Peer Review File
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Reviewer A

This is an institutional study Form the United States where the group aimed at evaluating the impact of Social Vulnerability Index on post-operative outcomes after lung resection by RATS. The study includes 320 patients between January 2021 and November 2022. I read this paper with great interest. A number of issues have come to my attention and need to be addressed before considering this article for publication. The main problem is the limited number of patients in the high SVI group compared to the other group which limits any conclusion.

> **Reply to Reviewer**: Thank you for your careful review of our manuscript. We appreciate your time, comments and suggestions and have incorporated many of them, and believe they have overall strengthened our work.

Methods, results section and Table 3: I would advise the authors to grade the complications according to the Clavier-Dido classification or any other classification. It would make the secondary objective a lot easier to read and help the reader better to evaluate the outcomes.

> **Reply to Reviewer**: Thank you, another reviewer also mentioned this and we agree this is a more objective measure. We have revised to include grading of all of our complications using the Clavien-Dindo Classification (new reference #19). We then compared the grades of individual complications between high and low SVI groups using Fisher's Exact tests, and compared the highest grade complication per patient by group. There was no significant difference in highest grade of complications between groups using median (IQR) grade (high SVI: 2 (2-3) vs low SVI: 2 (1-3), p=0.186).
>
> **Changes to Text**: Clavien-Dindo grading of complications has been added to Table 3, and summarized in the results section. An additional reference has been added coinciding with Clavien-Dindo Classification System (#19).

Line172: could the authors please detail how the preoperative variables were adjusted and how many patients were taken under consideration for the statistics?

> **Reply to Reviewer**: The details of the multivariable model are included in the methods section, under the statistical analysis header. This specified that the dependent outcomes of interest were the primary outcome, namely "overall morbidity" and secondary outcomes meaning individual complications that were significantly different on bivariate analysis. The specific independent variable of interest being "social vulnerability" high versus low. The preoperative variables that were adjusted for on multivariable analysis are included in, including: age, sex, race, ethnicity, ASA class and procedure. All patients were included in the analysis. We do feel that the model has been adequately described in the methods section and would prefer not to duplicate these details in the results section.
>
> **Changes to Text**: Given that the requested information is included in the methods section, statistical analysis sub section, no changes have occurred. We did however modify the statistical analysis section to include the notion that all patients were included in the multivariable models.

Table 3 : the high SVI group has more complications but a similar length of stay and re-admission rate. Could the authors please comment on that?

> **Reply to Reviewer**: We agree that these are important outcome measures and should be included in the results section.
>
> **Changes to Text**: Acknowledgment of index length of stay and readmission rates has been added to the results section, under the outcomes header; specifically "*index length of stay was not significantly different between high and low SVI groups (p=0.434), similarly the rates of ED presentation and readmission were not significantly different (p=0.573 and p=1.00, respectively).*"

Line 221: this sentence is too long and hard to understand. Could you please re-phrase?

> **Reply to Reviewer**: Thank you, this does warrant re-phrasing.
>
> **Changes to Text**: This sentence has been modified for clarity and simplicity: "*Social vulnerability has been associated with food insecurity, which has been linked to increased risk of readmission following major surgery.*"

Reviewer B

I read with great interest your manuscript regarding the correlation between the social vulnerability index and postoperative complications following robotic lung resections. Here are my remarks:

> **Reply to Reviewer**: Thank you for your careful review of our manuscript and interest in our work. We appreciate the time you spent providing comments and suggestions. We have addressed and incorporated many of them, and believe they have overall strengthened our manuscript.

1) Why did you decide the 75th percentile as the cut-off value/level to differentiate between high and low index? Was it based on previous studies or after some internal preliminary analysis? In any case, please specify it in the manuscript

> **Reply to Reviewer**: Much of the literature surrounding SVI and surgical outcomes uses the 75th percentile as a cut-off value including our cited references #15 - #18. This was specified in our manuscript under the methods section, study design sub-header, second paragraph. Previous studies have performed sensitivity analyses and determined this to be an appropriately representative cutoff without loss of information or overprediction.
>
> **Changes to Text**: No changes to text given this information was included in the methods section, under the study design sub-header, second paragraph with appropriate cited references.

