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Case Series: Point-of-Care Ultrasound on Oncology Inpatients with Respiratory Abnormalities

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Abstract

Background: Here, we present for the first time a case series demonstrating the ability of Point of Care ultrasonography (POCUS) to contribute clinically significant findings, which may affect the management of oncologic inpatients with respiratory symptoms.

Methods: We present a pilot, prospective case series of 13 patients with various malignancies admitted to the inpatient oncology ward at a large tertiary medical center. Patients presenting dyspnea or other respiratory abnormalities were examined by POCUS of the heart, lungs, and IVC. Exam findings were delivered to the patients' treating physicians with no other treatment or management recommendations. Our primary outcome was to assess the association between POCUS findings and the rate of management change among oncology patients with respiratory symptoms (i.e., administration of a new medication, new consult, new procedure, or transfer of a patient to another ward).

Results: Thirteen cancer patients admitted to the oncology ward who presented with dyspnea or developed a respiratory abnormality during their hospital stay were enrolled in the study. All received POCUS assessment for dyspnea. The POCUS exam revealed clinically relevant findings and led to alteration management among 11/13 (84%) of patients. Among 6/11 (54.5%) patients, a new procedure was performed (four pleural taps, one pleural drain was removed, one dialysis), in 3/11 patients (27.2%) a new imaging study was ordered (echocardiography in all cases), in 2/11 patients (18.1%) a new consult was requested, and in 3/11 patients (27.2%) a change in medical management was made based on POCUS findings.

Conclusion: This case series shows that the incorporation of POCUS exam into routine diagnostic workup of patients admitted to the oncological ward with new respiratory abnormalities does lead to frequent change in patient management and may potentially improve patient outcomes. The potential information provided from this study may be instrumental in the initial workup and working diagnosis of a patient presenting with acute symptoms.

Keywords: Dyspnea; Point of care ultrasound; Oncology; Cancer patients; POCUS

Introduction

Dyspnea, defined as an awareness of breathing discomfort, can significantly affect the quality of life of patients with cancer, with and without lung involvement [1,2]. Dyspnea occurs in 21-78.6% of advanced cancer patients, with reported severity of moderate to severe degrees in 10-63% of the patients [3]. Dyspnea may occur due to tumor progression, side effects of therapy, or an independent cause. Diagnosis of dyspnea and assessment of its severity depends on the clinical history and physical examination [1].

An additional tool, Point of Care ultrasonography [POCUS], is a useful modality in which ultrasonography is performed in real-time at the bedside of the patient by the treating physician [4]. POCUS images are obtained immediately, therefore allowing findings to be incorporated into diagnostic assessments and treatment options without interruption [5]. In fact, bedside ultrasonography has been shown to be a sensitive and specific means of diagnosing lung pathologies [6].

POCUS performed on the heart, lungs, and abdomen in addition to physical examination, may reveal significant clinical findings which were previously unknown to the primary treating team such as LV or RV dysfunction, ascites, pericardial/pleural effusion, pulmonary edema, valvular dysfunction, deep vein thrombosis and volume status of the patient (hypovolemia or hypervolemia) [7-11].

Although POCUS has been widely studied in various populations of patients, especially in the emergency room and intensive care unit settings [10,11], to the best of our knowledge, the utility of POCUS in a sub-acute setting such as in oncology inpatients has not yet been studied.

In this case series we present the contribution of POCUS in the change of management of oncologic inpatients with respiratory symptoms.

Methods

This study was designed as a pilot, single-center, prospective trial which took place at Soroka University Medical Center, a 1,200-bed university-affiliated referral center in Southern Israel, serving a population of approximately one million.

Patient enrollment took place between November 2016 to January 2019 in the oncology ward. A total of 13 cancer patients were identified during the study period who fulfilled the inclusion criteria as follows:

Inclusion criteria

Age >18, admission to the Oncology ward, dyspnea, respiratory rate (RR) >20, O2 Saturation <90%, increased oxygen requirement, a new requirement for non-invasive ventilation or mechanical ventilation, new-onset cough, chest pain.

Exclusion criteria

Cognitive impairment or inability to sign informed consent, patients who were given a prior consult by one of the POCUS operators pre-enrollments, myocardial infarction, pulmonary embolism established by computed tomography angiography (CT-A).

