Development of a Standard Protocol to address the high incidence of clinical and sub-clinical heart failure in our adult Acute Myeloid Leukemia population

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Meredith Mort, PharmD
Katie Ruefer, RN
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University of Virginia Health System

- 612-bed tertiary academic medical center in Charlottesville, VA
  - Inpatient hematology/oncology unit: 35 beds
  - 30-40 acute myeloid leukemia (AML) patients undergo induction chemotherapy annually
- UVA Cancer Center
  - NCI-designated cancer center
<table>
<thead>
<tr>
<th>Team Members</th>
<th>Role</th>
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</thead>
<tbody>
<tr>
<td>Erin McLoughlin, MD</td>
<td>Team Leader</td>
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<tr>
<td>• Oncology Fellow</td>
<td></td>
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<tr>
<td>Meredith Mort, PharmD</td>
<td>Core Team Member</td>
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<tr>
<td>• Oncology pharmacy resident</td>
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<tr>
<td>Katie Ruefer, RN</td>
<td>Core Team Member</td>
</tr>
<tr>
<td>• Assistant Nurse Manager Inpatient</td>
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<tr>
<td>Oncology</td>
<td></td>
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<tr>
<td>Idil Aktan, MD</td>
<td>Other Team Member</td>
</tr>
<tr>
<td>• Cardiology Fellow</td>
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<tr>
<td>Mohammad Abuannadi, MD</td>
<td>Other Team Member</td>
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<tr>
<td>• Attending Cardiologist</td>
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<tr>
<td>Kimberly Chadwell</td>
<td>Other Team Member</td>
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<tr>
<td>• Technical Director Echocardiography</td>
<td></td>
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<tr>
<td>Anthony Marino</td>
<td>Other Team Member</td>
</tr>
<tr>
<td>• Internal Medicine Resident</td>
<td></td>
</tr>
<tr>
<td>Joseph Mort</td>
<td>Other Team member</td>
</tr>
<tr>
<td>• Medical Student</td>
<td></td>
</tr>
<tr>
<td>Michael Keng, MD</td>
<td>QTP Improvement Coach</td>
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<tr>
<td>• Assistant Professor of Medicine</td>
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Fifteen percent of patients with newly diagnosed Acute Myeloid Leukemia at the University of Virginia receiving anthracycline containing chemotherapy between March 2011-March 2017 had evidence of clinical heart failure within 1 year of induction.

The reported incidence of heart failure in patients who receive similar lifetime doses of anthracyclines in other patient populations is reported to be between 3-5%. This has significant implications for transplant eligibility and long term morbidity and mortality.

Our institution does not have a standard protocol for how to screen, risk stratify or monitor patients for the development of this important treatment side effect. On retrospective review, 31% of our acute leukemia patients completed a standard screening and diagnostic cardiac evaluation based on our proposed ideal standard.
Background Data

• Prior retrospective cohort study
• Inclusion criteria
  – Adult patients (≥18 years) with AML
  – Receiving induction chemotherapy with an anthracycline
  – March 2011 March 2017

• N= 110 patients
  29 excluded- no follow up ECHO
  83 patients included in the study
Background Data

Waterfall plot of absolute difference from baseline to post-induction LVEF

24.1% had a reduced ejection fraction within 1 year of induction

15.7% had evidence of clinical heart failure within 1 year of induction
Background Data

Median: 25.5 days

Median: 225 mg/m²
Process Map - Current State

New diagnosis of AML suspected → Bone marrow biopsy performed

Alternative diagnosis

Diagnosis of AML → Good induction candidate?