2) Why did you choose only the robotic lung resections? Is it the institutional policy to perform only robotic surgery for lung resection, or are these patients only a fraction of the lung resections you completed during this period? If so, I would suggest adding the patients who underwent `traditional` thoracoscopic procedures. If you perform only robotic lung resections, please report it in the manuscript.

> **Reply to Reviewer**: Our group, where able, preferentially performs lung resections using the robotic-assisted approach due to advantages of improved visualization and dexterity. We do however

additionally perform open and video-assisted thoracoscopic approaches when indicated based on patient or other preoperative factors. We elected to study RATS approaches specifically here to eliminate the bias of approach as prior studies have demonstrate significant differences in perioperative morbidity and mortality by approach, specifically with significantly lower rates among patients who underwent RATS compared to open resection (PMID: 26770372). Additionally, we feel this approach is reflective of the current trend in increasing rates of RATS utilization as a minimally invasive approach compared to VATS (PMID: 36590738).

Changes to Text: To clarify your pertinent question, we have added to the methods section that for surgeons operated during the study period, and that all four perform the open, VATS and RATS approaches to lung resection. Additionally, we have added the focus on RATS to be a limitation, that likely limited sample size, but explained or decision including the above described differences in morbidity/mortality, as well as the trends towards increased utilization of rates. This has involved the addition of a new references, now number 45.

3) In Table 3, you could remove all these complications that had a 0% rate and describe them in the text. That way, the table will be much more user-friendly.

Reply to Reviewer: Thank you for this suggestion, we agree that this simplifies the table and have removed the 0% complications and placed these into the results section. We have elected to keep 30-day mortality in the table, however.

Changes to Text: The results section, outcomes sub-header, has been modified to include the notion that there were “no occurrences of reintubation, prolonged ventilator use, tracheostomy, DVT/PE, myocardial infarction or stoke in either group”. Table 3 has been modified to remove the complications with 0% rate as suggested.

4) I suggest organizing the postoperative complications according to the classification of Clavien-Dindo or TMM (thoracic morbidity mortality). More importantly, I recommend documenting them in Table 3 according to their importance. It is not that meaningful to have the unplanned return to the ICU or postoperative pneumonia by lung-operated patients with a superficial surgical site infection on the same table.

Reply to Reviewer: Thank you, another reviewer also mentioned this and we agree this is a more objective measure and have graded all of our complications using the Clavien-Dindo Classification (new reference #19). We additionally compared the grades of individual complications between high and low SVI groups using Fisher’s Exact tests, and compared the highest grade complication per patient by group. There was no significant difference in highest grade of complications between groups using median (IQR) grade (high SVI: 2 (2-3) vs low SVI: 2 (1-3), p=0.186).

Changes to Text: Clavien-Dindo grading of complications has been added to Table 3, and summarized in the results section. An additional reference has been added coinciding with Clavien-Dindo Classification System (#19).

Reviewer C

This is an interesting study about the Social Vulnerability Index in Robotic-assisted lung resections. The paper is very well written. In addition, very little literature has been published on the topic regarding

thoracic surgery. However, I have some major comments on the methodology and other observations on the manuscript. I thank the authors for reading and considering my thoughts.

> **Reply to Reviewer:** Thank you for your careful review of our manuscript. We hope we have adequately addressed your comments and concerns below, and in our updated manuscript, and feel your recommendations have greatly improved the quality of our work.

The authors include different types of lung resection in the study (lobectomy, segmentectomy and wedge) in different indications. I believe that Interstitial lung disease diagnostic wedges are not comparable with the other resections and thus should not be included. On one hand, this is a diagnostic procedure. On the other hand, the complication rate in this group is usually very low (<10%) and related to the interstitial disease, so I don't see the point in including this type of resection in the study. I believe the authors need to justify in the manuscript why they include these types of resections.

> **Reply to Reviewer**: We agree that robotic wedge resections are low morbidity and our data confirms this with the most frequently experienced complication following RATS Wedge. We elected to include them here as the majority of our wedge resections in this series were performed for malignant indications (77.4%), while a total of 13 RATS wedge resections were performed for ILD (21.0%). Based on your below request for a sub-group analysis of complications by procedure, we were able to demonstrate that overall morbidity follow wedge resections was 11.2% (n=7/62), all of these patients were in the low SVI group. When further examining by indication, there were no patients who underwent RATS Wedge for ILD (N=13) who had a postoperative complication. Per your other comments, we have additionally performed a subset analysis of complications by approach and included it as a supplemental table.
>
> **Changes to Text**: Justification for inclusion of wedge resections based on majority malignant indication has been added to the discussion section, in the limitations paragraph. Subset analysis of complications by approach has been added as supplemental table 1 and briefly mentioned in the results sections.

