Diagnostic yield, complications, and downstream lung cancer treatment after shape-sensing robotic-assisted bronchoscopy (ssRAB) compared to transthoracic needle aspiration biopsy

Sam E. Wing[1], Adam Gaertner[1], I-Fan Shih[1], Yuki Liu[1]

[1]Intuitive Surgical, Sunnyvale, CA USA

BACKGROUND

For patients with suspected lung cancer nodules, **shape-sensing robotic-assisted bronchoscopy (ssRAB) may offer improved diagnostic yields with a strong safety profile.**[1,2] This could improve access to curative treatments for patients despite the higher upfront cost of a navigational bronchoscopic biopsy compared to percutaneous biopsy methods. **Faster access to treatment can also prevent adverse outcomes like upstaging and cancer progression, which can negatively impact patient survival**.[3]

Using a large, US-based RWE database, we analyze the biopsy results and downstream lung cancer treatments of patients undergoing either transthoracic needle aspiration (TTNA) or ssRAB lung nodule biopsies.

METHODOLOGY

Data Source:
Premier Healthcare Database
- Patient-level data from hospital discharges in the United States

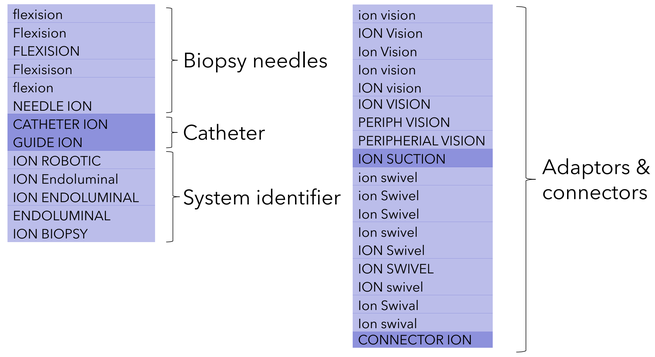
Patient Identification:
TTNA Patients: CPT & ICD 10-PCS codes*
ssRAB: Billing text strings (see case identification)
Solitary pulmonary nodules: ICD 10-CM codes*

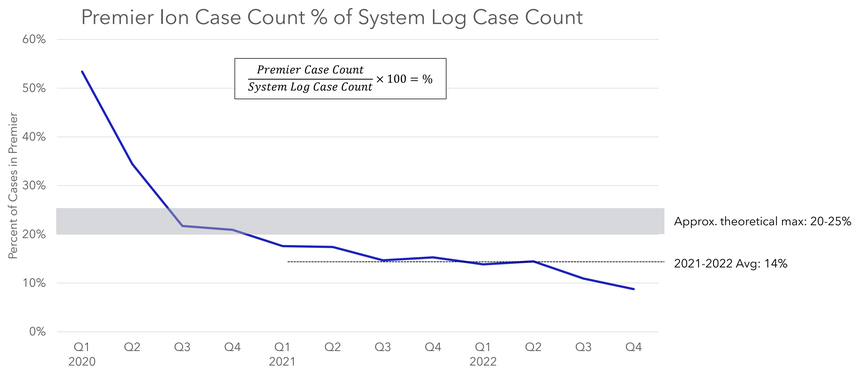
Follow Up:
Patients were followed for 1 year after their index biopsy encounter

Statistical Analysis:
Propensity score matching was performed to compare complication rates. The propensity score was built using:
- Admission type
- Age
- Gender
- Race/ethnicity
- Charlson Comorbidity Index
- Obesity
- Physician volumes

ssRAB CASE IDENTIFICATION

ssRAB cases were identified using the following text strings found in bronchoscopy billing files:





RESULTS

Patient Population:
Among 159,961 patients receiving a biopsy, **2.8% (n=4,337) underwent an ssRAB** and 97.2% (n=152,594) underwent TTNA.

Diagnostic Results:
62% of ssRAB patients vs 52% of TTNA patients had a diagnostic result with a malignant pathology. 38% of ssRAB malignancies and 27% of TTNA malignancies received cancer treatment in the database.

Downstream Cancer Treatments:
Surgery (27.9%) or radiotherapy (27.4%) were the most common treatment approaches, with **surgery and radiotherapy occurring 2.3x and 1.4x more often among ssRAB patients vs. TTNA patients**.

Complications:
The unadjusted **odds ratio of a pneumothorax was 9.13 (p < 0.001)** comparing TTNA to ssRAB outpatient cases. The unadjusted **odds ratio of a pneumothorax with a chest tube intervention was 13.07 (p < 0.001)** comparing TTNA to ssRAB outpatient cases. This relationship was materially unchanged after propensity score matching.