Clinical data including basic demographic information (Table 1), type of malignancy (Figure 1), past medical history, smoking history, use of home oxygen, use of home BIPAP/CPAP were recorded.

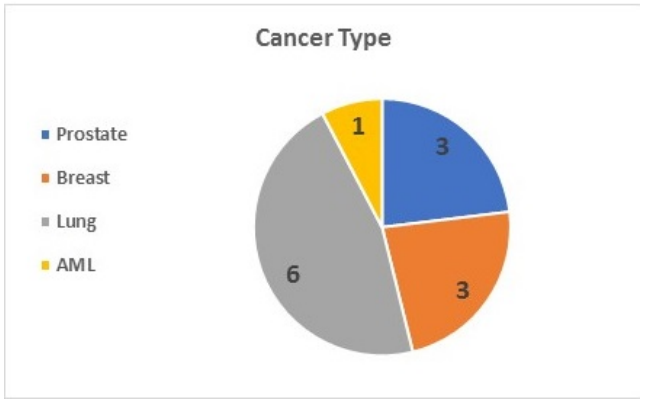

Figure 1: Types of Malignancies in the Study Population-Types of malignancies amongst the study population (n=13); Lung cancer 6/13 (46.2%), breast cancer 3/13 (23.1%), prostate cancer 3/13 (23.1%), AML 1/13 (7.7%), AML: Acute myeloid leukemia.

The study was approved by the hospital ethics research committee, number SOR- 0217-16. All patients provided written informed consent prior to enrollment.

N=13	
Mean Age (years)	64.6 ± 12.52
Sex	
Male	11 (84.6%)
Female	2 (15.4%)
Relevant medical history	
COPD	5 (38.5%)
Congestive Heart Failure	1 (7.7%)
Hypertension	7 (53.8%)
Diabetes Mellitus	3 (23.1%)
Ischemic Heart disease	3 (23.1%)
Prior DVT /PE	2 (15.4%)
Dyslipidemia	2 (15.4%)
CKD\ESRD	2 (15.4%)
Smoking status	
Non-smoker	7 (53.8%)
Present or past	6 (46.2%)
Home Oxygen	3 (23.1%)
Home BIPAP\CPAP	1 (7.7%)
Cancer type	
Lung	6 (46.2%)
Breast	3 (23.1%)
Prostate	3 (23.1%)
Leukemia	1 (7.7%)
Background demographics, study population = 13 patients.	
COPD: Chronic Obstructive Pulmonary Disease; DVT: Deep Vein Thrombosis; PE: Pulmonary Embolism; CKD: Chronic Kidney Disease; ESRD: End Stage Renal Disease; BIPAP: Bilevel Positive Airway Pressure; CPAP: Continuous Positive Airway Pressure.	

Table 1: Demographics of the study population.

Patient screening and enrollment

All patients completed a routine primary assessment conducted by the primary treating oncology team prior to POCUS assessment according to the standard of care, including medical history, physical examination, and initial laboratory and imaging tests.

Patients who were admitted with an initial chief complaint of dyspnea or developed a respiratory abnormality during their hospital stay, as described in the inclusion criteria, were enrolled in the study.

Within 24 hours from patients' admission to the oncology ward or from the time of development of respiratory abnormality, medical records were reviewed by one of the study coordinators, and eligible patients were enrolled after informed consent was signed.

Once enrolled, patients' demographics and medical data were collected and recorded. The primary oncology team, after routine assessment of the patient (without POCUS), completed the form 'Clinical Findings on Admission or Before POCUS Assessment' (Supplementary Figure 1), identifying the factors in which they believed were contributing to the patient's respiratory symptoms.

Point of care ultrasound protocol

Following enrollment, a focused sonographic assessment of the heart, lungs, and IVC was performed at the bedside, as early as possible but not beyond 24 hours from the time of onset of respiratory symptoms or from ward admission (if the reason for admission was dyspnea). The exam was conducted by the research team, external to the primary team assessment of the patient. The exam was done according to our local point of care ultrasonography protocol, which is based on accepted international POCUS guidelines [12,13]. In short, the protocol includes: 1) Cardiac assessment using Standard TTE and IVC views evaluating the ventricular and valvular function and abnormalities, volume status and presence of pericardial fluid, 2) Lung and pleural space assessment searching for B lines, pleural effusion, or signs of atelectasis or lung consolidation.