One frequent complication after thoracic surgery is prolonged air leak. Did the authors include it in the overall complication rate? If not, I believe that it should be included. If yes, it should be reported in Table 3.

> **Reply to Reviewer**: We did not initially include prolonged airleak as it is not traditionally included in NSQIP style outcomes but agree that this is an important morbidity in thoracic surgery. We have updated our data set to include prolonged airleak, defined by >5 days. Across all patients (n=347) there was an air-leak rate of 11.3% which is consistent with rates in the literature following RATS (PMID: 36910080). There were no significant difference in rates of prolonged air leak between high and low SVI groups (15.0% vs 10.7%, p=0.423). When adding in prolonged air leak to count as a morbidity, 5 patients (5 low SVI and 0 high SVI) went from no complications to having at least 1, meaning these 5 patients had prolonged air leaks as their only complication. This changed our overall complication rate in the low SVI group to 24.6%, in the high SVI group to 42.5% and across all patients to 26.9%. This attenuated the p-value slightly, as on repeat analysis, high SVI patients continued to have increased rates of overall morbidity (42.5% vs 24.6%, p=0.017 (up from 0.008)). These updated data also changed our multivariable analysis slightly, now with odds of overall morbidity in the high SVI group (when compared to the low SVI group) being OR 2.53, with a 95% confidence interval (CI) of 1.19-5.35, p=0.015.

Changes to Text: Prolonged air-leak has been added to table 3. This additional altered the overall morbidity count, so the row for any complication in table 3 has been updated as above. Concurrent changes have also been made in the results section (and abstract) to reflect these changes, with updated multivariable analysis.

I am concerned about the small cohort of patients in the high SVI group. The authors should explain how they calculated the necessary sample size

Reply to Reviewer: While we agree that the cohort of patients in the high SVI group is small (n=40) we were evidently powered enough to detect statistical difference in several outcomes. The concern with small sample sizes is traditionally the worry of being underpowered and being unable to detect differences that are actually there (type II error, false negative) (PMID: 20952828). To calculate a ball-park necessary sample size to detect a statical difference we used the standard equation necessary sample size = $[(\text{Z-score})^2 \times (\text{StdDev}) \times (1\text{-StdDev})] / (\text{margin of error set at } 0.05)^2$, which we exceeded.

Changes to Text: No changes to text as low sample size is discussed as a limitation, acknowledging that this is more likely contributing to underpowering detection of a difference.

Page 5, line 155: The authors observed that patients in the high SVI group were more likely to have COPD (p=0.042). The authors should explain in the Discussion if this may influence the results?.

Reply to Reviewer: We agree, any baseline health condition could conceivable influence postoperative outcomes, especially COPD in the thoracic surgery population. We did correct for the presence of comorbidities in our model, however this should be considered.

Changes to Text: We have added acknowledgment of increased COPD history in the highly vulnerable group, and its potential implications on postoperative outcomes in the discussion section.

Results of the multivariate analysis could be shown in a table.

Reply to Reviewer: We agree, and have added a table 4 which includes the results of the multivariable analysis and shown the risk-adjusted predictors of any complication.

Changes to Text: Table 4 has been added to show the risk-adjusted multivariable analysis results.

The authors should report if any patient was discharge with portable drainage.

Reply to Reviewer: All patients were prolonged air-leak (N=36) were reviewed for discharge with a drain, and no patients with discharged with portable drains.

Changes to Text: This has been added to the results section.

It would be interesting a sub-analysis showing % of any complications in the different types of resection in both groups.

Reply to Reviewer: Based on your request, we have performed a subgroup analysis by resection extent and demonstrated in below. The lobectomy subgroup analysis results are consistent with that

of the full analysis (with the exception of no difference in superficial SSI noted on subgroup analysis). This is unsurprising as our cohort was predominantly lobectomies, and lobectomies are likely the only subgroup powered to show difference given limited sample size.

