A first for Robotic Navigational Bronchoscopy and the Use of “Tele-ROSE” in diagnosing lung pathology.

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Introduction

- Lung cancer is the most common cause of cancer death worldwide in 2020, estimated at 1.80 million deaths, according to WHO. Lack of access to timely diagnosis and treatment is a major contributing factor in the morbidity and mortality associated with lung cancer.
- The standard of care for diagnosing and staging lung cancer remains tissue biopsy, preferably obtained via minimally invasive method such as endoscopy.
- In diagnosing malignancy or lung pathology, the adequacy of tissue specimens are ideally assessed with ROSE (rapid onsite evaluation) and a cytopathologist. It is unknown how many institutions currently utilize ROSE worldwide.
- Due to the financial constraints of the COVID-19 pandemic, an onsite pathologist for timely sample evaluation was not always available. This pilot study is presented as the first instance of teleROSE being utilized in navigation robotic bronchoscopies in identifying peripheral lung lesions with high suspicion for malignancy.

Methodology

- A total of 53 patients with peripheral lung lesions accessible with navigation bronchoscopy/EBUS with high suspicion for malignancy were included.
- Pre-intervention is where the patient sample would be obtained and driven to an outlying hospital for adequacy assessment by a cytopathologist. The patient would remain on the table under anesthesia while the sample was evaluated.
- Post intervention included a cytopathology technician who prepared and streamed the slides in real time using a Leica Flexacam C3 with an Olympus BX43 Microscope (Figure 1), over the Webex video conferencing platform. A secure hospital internet connection allowed the pathologist, at an outlying facility to assess for adequacy. The primary endpoint was measuring the time to calling a specimen for adequacy.
- 28 patients evaluated the traditional way (pre-intervention) and controlled for confounding factors like demographics and staging of cancer were compared to the outcomes of 27 patients evaluated with teleROSE (post-intervention).
- JMP 16.1.0 was used for the statistical analysis to evaluate the significance for the turnaround time between the pre-intervention and post-intervention condition (see Figure 5).

Figure 1: Workflow setup within the bronchoscopy suite. (1) refers to the Leica Flexacam C3, connected to (2) the Olympus BX43 Microscope. Live images from the microscope are broadcasted (3) for the interventional pulmonologist. (4) shows the overall mobile station that the cytotechnologist uses to communicate with the remote pathologist at another institution.

Results

- TeleROSE reduced the time to call adequacy from 23 minutes to 8 minutes.
- Access to right upper lobe (RUL) increased from 23% to 32% and left upper lobe (LUL) increased from 23% to 38% after implementation of TeleROSE (see Figure 2 and 3).
- Rate of malignancy detection of 66.67% for inadequate samples pre-intervention was reduced to 23% for adequate samples with the use of streaming system.

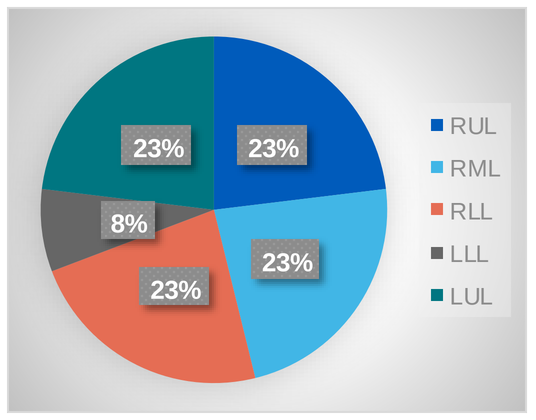


Figure 2: Sites Accessed Before Using TeleROSE.