Two Ultrasound machines were used: GE Vivid S70 with Cardiac Sector Probe M5Sc-D and ESaote Italy/MyLab 5/cardiac probe PA121, Naples, Italy. Echocardiography views were used with both two dimensional and color Doppler imaging modalities for the examination.

Upon the completion of the POCUS exam, a full report (Supplementary Figure 2) was delivered by one of the study coordinators to the treating physician in the oncology ward, both written and orally. Results of POCUS were recorded to the patients' electronic medical records. Trying to isolate the effect of POCUS findings on patient management, no treatment or diagnostic recommendations were given by the POCUS operator. The principle behind this design was to enable an early POCUS assessment to the primary team, but with no further treatment or management recommendations given from the POCUS operatory. After receiving the POCUS report, the treating oncologist rated the relevance of POCUS findings and clinical implications of the study by filling out the form entitled "Post POCUS evaluation" (Supplementary Figure 3).

Our primary outcome was to measure the rate and describe new, previously unknown, and clinically significant findings discovered by POCUS. Clinically significant findings were defined as findings that may potentially result in a change of management or diagnostic measures (Table 2). In each case, we identified alterations in the management of the patients by virtue of POCUS findings such as a change in medical management, the performance of a procedure, transfer of a patient to a different ward, or request of a new consult.

Table A	
Findings	**Number of patients with this POCUS finding, n=13**
LV dysfunction	1 (7.6%)
LVH	1 (7.6%)
RVH	1 (7.6%)
Proximal DVT ruled out	1 (7.6%)
Lung consolidation	1 (7.6%)
Hypovolemia or hypervolemia	2 (15.3%)
Pulmonary HTN	1 (7.6%)
Valvulopathy	3 (23.0%)
Heart failure	1 (7.6%)
Pericardial effusion (any size)	1 (7.6%)
Atelectasis	7 (53.8%)
Large sized pleural effusion	3 (23.0%)
Moderate sized pleural effusion	1 (7.6%)
Small sized pleural effusion	3 (23.0%)
Arrhythmia	1 (7.6%)
Pulmonary congestion	2 (15.3%)
Normal scan	2 (15.3%)
Table B	
Relevance of POCUS	

1 (low)	1 (7.6%)
2	2 (15.3%)
3	0 (0%)
4	3 (23%)
5 (high)	7 (53.8%)
Did the exam provide new information?	
No	1 (7.6%)
Yes. New information was NOT clinically relevant to the current admission	4 (30.7%)
Yes. New information WAS clinically relevant to the current admission	9 (69.2 %)
Did the exam alter management? by the following:	
Medical treatment	3 (23.0%)
Imaging study performed	3 (23.1%)
Consult requested	2 (15.4%)
Intervention performed	6 (46.2%)
Table A. Various findings of the POCUS study of the heart, lungs, and proximal veins.	
Table B. Relevance of the POCUS study findings as rated by the primary treating oncologist and the way in which management was altered based on the new POCUS findings as provided by the study.	
LV: Left Ventricle; LVH: Left Ventricle Hypertrophy; RVH: Right Ventricle Hypertrophy; DVT: Deep Vein Thrombosis; HTN: Hypertension; POCUS: Point of Care Ultrasound.	

Table 2: POC US Findings and the Effect on Management.

Results

Thirteen cancer patients, with various types of malignancies, admitted to the oncology ward who presented with dyspnea or developed a respiratory abnormality during their hospital stay were enrolled in the study and received POCUS assessment for dyspnea (Supplementary Table 1). The POCUS exam revealed clinically relevant findings and led to alteration management among 11/13 (84%) of patients. Amongst these 11 patients in which POCUS exam findings revealed clinically significant information, in 6/11 (54.5%) patients a new procedure was performed (four pleural taps, one pleural drain was removed, one dialysis), in 3/11 patients (27.2%) a new imaging study was ordered (echocardiography in all cases), in 2/11 patients (18.1%) a new consult was requested (one nephrology, one surgery), and in 3/11 patients (27.2%) a change in medical management was made based on POCUS findings (two initiation of heart failure treatment and one initiation of antibiotics for suspected pneumonia). Amongst the cases (2/13, 15.4%) in which POCUS did not expose clinically relevant information was one case in which POCUS revealed a normal heart and lung study, and results were thus deemed irrelevant to the treating team. In the second case, POCUS revealed bilateral pleural effusions which were previously suspected by the primary team by initial history, physical exam, and routine chest x-ray performed in the emergency department prior to admission.

