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Length of Stay Is Associated with a Delay in Diagnosis of Acute Chest Syndrome in Sickle Cell Disease Patients: Leveraging Artificial Intelligence As a Tool for Earlier Diagnosis

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Acute chest syndrome (ACS) is a leading cause of hospitalization in children with sickle cell disease(SCD). Many SCD patients with ACS often present with an initial negative CXR on presentation with vaso-occlusive pain crises. Prompt treatment may help prevent rapid progression in disease severity. However, apart from the ASH guidelines recommending red blood cell transfusions for moderate to severe cases of ACS, there are limited evidence-based recommendations for timely ACS diagnosis and treatment. Children who have a chest xray performed at a prior emergency visit, within the week before ACS is diagnosed, may represent a population who could benefit from artificial intelligence (AI) systems. AI has already demonstrated ability accurately identify COVID-19, ACS, as well as other lung pathology from pediatric chest xrays.

The objective was to determine if a delay in diagnosis of ACS is associated with a longer length of stay in a large SCD pediatric population presenting to the Emergency Department @ Children's National Hospital.

We performed a de-identified, retrospective, observational, single-center study of pediatric emergency visits for patients with sickle cell disease between 2016-2023. Our hospital is the referral center for patients followed by hematologists within our health system as well as other health systems in the region. We defined "delayed diagnosis" as any patient with a chest xray performed at a prior emergency visit in the preceding seven days. We included adults who presented the pediatric emergency department after their 18th birthday and excluded outlier patients with >95%ile LOS. Descriptive statistics were performed including demographics, clinical characteristics in children with ACS and compared hospital length of stay (LOS) in children with and without delayed diagnosis of ACS.

There were 1733 visits (775 unique patients) for ACS between 2016-2023, with 1364 visits for children (78.7% of visits, 663 unique patients). After excluding outliers, among patients who were not critically ill, LOS was longer if there was a delayed diagnosis of ACS (69 visits, mean LOS: 88.3 hours, SD: 56.0) compared to visits without a delayed diagnosis (N = 1289 LOS: 74.5, SD: 49.7; p=0.026). Among patients who were admitted to the critical care unit, LOS was similar for visits with (N = 10) and without (N = 189) a delayed diagnosis of ACS (mean LOS: 143.5 and 148.0 hours and SD: 40.9, 50.1, respectively). For the group of patients with a delayed diagnosis of ACS, there was not a strong relationship between delay in hours from chest xray at preceding visit and the overall LOS in hours.

Data at our site suggests patients with a delayed diagnosis of ACS may have significantly longer LOS. While there is an association between delayed diagnosis and increased LOS, this relationship is complex. LOS in patients with critical illness is similar, regardless of whether or not they had a delayed diagnosis, and the duration of the delay does not explain the variation in LOS among patients known to have a delayed diagnosis. Future work is necessary to better understand the relationship between delayed diagnosis of ACS and LOS. Our findings suggest an opportunity to improve outcomes and decrease health system cost if AI systems can be used to identify ACS earlier or accurately predict the risk of ACS using chest xrays at earlier timepoints than occurs with the current standard of care.

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