from other institutes and to further determine the optimal margin distance for small tumors. This association should be investigated in future studies that explicitly consider the relationship between the margin distance and local recurrence.

References


Discussion

Dr Joshua R. Sonett (New York, NY). Thank you for your excellent presentation and for the rather significant effort and energy to collect, analyze, and study this large cohort of patients. Having pathologic data with long-term follow-up of patients who underwent wedge resection for this is important, because our treatment options for early-stage lung cancer are continually debated, not only by surgeons. As our less invasive options for treating lung cancer are introduced, we need to ensure we do not diminish our cure rates at the heels of ease, expediency, and minimalism.

Your results build on the results from El-Sherif in that ≥1-cm margins are important, and you conclude that >1.5 cm might be the point of diminishing return. I, similar to probably half this audience, do not understand spline statistics, but I had a very competent statistician look at it for me. They thought your data were done

The Journal of Thoracic and Cardiovascular Surgery • Volume 147, Number 4 1175
very well in terms of the statistics, although the >1.5-cm population was a little bit low in the number of patients you had, those with margins >1.5 cm.

I have several questions, more about the philosophy for wedge resection and how you responded to the results. By the age of your patients when I read your report, the pulmonary function, which was pretty reasonable in a large population, and the tumor location, which was predominantly right upper lobe, left upper lobe, and middle lobe, it appears to me that these patients would have easily tolerated much larger resections. So, how do you presently decide, short of the currently randomized Cancer and Leukemia Group B (CALGB) trial, in which patients with <2-cm tumors receive a wedge resection?

**Dr Mohiuddin.** Thank you very much.

We presently decide according to patient age, tumor size, tumor location, percentage of forced expiratory volume in 1 second (FEV1), distant metastasis, and patient comorbidities. Those are our criteria.

**Dr Sonett.** In your data, 60% of your patients had <1-cm margins and 67% had no lymph nodes sampled. Again, this was by very competent thoracic surgeons. So, what is your current practice for lymph node sampling in these patients? Do you think it is relevant in this cohort to sample the lymph nodes, and how can you advocate for surgical resection instead of, say, stereotactic body radiotherapy (SBRT) if we are not going to sample the nodes and achieve >1-cm margins?

**Dr Mohiuddin.** Our current practice is to take the lymph nodes, and we strongly think it is relevant to sample the lymph nodes. How we advocate surgical resection over SBRT, we believe surgical resection has more advantages and benefits, such as sampling the lymph nodes. With SBRT, we cannot sample the lymph nodes. No long-term data are yet available on the effect of radiation on the lungs.

**Dr Sonett.** Much of the published data, and I would say including the last report and Dr Faber’s discussion, have shown improved results with segmental resection. Now, it is not clear whether the benefit of segmental resection results from actually removing the anatomic segment and lymphatics versus just attaining a good, safe margin. Given your data presented, do you measure the distance of your margin in the operating room and consider performing either a larger resection or segmentectomy if the margin is not adequate as you had defined?

**Dr Mohiuddin.** We ensure that the surgical resection margin is negative in the operating room, and we do measure the distance, and we do consider performing a larger resection or a segmentectomy or lobectomy if the patient has an adequate percentage of FEV1.

**Dr Sonett.** So, as opposed to the historical data, now that you have shown these data, if you were to perform a wedge resection right now with a <1-cm margin, what would be your course of events?

**Dr Mohiuddin.** Sorry, can you repeat the question?

**Dr Sonett.** If you were to perform a wedge tomorrow for a lesion and, pathologically, on frozen section analysis, the margin was <1 cm, what would be your answer in the operating room?

**Dr Mohiuddin.** We have 2 options. It all depends on the FEV1 for determining whether we can go back and resect at the same time.

**Dr Scott J. Swanson (Boston, Mass).** I can maybe answer that. Kamran is a fellow, and I think he is not going to really make that decision. I think our philosophy based on the learning from this database would be to perform a more aggressive resection, whether segmentectomy or lobectomy, with nodal dissection, and I think this has been pretty informative for us. The points you brought up are pretty revealing. So, we are taking this forward to do a more aggressive resection. But, is 15 mm the right number? I do not think we know that. However, if we believe that we are not at least over the tumor diameter ratio, I think most of us would do a larger resection.

**Dr Sonett.** Well, if you consider Dr Altorki’s results, you consider your results, and you consider the prospective trial on radiation seeds that was presented at the Southern, those 3 trials, all by really good, dedicated thoracic surgeons, all had miserable margins. So it would be hard for us to advocate for surgery when we are achieving crappy margins against SBRT. I think we as a group have to either do better segmental resections or perform lobectomies, but we cannot perform a crappy wedge resection with small margins just to try to keep pace with SBRT, because we will not be doing anybody a favor, including ourselves and our patients.

**Dr Harvey Pass (New York, NY).** I would like to follow-up on what Josh said and also to ask the Brigham group. The Brigham group is known, not only for terrific thoracic surgery, but also for terrific radiology imaging. My problem as an old surgeon is where is the lesion? There are easy wedges, and there are deep wedges that are not very easy. You have a study that considered the margins and you also have imaging studies for all these patients. Is not this the perfect study to also correlate the image findings preoperatively of where the lesion is and whether you could actually document beforehand whether you could perform an adequate resection? The deeper lesions will be the ones that, yes, you find you cannot resect and achieve a 1-cm margin, but you cannot do another resection; you must use segmentectomy. As I get older, I like to plan and know what I will have to do beforehand. I think that your imaging data at the cross-sectional diameter, where this is, and the distance from the hilum as a uniform point, or from the visceral pleura, could be very enlightening regarding whether you approach a case as a wedge or segmentectomy.