Discussion

While point-of-care ultrasound (POCUS) is widely used in the acute setting of the emergency room as well as by internal physicians, pulmonologists, thoracic surgeons, and intensivists, little is known about its use in the subacute setting, such an inpatient oncology ward. Bedside US can diagnose lung pathologies such as pleural effusion, alveolar consolidation, and alveolar-interstitial syndrome [6] in critically ill patients with up to 96% accuracy.

This presented case-series study, to the best of our knowledge, is the first attempt to investigate the effect of early POCUS assessment on diagnosis and management among patients admitted to the oncological ward with new-onset respiratory abnormalities. We found that POCUS was an effective tool in both evaluating the root cause of dyspnea in oncological patients.

It was recently suggested that POCUS is the fifth pillar of physical examination [14]. Therefore, it is not surprising to see this tool used primarily in the acute setting, mainly the ER, OR and ICU departments [15]. While there are initiatives to promote POCUS training amongst internal medicine physicians [16], there is no evidence of POCUS training across sub-acute settings, such as amongst oncologists.

The oncology department hosts patients that often experience dyspnea both as a primary pathology or secondary to malignancy, causing a significant impact on disease progression and quality of life [17]. Dyspnea, in an advanced cancer patient, may allude to poor prognosis and functional decline. In a complicated oncological patient,

often with metastatic features and other active medical illnesses, new onset-dyspnea can be difficult to interpret by the oncological clinician. There are numerous protocols regarding dyspnea among oncology patients, according to the recent European Society for Medical Oncology (ESMO) guidelines dyspnea management requires physical and technical examinations (complete blood count, electrolytes, creatinine, oximetry, and full blood gas assessment, electrocardiogram, brain natriuretic peptide or chest X-ray and computed tomography scan) [18]. However, transporting a dyspneic patient from the ward to perform imaging studies is not always safe nor immediately available, and waiting for blood analysis takes time and may not reveal the exact cause of dyspnea.

As POCUS is part of the nowadays acute setting, we propose using POCUS as well in the sub-acute setting. Our study, using POCUS, revealed clinically relevant findings that led to alteration management among 11/13 (84%) of patients.

A case of note was a-66-year-old male with a history of lung cancer, hypertension, COPD, and congestive heart failure who was admitted due to fever and dyspnea. With POCUS, severe decompensated heart failure and significant pulmonary hypertension were discovered. As a result, medical treatment was promptly initiated, and formal imaging was ordered.

Another case to highlight was a 69-year-old male with a history of lung cancer, ischemic heart disease, and chronic kidney failure, who was admitted due to fever and shortness of breath. Using POCUS, a large left sided pleural effusion was discovered, and drainage of the fluid was performed immediately without interruption. In these cases, POCUS assessment proved to be a crucial diagnostic step and prevented respiratory failure.

Due to difficulty coordination between the POCUS operator and the oncology department, recruiting patients was difficult. Nevertheless, we present a few subjects but with an extremely high percentage of management change due to POCUS bedside utilization. Further studies need to be done to establish POCUS as an integral part of the sub-acute settings.

The results presented in our case series study show that there is value in considering POCUS as an adjunct to the initial workup of patients, as a wide range of therapeutic tools were subsequently used. No previous study, among oncologic dyspneic patients, ever assessed the association of POCUS and management change among this group of patients.

Conclusion

This case series shows that the incorporation of POCUS exam into routine diagnostic workup of patients admitted to the oncological ward with new respiratory abnormalities does lead to frequent change in patient management and may potentially improve patient outcomes. The potential information provided from this study may be instrumental in the initial workup and working diagnosis of a patient presenting with acute symptoms.

These results should be further investigated in larger prospective studies to strengthen the evidence that POCUS assessment affects clinical outcomes in the subacute setting. Such findings will further expedite the integration of POCUS as integral part of standard modern physical examination in oncology and across all medical fields.

Author Contribution

Conception and design: JD, WK, LCR, LF. Manuscript writing: All authors. Final approval of manuscript: All authors.

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Footnotes

Conflicts of interest: All the authors have no conflicts of interest to declare

Ethical statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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