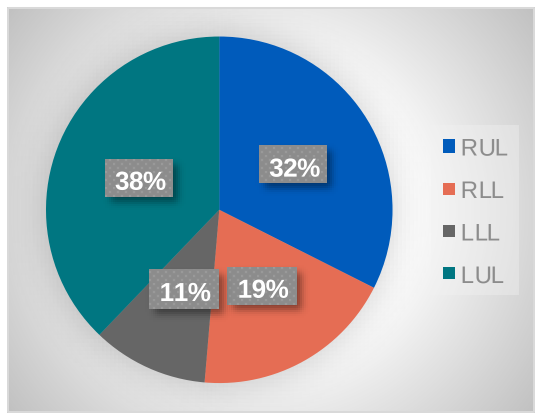
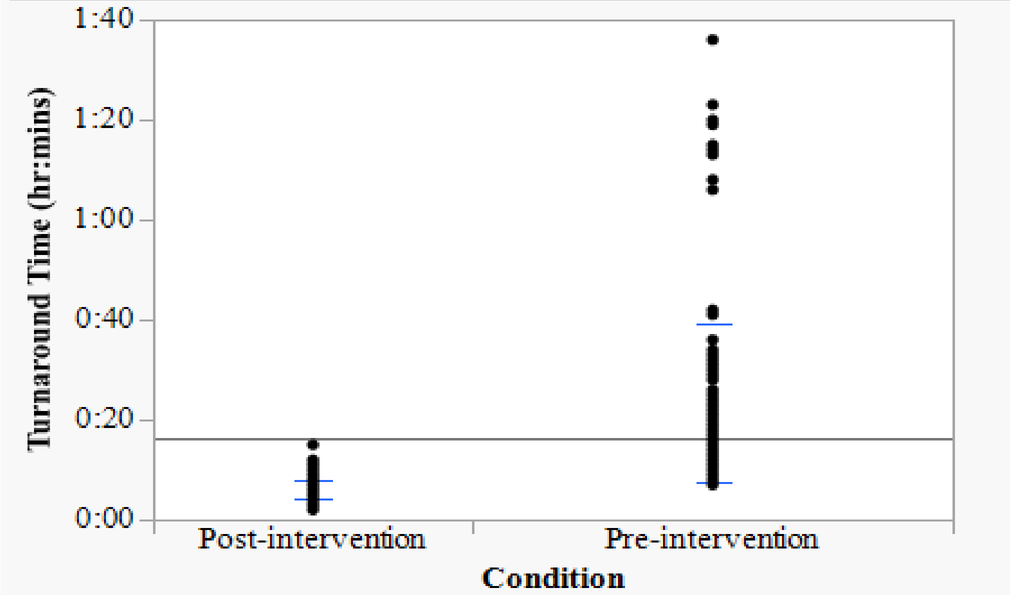
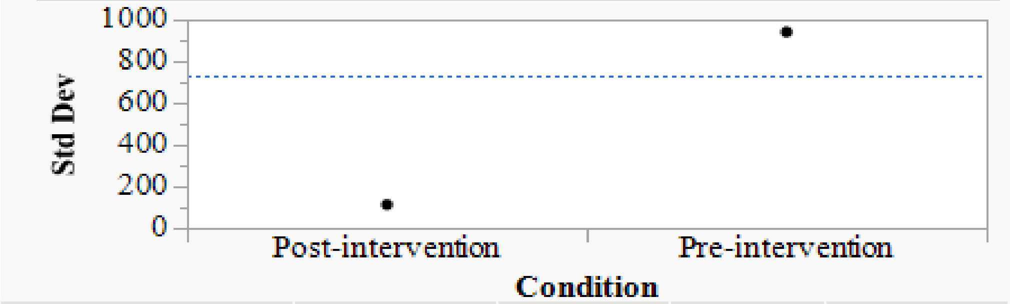


Figure 3: Sites Accessed After Using TeleROSE.

Oneway Analysis of Turnaround Time (hr:mins) By Condition



Tests that the Variances are Equal



Test	F Ratio	DFNum	DFDen	p-Value
O'Brien[.5]	11.7954	1	271	0.0007*
Brown-Forsythe	32.1555	1	271	<.0001*
Levene	50.9518	1	271	<.0001*
Bartlett	319.6762	1	.	<.0001*
F Test 2-sided	68.2305	163	108	<.0001*

t Test

Pre-intervention-Post-intervention

Assuming unequal variances

Difference	1039.93	t Ratio	14.00664
Std Err Dif	74.25	DF	170.1432
Upper CL Dif	1186.50	Prob > |t|	<.0001*
Lower CL Dif	893.37	Prob > t	<.0001*
Confidence	0.95	Prob < t	1.0000

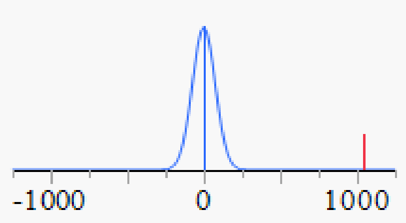


Figure 4: Statistical analysis of turnaround time in minutes pre and post use of TeleROSE

Discussion

- From the statistical analysis, this platform is a viable option to not have in-house ROSE, but rather using telemedicine to assess the adequacy of peripheral nodule specimens.
- Levene and F-Test for turnaround time were statistically significant with a p value < 0.05 (see Figure 4). Furthermore, the t-test for unequal variance using an alpha of 0.05 had a p value < 0.05. The 95% confidence interval on the mean difference does not include zero, indicating that the difference in the means (for the turnaround time) is significantly different.
- The use of teleROSE, allowed us to go after more upper lobe targets, which shows the increase in sampling rate of the upper lobes, post-teleROSE implementation.
- The average cost of telemedicine implementation systems is anywhere from $30,000 to $150,000.
- On an institutional level, TeleROSE bypasses the need for expensive licensing fees for proprietary streaming platforms. This includes the cost for the devices ($200 x 50 = $10,000), server infrastructure (($1,000 per 10 devices) x 5 = $5,000), Software ($99/month x 50 = $4,950/month x 12months = $59,400/year), Setting up and deployment- 3 business days ($50/hour x 8 x 3 = $1,200), DevOps to manage the system 24/7 ($50/hour x 24 x 7 = $8400/week x 52 weeks = $436,800/year) (Helpi et al).
- From the standpoint of the patient, the time under anesthesia is reduced, which would improve safety outcomes and reduce risk of complications related to prolonged anesthesia.

Conclusion

- TeleROSE was an effort to deliver standard of care to patients while adapting to scarcity in the wake of the COVID-19 pandemic.
- To flourish with this modality, a remote institution with limited resources would only need an available pathologist, a cytopathology technician, a microscope, and a secure internet connection.
- It may become a new standard model for physicians to deliver essential equitable services/care globally. Reducing the overall time from diagnosis to treatment will increase efficiency and decrease costs, without compromising on accuracy.

No financial or conflicts of interest to disclose

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