Pneumothorax Diagnosis (2020 - 2023)	Ion	TTNA
Total Procedures w/ SPN Diagnosis (n)	3,823	61,123
Inpatient (n, %)	19 (0.5%)	14,886 (24.4%)
Outpatient (n, %)	3,804 (99.5%)	46,237 (75.6%)
Pneumothorax diagnoses, 0-3 days post bx (n, %)	**37 (1.0%)**	**4,112 (8.9%)**
7-day reencounter rate (n, %)	2 (5.4%)	1,439 (35.0%)
Reencounter LOS (Mean, SD)	0 (0)	0.15 (0.75)
Pneumo. dx w/ chest tube, 0-3 days post bx (n, %)	**10 (0.3%)**	**1,589 (3.4%)**
7-day reencounter rate (n, %)	2 (20.0%)	576 (36.2%)
Reencounter LOS (Mean, SD)	0 (0)	0.13 (0.63)

STRENGTHS + LIMITATIONS

Strengths:
- Identification of ssRAB patients in a large, RWD source is a novel approach & helps generalize findings from smaller clinical studies

Limitations:
- Claims database has limited clinical information, including nodule size and tumor pathology
- Lost-to-follow-up occurred if patients received treatment at an outside facility

CONCLUSION

- Patients undergoing an ssRAB were more likely to receive a malignant diagnosis, possibly improving their ability to expedite entry into the treatment path and avoid the negative consequences of delaying cancer care
- ssRAB was also linked to a higher continuity of care, where patients were more likely to receive treatment within the same hospital
- TTNA encounters were significantly more likely to result in a complication, demonstrating ssRAB's strong safety profile
- Future studies should evaluate the impact of ssRAB on other adverse biopsy outcomes (e.g hemorrhage and repeat biopsies), especially among patients with small lung nodules

***Procedure & Diagnosis Codes**
TTNA Procedure Codes: 32400, 32405, 32408, 0B9N3ZX, 0B9N4ZX, 0B9P3ZX, 0B9P4ZX, 0BB33ZX, 0BB34ZX, 0BB43ZX, 0BB44ZX, 0BB53ZX, 0BB54ZX, 0BB63ZX, 0BB64ZX, 0BB73ZX, 0BB74ZX, 0BB83ZX, 0BB84ZX, 0BB94ZX, 0BBB3ZX, 0BBB4ZX, 0BBC3ZX, 0BBC3ZX , 0BBC4ZX, 0BBD3ZX, 0BBD3ZX , 0BBD4ZX, 0BBF3ZX, 0BBF3ZX , 0BBF4ZX, 0BBG3ZX, 0BBG3ZX , 0BBG4ZX, 0BBH3ZX, 0BBH3ZX , 0BBH4ZX, 0BBJ3ZX, 0BBJ3ZX , 0BBJ4ZX, 0BBK3ZX, 0BBK4ZX, 0BBL3ZX, 0BBL3ZX , 0BBL4ZX, 0BBM3ZX, 0BBM3ZX , 0BBN3ZX, 0BBN4ZX, 0BBP3ZX, 0BBP4ZX, 0BD34ZX, 0BD44ZX, 0BD54ZX, 0BD64ZX, 0BD74ZX, 0BD84ZX, 0BD94ZX, 0BDB4ZX, 0BDC4ZX, 0BDD4ZX, 0BDF4ZX, 0BDG4ZX, 0BDH4ZX, 0BDJ4ZX, 0BDK4ZX, 0BDL4ZX, 0BJ04ZZ, 0BJK4ZZ, 0BJL4ZZ, 0W993ZX, 0W994ZX, 0W9B3ZX, 0W9B4ZX, 0WBC3ZX
Pneumothorax Diagnosis Codes: J93, J93.0, J93.1, J93.11, J93.12, J93.8, J93.82, J93.83, J93.9, J95.811, J95.812,
Chest Tube Procedure Codes: 0W980ZZ, 0W9830Z, 0W983ZZ, 0W9840Z, 0W984ZZ, 0W9900Z, 0W990ZZ, 0W9930Z, 0W993ZZ, 0W9940Z, 0W994ZZ, 0W9B0ZZ, 0W9B30Z, 0W9B3ZZ, 0W9B40Z, 0W9B4ZZ,

Selected References:
1. Yarmus L, Akulian J, Wahidi M, et al. A Prospective Randomized Comparative Study of Three Guided Bronchoscopic Approaches for Investigating Pulmonary Nodules: The PRECISION-1 Study. Chest. 2020;157(3):694-701.
2. Simoff MJ, Pritchett MA, Reisenauer JS, et al. Shape-sensing robotic-assisted bronchoscopy for pulmonary nodules: initial multicenter experience using the Ion™ Endoluminal System. BMC Pulmonary Medicine. 2021;21(1):322.
3. Mohammed N, Kestin LL, Grills IS, et al. Rapid Disease Progression With Delay in Treatment of Non-Small-Cell Lung Cancer. International Journal of Radiation Oncology*Biology*Physics. 2011;79(2):466-472.