	RATS Lobectomy (N=207)			RATS Segmentectomy (N=51)			RATS Wedge (N=62)		
	Low SVI (N=179)	High SVI (N=28)	P-Value	Low SVI (N=49)	High SVI (N=2)	P-Value	Low SVI (N=52)	High SVI (N=10)	P-Value
Superficial SSI	10 (5.6%)	4 (14.3%)	0.103	1 (2.0%)	1 (50.0%)	0.078	1 (1.9%)	0 (0.0%)	0.658
Deep SSI	0 (0.0%)	0 (0.0%)	-	1 (2.0%)	0 (0.0%)	1.000	0 (0.0%)	0 (0.0%)	-
Pneumothorax	9 (5.0%)	3 (10.7%)	0.210	2 (4.1%)	0 (0.0%)	1.000	1 (1.9%)	0 (0.0%)	1.000
Hemothorax	0 (0.0%)	2 (7.1%)	**0.018**	0 (0.0%)	0 (0.0%)	-	0 (0.0%)	0 (0.0%)	-
Pleural Effusion	1 (0.6%)	0 (0.0%)	1.000	1 (2.0%)	0 (0.0%)	1.000	1 (1.9%)	0 (0.0%)	1.000
Pneumonia	6 (3.4%)	1 (3.6%)	1.000	0 (0.0%)	0 (0.0%)	-	0 (0.0%)	0 (0.0%)	-
Therapeutic Bronchoscopy	2 (1.1%)	1 (3.6%)	0.355	1 (2.0%)	0 (0.0%)	1.000	0 (0.0%)	0 (0.0%)	-
Prolonged Air Leak	23 (12.8%)	6 (21.4%)	0.224	0 (0.0%)	0 (0.0%)	1.000	1 (1.9%)	0 (0.0%)	1.000
ICU Upgrade	7 (3.9%)	6 (21.4%)	**<0.001**	4 (8.2%)	0 (0.0%)	1.000	2 (3.8%)	0 (0.0%)	1.000
Sepsis	2 (1.1%)	3 (10.7%)	**0.019**	1 (2.0%)	1 (50.0%)	0.078	0 (0.0%)	0 (0.0%)	-
Septic Shock	2 (1.1%)	1 (3.6%)	0.355	0 (0.0%)	0 (0.0%)	-	0 (0.0%)	0 (0.0%)	-
Arrythmia	5 (2.8%)	3 (10.7%)	0.078	4 (8.2%)	0 (0.0%)	1.000	2 (3.8%)	0 (0.0%)	1.000
Cardiac Arrest	1 (0.6%)	0 (0.0%)	1.000	0 (0.0%)	0 (0.0%)	-	0 (0.0%)	0 (0.0%)	-
Conversion to Open	4 (2.2%)	2 (7.1%)	0.188	0 (0.0%)	0 (0.0%)	-	0 (0.0%)	0 (0.0%)	-
Return to Operating Room	0 (0.0%)	2 (7.1%)	**0.018**	1 (2.0%)	0 (0.0%)	1.000	0 (0.0%)	0 (0.0%)	-
Any Complication	48 (26.8%)	16 (57.1%)	**0.001**	14 (28.6%)	1 (50.0%)	0.506	7 (13.5%)	0 (0.0%)	0.586
ED Presentation	16 (8.9%)	5 (17.9%)	0.146	0 (0.0%)	0 (0.0%)	1.000	0 (0.0%)	0 (0.0%)	-
Readmission	12 (6.7%)	3 (10.7%)	0.434	7 (14.3%)	0 (0.0%)	1.000	2 (3.8%)	0 (0.0%)	1.000

Changes to Text: This analysis has been added as supplemental table 1 and briefly mentioned in the results sections.

Discussion: Is there any published literature regarding VATS and open?

Reply to Reviewer: There are three existing studies examining SVI and lung resection, by Diaz et al. (now references 22 and 24) and Hyer et al. (now reference 23). Notably, these studies do not specify operative approach in the lung resection cohorts. Presumably, these cohorts include all approaches since it is not mentioned. Our data supports, and confirms these prior findings and builds upon them by demonstrating the specific complications affected by socioeconomic status while using more discrete census-tract level information rather than county level data, and focusing on the RATS approach which is reflective of the modern era of thoracic surgery.