Alternative to induction chemotherapy

YES → Resident enters order for Echo

Order received by Echo technician → Technician performs Echo

Echo interpreted by cardiology attending and report finalized

Echo reviewed by hematology attending or fellow

Induction chemotherapy

YES → Follow up Echo if re-induction, symptoms or for transplant w/u

Non-anthracycline containing induction regimen

EF > 55%? → NO
Measures

- **Measures:**
  - Process: 9 agreed upon components of an “ideal standard” for our AML patients
    - Correct diagnostic work up prior to induction, standard anthracycline dosing
    - Outcome measure: reduced EF events

- **Patient population:**
  - Baseline AML patients receiving induction chemotherapy 01/2016-07/2017
  - N=39 patients

- **Data source:** Review of electronic medical records (EPIC)

- **Calculation methodology:**
  - Numerator: number of times a variation from the standard occurred
  - Denominator: total number of times a variation from the standard occurred

- **Data collection frequency:** Plan to evaluate new AML patients on a rolling basis
Based on the 9 proposed components of an ideal standard protocol for cardiac evaluation, we calculated the percentage of patients for which the standard was achieved (defined as documentation of at least 80% of the individual measures) to be **23%**.

To narrow our scope, we then chose 6 of our 9 initial measures that would be easy to assess in shorter intervals of time. We evaluated the percentage of patients who hit at least 80% of all 6 standards, when applicable.

Based on our review, **31%** of our acute leukemia patients completed a standard screening and diagnostic cardiac evaluation based on our proposed ideal standard.
<table>
<thead>
<tr>
<th>Reason for Variation from Ideal Standard</th>
<th># of times variation occurred</th>
</tr>
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<tbody>
<tr>
<td>Strain not reported on Echocardiogram report</td>
<td>20</td>
</tr>
<tr>
<td>No follow up ECHO within 3 months of last anthracycline use</td>
<td>17</td>
</tr>
<tr>
<td>Incorrect ECHO ordered</td>
<td>16</td>
</tr>
<tr>
<td>Non-standard anthracycline dosing</td>
<td>14</td>
</tr>
<tr>
<td>No EKG prior to induction</td>
<td>10</td>
</tr>
<tr>
<td>No cardiology consult after a reduced EF event</td>
<td>7</td>
</tr>
<tr>
<td>No ECHO prior to re-induction</td>
<td>5</td>
</tr>
<tr>
<td>No ECHO prior to anthracycline consolidation</td>
<td>4</td>
</tr>
<tr>
<td>No medical intervention after a reduced EF event</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>97</strong></td>
</tr>
</tbody>
</table>
Strain not reported on initial ECHO
No follow up ECHO within 3 months of last anthracycline use
Incorrect ECHO ordered
Non-standard anthracycline dosing
No EKG prior to induction
No cards consult after a reduced EF event
No Echo prior to re-induction
No Echo prior to anthracycline consolidation
No intervention after a reduced EF event
Priority/Pay –Off Matrix

- **High Impact**
  - Medical treatment before reduced LVEF
  - Prophylactic cardiac cath prior to induction
  - Mandatory cardiology consult if reduced LVEF event/risks
  - Interpretation of cardiac risk factor screening
  - Standard cardiac risk factor screening performed documented
  - Standard education of medical residents to order echo

- **Low Impact**
  - EKG in treatment plan
  - Create standard echo order for use in ALL patients
  - Standard procedure for echo leads to perform echo on ALL patients
  - Mandatory scheduling of 3-month post-chemotherapy echo at discharge

- **Easy**
  - Create standard echo order for use in ALL patients
  - Standard procedure for echo leads to perform echo on ALL patients
  - Order echo prior to repeat anthracyline

- **Difficult**
  - Cardiology interpretation of echo (with strain)
  - Standard procedure for post-chemotherapy cardiac monitoring

- **Low Effort**
  - Create standard echo order for use in ALL patients

- **High Effort**
  - Medical treatment before reduced LVEF
  - Prophylactic cardiac cath prior to induction
  - Mandatory cardiology consult if reduced LVEF event/risks
  - Interpretation of cardiac risk factor screening
  - Standard cardiac risk factor screening performed documented
  - Standard education of medical residents to order echo
<table>
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<tr>
<th>Date of PDSA Cycle</th>
<th>Description of Intervention</th>
<th>Results</th>
<th>Action Steps</th>
</tr>
</thead>
</table>
| November 5\(^{th}\) 2018- January 30th 2019 | 1. Education to the Internal Medicine Residents on correct Echocardiogram to order and why  
2. Standardization of ECHO reports | Ongoing   |              |

PDSA Plan (Test of Change)
Given the limited timeline for our proposed PDSA cycle we again limited our scope to look at only 4 of the components of our proposed standard protocol