**Dr Mohiuddin.** I agree with you. Thanks.

**Dr Daniel L. Miller (Atlanta, Ga).** We are killing ourselves here. I mean from the point of view of lymph node evaluation, we suck: 67%, nothing in this. The previous study, 44%. We are giving these cases away. That is not acceptable. I am sorry; it is not. We must do a better job at that or we are going to lose this business. SBRT results in a 5-mm margin. We are coming down to their database would be to perform a more aggressive resection, whether segmentectomy or lobectomy, with nodal dissection, and I think this has been pretty informative for us. The points you brought up are pretty revealing. So, we are taking this forward to do a more aggressive resection. But, is 15 mm the right number? I do not think we know that. However, if we believe that we are not at least over the tumor diameter ratio, I think most of us would do a larger resection.

**Dr Sonett.** Well, if you consider Dr Altorki’s results, you consider your results, and you consider the prospective trial on radiation seeds that was presented at the Southern, those 3 trials, all by really good, dedicated thoracic surgeons, all had miserable margins. So it would be hard for us to advocate for surgery when we are achieving crappy margins against SBRT. I think we as a group have to either do better segmental resections or perform lobectomies, but we cannot perform a crappy wedge resection with small margins just to try to keep pace with SBRT, because we will not be doing anybody a favor, including ourselves and our patients.

**Dr Harvey Pass (New York, NY).** I would like to follow-up on what Josh said and also to ask the Brigham group. The Brigham group is known, not only for terrific thoracic surgery, but also for terrific radiology imaging. My problem as an old surgeon is where is the lesion? There are easy wedges, and there are deep wedges that are not very easy. You have a study that considered the margins and you also have imaging studies for all these patients. Is not this the perfect study to also correlate the image findings preoperatively of where the lesion is and whether you could actually document beforehand whether you could perform an adequate resection? The deeper lesions will be the ones that, yes, you find you cannot resect and achieve a 1-cm margin, but you cannot do another resection; you must use segmentectomy. As I get older, I like to plan and know what I will have to do beforehand. I think that your imaging data at the cross-sectional diameter, where this is, and the distance from the hilum as a uniform point, or from the visceral pleura, could be very enlightening regarding whether you approach a case as a wedge or segmentectomy.

**Dr Mohiuddin.** I agree with you. Thanks.

**Dr Daniel L. Miller (Atlanta, Ga).** We are killing ourselves here. I mean from the point of view of lymph node evaluation, we suck: 67%, nothing in this. The previous study, 44%. We are giving these cases away. That is not acceptable. I am sorry; it is not. We must do a better job at that or we are going to lose this business. SBRT results in a 5-mm margin. We are coming down to their level. We must do better than that. Now, I think it is embarrassing that we have these studies that show that. If the values are not there, we take that out of our analysis. But we must do a better job or we are going to lose this.

My 1 question I have is, did you consider the biohistologic features of the tumor? Was there a difference in the lymphatic invasion, neuroinvasion, and vascular invasion and was there a difference in visceral pleural invasion? I think that considers recurrence and so forth, but we must do better.

**Dr Mohiuddin.** I agree with you. We did include lymphovascular invasion and pleural invasion, and we adjusted for that in our analysis.

**Dr Miller.** But, did you have to resect a larger volume for those patients?
Dr Mohiuddin. I agree. We need more patient data. Right now, we cannot comment on that.

Dr Michael I. Ebright (Boston, Mass). I am going to follow-up on Dr Pass’s point. Previous studies have suggested that tumors within the central one third of the lung, the central tumors, will have up to a 50% rate of lymph node metastases. As one’s tumors become more central, it becomes more technically difficult or perhaps not even feasible to perform a sublobar resection with a wedge, and we might need to default to segmentectomy, even if that would not be our initial preferred approach. I would assume that most of the tumors in your studies were peripheral, but I am wondering whether you have any data to suggest whether you are treating the peripheral tumors differently than the central tumors.

Dr Mohiuddin. I agree. In our data we have had more peripheral tumors. That was determined by the radiologic evaluation. The radiologist evaluated within the hemithorax the location, and from our data, you are right.

Dr David C. Rice (Houston, Tex). How did you measure your margin? The Sawabata report measured it from the cut edge of the staple line and did smears on that; thus, that little 5-mm bit was included in their margin.

I also want to make a comment. We are shooting ourselves in the foot if we continue to call this local recurrence, because the radiation oncologists, like it or not, are not going to play by our rules. They have termed recurrence at the tumor site “local recurrence.” This is really locoregional recurrence if you are including the lymph nodes. I would beg you to include that in your report, at least make it clear, so that an internist will at least be able to compare apples with apples.

Dr Mohiuddin. The resection margin was evaluated by the pathologist, and it was the distance from the tumor to the resection margin, not including the staple line.

I am sorry, can you repeat the second question?

Dr Rice. That is okay. It was just a comment.

Dr Gunda Leschber (Berlin, Germany). I would like to come back to this margin and the measurement of the margin. You said the pathologist measured it, but was it with an inflated lung or was it in a formalin-fixed lung? When was it measured? We know that the margin will shrink if we put it in formalin.

Dr Mohiuddin. It was in an inflated lung.

Dr Thomas Rice (Cleveland, Ohio). I am curious about your need to create a new term. “Margin length.” I expected you to measure the length of the margin. Why did you not call it what we all call it—the distance from the primary tumor to the closest margin. Be precise. Be accurate. You are a surgeon. I would change your term “margin length.”

Dr Mohiuddin. Thank you.