Changes to Text: The additional study by Diaz (now reference #22) has been added to the discussion section, in the context of the additional two references (#23/24) with acknowledgment that approach is not discussed in the current literature.

Page 4, line 101: The authors should state if the colectomy and esophagectomy procedures included in the cited studies are minimally invasive.

Reply to Reviewer: Both studies include minimally invasive approaches in their cohorts.

Changes to Text: The inclusion of minimally invasive approaches in these studies has been added to the introduction section.

Methods: The authors should state if the operating time includes docking.

Reply to Reviewer: Our operative times do include robotic docking time.

Changes to Text: We have added this statement to the methods section, under the study design sub-header

Page 6, line 168: This sentence is not well explained. Could the authors rewrite it in order to be more clear?

> **Reply to Reviewer**: We agree that this sentence is convoluted, it has been simplified.
>
> **Changes to Text**: The suggested sentence has been simplified to "*high SVI was associated with increased rates of several complications including…".*

Reviewer D

Thanks for giving me the chance to review this interesting manuscript, which attempts to relate social vulnerability with post-operative complications after RATS lung resections. I have to congratulates the authors for the quite well written manuscript. Social vulnerability is an emerging topic in the surgical field, which is worth to be still deeply analyzed in thoracic surgery, therefore I think this work is worth to be considered for publication.

I have the following concerns, which should be addressed before considering the work suitable for publication:

It would be interesting to report in Table 3 also the results from multivariable analysis, though, as you have correctly underlined, the low number of events doesn't allow fair comparison

> **Reply to Reviewer**: The individual complications are not powered for multivariable analysis as discussed, as such the authors do not feel it appropriate to add.
>
> **Changes to Text**: No changes given statistical limitations.

Surgical procedures were performed by the same equipe of surgeons? They are board-certified for RATS? please add this info

> **Reply to Reviewer**: Yes, all of our surgeons are board-certified thoracic surgeons with the appropriate certifications to perform robotic-assisted lung resections. Our group, where able, preferentially performs lung resections using the robotic-assisted approach due to advantages of improved visualization and dexterity. We do however additionally perform open and video-assisted thoracoscopic approaches when indicated based on patient or other preoperative factors.
>
> **Changes to Text**: The details regarding our four board-certified thoracic surgeons have been added to the methods section, under the study design sub-header.

Why do you think the increased incidence of complications on high SVI group didn't reflect on prolonged hospital stay? Please comment on this

> **Reply to Reviewer**: Thank you. We have added in more direct recognition of no change in length of stay to the results section. This is an interesting observation and at this point we do feel that our comparison here is limited by sample size. Additionally, it is possible that the overall observed difference in morbidity is driven by superficial SSI, many of which are detected on outpatient follow-up and thus do not affect index length of stay.

Changes to Text: Discussion regarding the observation that despite increased complications in the high SVI group, there was no difference in hospital length of stay has been added to the discussion section, limitations section.

Lines 187-188, social vulnerability definition in healthcare should be referenced

Reply to Reviewer: Thank you we agree this phrasing warrants citation, PMID:35431543

Changes to Text: The appropriate citation has been added, now new reference #20.

Please, report a figure showing 16 variables of SVI

Reply to Reviewer: We agree that this would be helpful to the reader.

Changes to Text: A figure showing the 16 variables of SVI has been added to the manuscript as Figure 1.

The following references should be addedd e properly discussed: (1) Diaz A, Dalmacy D, Hyer JM, Tsilimigras D, Pawlik TM. Intersection of social vulnerability and residential diversity: Postoperative outcomes following resection of lung and colon cancer. J Surg Oncol. 2021 Oct;124(5):886-893. doi: 10.1002/jso.26588. Epub 2021 Jul 1. And (2) Hyer JM, Tsilimigras DI, Diaz A, Mirdad RS, Azap RA, Cloyd J, Dillhoff M, Ejaz A, Tsung A, Pawlik TM. High Social Vulnerability and "Textbook Outcomes" after Cancer Operation. J Am Coll Surg. 2021 Apr;232(4):351-359. doi: 10.1016/j.jamcollsurg.2020.11.024.

Reply to Reviewer: Thank you for your suggestions, we agree.

Changes to Text: The first reference provided has been added and discussed as new reference #23, and the second reference you provided has been added and discussed as new reference #22.