Effective & Early Diagnosis of Pneumonia in Patients with Acute Leukemia in a Comprehensive Cancer Center: How can we improve the microbiological diagnosis?

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Abstract (Revised)

Background:
Pneumonia is one of the main causes of morbi-mortality in acute leukemia (AL) pts. The positive yield of microbiology diagnosis is still significantly low. The aim of the study was to evaluate the possible impact of use of diagnostic methods (within first 48hs of diagnosis) in AL pts with pneumonia during chemotherapy.

Methods:
Retrospective study (January 2017-December 2017) at MD Anderson Cancer Center. The medical records of adult pts with AML, MDS or ALL who developed CT-confirmed pneumonia after induction or 2nd-line chemotherapy were reviewed, including demographic, clinical, microbiology data and outcomes. We also developed the diagnostic work-up order set for pneumonia for quality improvement (QI) project and prospectively reviewed the medical records of patients who used diagnostic order set (July 2017-Aug 2018).

Results:
During 2017, 174 pts with AL developed pneumonia confirmed by CT chest. 50 (29%) of them during induction/2nd -line chemotherapy: 42 (84%) AML, 5 (10%) MDS and 3 (6%) ALL. 31 (62%) showed consolidation in CT, 14 (28%) nodules and 5 (10%) both findings. Mean age was 65 (SD: 11.5, range: 24-87) years with 46% males. 33 (66%) pts had neutropenia (ANC<500) at time of pneumonia. ID was consulted in 38 (76%) and pulmonary in 37 (74%) pts. Bronchoscopy/BAL (bronch) was performed in only 24 (48%) pts, still with the highest diagnostic yield (13/24, 54%) compared to other diagnostic methods (sputum and blood cultures; and galactomannan, beta-glucan and cryptococcal antigen in serum). 12 of 24 (50%) pts had an early bronch (within 48hs), with higher identification of bacteria (3/12, 25%), fungi (2/12, 16.7%), and virus (3/12, 25%) compared to those 12 performed later. A trend of more viral infection (6/12, 50%), including CMV, was found in late-performed bronch (>48hs after diagnosis). The pts with early bronch were sicker, with higher rate of ICU admission (42% vs 0% in late group) and in-hospital mortality (25% vs 8% in late group). However, those pts who underwent bronch later had a higher rate of 30-day re-admission (33% vs 22% in early group). We also reviewed 14 leukemia patients with pneumonia who used diagnostic work-up order set. After the introduction of the pneumonia diagnostic work-up order set, the implementation rate of diagnostic tests (e.g. sputum culture, bronchoscopy, serology) increased from a range 12-86% to a range 64-100%. The overall rate of the pathogen identification increased from 38% to 50%.

Conclusion:
Bronchoscopy/BAL was the best diagnostic test in patients with AL and CT-confirmed pneumonia, even though it was only performed in 48% of pts. Early bronchoscopy (first 48 hs) has better diagnostic yield than late bronchoscopy (>48 hs), directing the antimicrobial therapy on these pts (based on the identification of bacteria, fungus or viruses), and decreasing the 30-day re-admission rate. The introduction of the pneumonia diagnostic work-up order set dramatically improved the implementation rate of diagnostic tests and microbiological diagnostic rate of pneumonia.

Background

- Pneumonia is the most common infectious complication in patients with acute leukemia, which has high mortality.
- Timely diagnosis of pneumonia as well as the identification of pathogen is essential to improve the clinical outcome of pneumonia, which would allow providers to optimize the antimicrobial treatment.
- However, the initial diagnostic tests or procedures are often missed or delayed, which leads to decreased diagnostic yields and possible treatment failure.

Purpose

❑ To evaluate the possible impact of use of diagnostic methods (within first 48hs of diagnosis) in acute leukemia patients with pneumonia during chemotherapy.

❑ To develop the pneumonia diagnostic work-up order set and assess the clinical impact of use of the order set (Quality Improvement Project).

Methods

1.Design: Retrospective cohort study
2.Setting: MD Anderson Cancer Center
3. Study period: January 2017-December 2017
4. Patient population: We reviewed the medical records of adult patients aged ≧18 years with acute leukemia (acute myeloid leukemia, acute lymphoid leukemia, MDS)
5. Definition of pneumonia: based on the American Thoracic Society/IDSA guidelines 2005
6. Methods: Demographic, clinical, microbiological and outcome data were analyzed.