1. Was the Echocardiogram ordered correctly?
2. Did the Echocardiogram report strain in a standardized way?
3. Was an EKG obtained prior to the start of chemotherapy?
4. Did the patient receive standard anthracycline dosing per UVA guidelines? (This was a previously implemented intervention)

New baseline: 50% of patients had 100% compliance with these 4 proposed measures
By January 30, 2019, 75% of newly diagnosed AML patients at UVA will have 100% compliance with the first 4 of the proposed measures of our standard screening/diagnostic cardiac evaluation prior to undergoing induction chemotherapy.
Admitting a newly diagnosed AML patient?

**Background:** Approximately 24% of AML patients (2011-2017) experienced a reduction in EF within 1-year of receiving induction chemotherapy.

**GOAL:** Every newly diagnosed AML patient should receive a screening TTE with oncology protocol before receiving induction therapy (see below):

This will direct cardiology to include measurements of EF and strain on the final report.

**Why?** To standardize the screening cardiac evaluation of our AML patients. We aim to better understand the high incidence of decreased EF (which affects future treatment eligibility, e.g. stem cell transplantation) as well as plan for future interventions to medically optimize patients before and after oncology treatments.

Questions: Erin McLoughlin (emm8jd) or Anthony Marino (am7hq)
**PDSA Cycle**

**Intervention Part #2**

**Procedure Name**

93306 - TTE COMPLETE W/ STRAIN

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**Cardiovascular Findings**

<table>
<thead>
<tr>
<th>Structure</th>
<th>Findings</th>
</tr>
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<tbody>
<tr>
<td>Left Ventricle</td>
<td>Normal cavity size and wall thickness. Ejection fraction is 55 - 60%. Global and segmental wall motion within normal limits. The Global Longitudinal Strain value is within normal limits. Normal left ventricular diastolic function. Normal left atrial pressure.</td>
</tr>
<tr>
<td>Right Ventricle</td>
<td>Normal cavity size and ejection fraction.</td>
</tr>
<tr>
<td>Left Atrium</td>
<td>Normal cavity size.</td>
</tr>
<tr>
<td>Aortic Valve</td>
<td>Aortic valve is trileaflet.</td>
</tr>
<tr>
<td>Mitral Valve</td>
<td>Normal valve structure. Trace regurgitation.</td>
</tr>
<tr>
<td>Tricuspid Valve</td>
<td>Normal valve structure. Trace regurgitation. There is no evidence of pulmonary artery systolic pressure elevation. No evidence of tricuspid valve stenosis.</td>
</tr>
<tr>
<td>Pulmonic Valve</td>
<td>Normal valve structure. No regurgitation. No stenosis.</td>
</tr>
<tr>
<td>Pericardium</td>
<td>Pericardium is normal.</td>
</tr>
<tr>
<td>Ascending Aorta</td>
<td>Normal aortic root size and contour.</td>
</tr>
<tr>
<td>IVC/SVC</td>
<td>The IVC demonstrates a diameter of &lt;21 mm and collapses &gt;50%; therefore, the right atrial pressure is estimated a</td>
</tr>
</tbody>
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**Systolic Function**

- Global Strain: -18.89 %

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**ASCO Quality Training Program**
Change Data

Standardization of a Cardiac Protocol for Acute Myeloid Leukemia Patients

Baseline Data
01/2016-02/2017
N=24

PDSA #1
03/2017-07/2017
N=13

PDSA #2
11/2018-ongoing
N=3

MEAN 79.4%
MEAN 48.9%

Intervention #1
Intervention #2

% compliance with standard cardiac protocol

Patient Number
Next Steps/Plan for Sustainability

• What happened to patient #3?
  – No EKG before induction chemo
    • Add to reminder sheet in resident work room?
    • Add EKG to treatment plan?
  – ECHO was not ordered correctly BUT was still reported and done correctly because of our two part intervention
Conclusions

• So far too soon to tell!
• We have some easy low hanging fruit we can tackle
• Will plan to expand out each PDSA cycle to include more of the core measures of our standard cardiac protocol