❑ **QI process**

1. Developed pneumonia diagnostic work-up order set (containing microbiological/radiological tests, consultation, diet), which can be utilized in patients with clinical symptoms suggestive of pneumonia.
2. Notified the primary team of order sets by sending an email. 3. Develop an systems to prospectively collect data from all patients with Pneumonia in leukemia patients

Fig 1. Before QI process

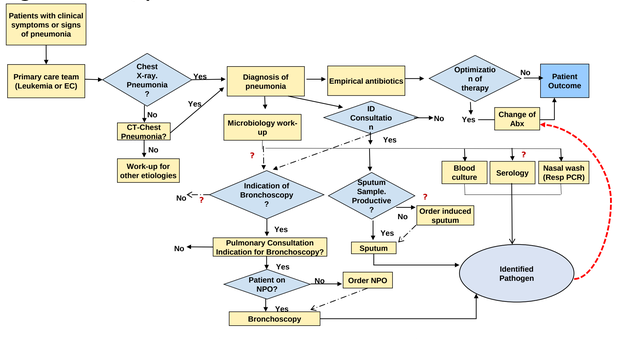
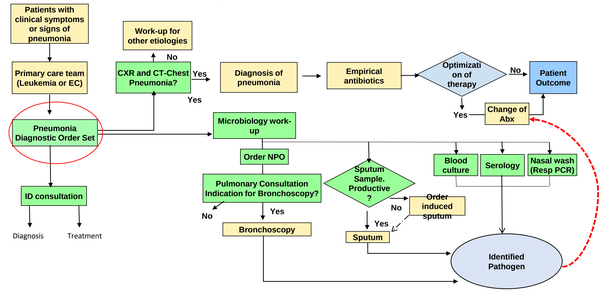


Fig 2. After QI process (July 10,2018- Current)



Results

Table1: Before QI Process, Patient Characteristics

Demographics	Total number 50
Gender : Male	23 (46%)
Age, mean (SD)	65.14 (SD 11.5)
Disease	
AML	41 (82%)
ALL	3 (6%)
MDS	5 (10%)
Biphenotipic	1 (2%)
Neutropenia (ANA<500)	33 (66%)
CT finding	
Consolidation/GGO unilateral	10
Consolidation/GGO bilateral	21
Nodule unilateral	8
Nodule bilateral	6
Mixed (consolidation/nodule) unilateral	2
Mixed (consolidation /nodule) bilateral	3

Table2: Before QI Process, Outcomes

	Overall (N=50)	Early Bronch (<48 H) N= 12	Late Bronch (≧48) N=12	No-Bronch N=26
ICU admission	7/50 (14%)	4/24 (16.7%)	2/26 (7.7%)	2/26 (7.7%)
Intubation	2/50 (4%)	2/24 (8.3%)	0/26	0/26
30-day mortality	7/50 (14%)	4/24(16.7%)	3/26 (11.5%)	3/26 (11.5%)
In hospital mortality	9/50 (18%)	4/24(16.7%)	5/26 (19.2%)	5/26 (19.2%)
Re-admission rate	10/40 (25%)	6/20 (30%)	4/20 (20%)	4/20 (20%)

Fig 3. Timing of Bronchoscopy and Diagnostic Yield

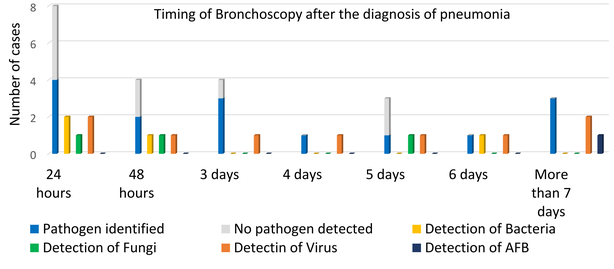


Table 3: Diagnostic Yield, Before and After QI Process Implementation Rate of tests

Diagnostic tests	Diagnostic Yield	Pre-CS&E Implementation Rate (N=50)	Post-CS&E Implementation Rate (N=14)
Overall rate of pathogen identification	19/50 (38%)		7/14 (50%)
Sputum smear/culture	3/6 (50%)	6/50 (12%)	9/14 (64%)
Blood culture	5/43 (11.6%)	43/50(86%)	14/14 (100%)
Respiratory PCR panel (Nasal wash)	4/33 (12.1%)	33/50 (66%)	14/14 (100%)
Bronchoscopy/BAL	13/24 (54.2%)	24/50 (48%)	10/14 (71%)
Galactomannan Antigen (GM)	1/36 (2.8%)	36 /50 (72%)	14/14 (100%)
Fungitell (Beta-D Glucan assay)	0/18 (0%)	18 /50 (36%)	9/14 (64%)
Cryptococcus antigen (serum)	0/30 (0%)	15/50 (30%)	14/14 (100%)

❑ After the introduction of the pneumonia diagnostic work-up order set, the implementation rate of diagnostic tests increased from a range 12-86% to a range 64-100%. The overall rate of the pathogen identification increased from 38% to 50%.
❑ We intend to include larger number of patients to evaluate the impact of the order set on microbiological diagnostic rate and patient outcomes.

Conclusions

❑ Bronchoscopy/BAL was the best diagnostic test in patients with acute leukemia and CT-confirmed pneumonia, even though it was only performed in 48% of pts.
❑ Early bronchoscopy (first 48 hs) has better diagnostic yield than late bronchoscopy (>48 hs), directing the antimicrobial therapy on these pts (based on the identification of bacteria, fungus or viruses), and decreasing the 30-day re-admission rate.
❑ The introduction of the pneumonia diagnostic work-up order set through quality improvement project dramatically improved the implementation rate of diagnostic tests and microbiological diagnostic rate of pneumonia.