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Vaso-Occlusive Episodes in Older Children with Sickle Cell Disease: Emergency Department Management and Pain Assessment

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Abstract

Objectives—To describe emergency department (ED) management of older children with sickle cell disease (SCD) experiencing a vaso-occlusive episode (VOE) and factors associated with disposition and ED return.

Study design—We retrospectively reviewed ED visits of children 8 years of age with SCD over the course of one year. Data were collected from the electronic medical record and sickle cell database.

Results—VOE was diagnosed 279 times in 105 patients; 45 children had one, 25 two, and 16 five ED visits. Overall admission rate was 178/279 (64%), 166 on the first ED visit and 12 upon return within 72 hours. Use of home opioids, duration of VOE, and hemoglobin concentration were not associated with disposition. Discharge after two doses of morphine occurred in 33 patients. After one dose, pain relief, using a 0–5 FACES scale, differed significantly (1.1 vs. 2.5, $p < 0.0001$) for admitted versus discharged patients.

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Conclusion—Suboptimal pain relief after one dose of IV morphine was associated with admission from the ED. Further investigation of pain relief, using validated pain assessment scales, as an outcome in VOE management is warranted.

Severe pain during a vaso-occlusive episode (VOE) is the most common cause of acute morbidity in patients with sickle cell disease (SCD) and has been linked with increased mortality in adults.¹ Patients with sickle cell anemia average 0.8 painful episodes annually up to 60% of which require hospital based care.² Limited published data indicate that after presenting to the emergency department (ED) 22% of adults³ and 42% of children experiencing a VOE are admitted for inpatient treatment.⁴ Adult studies have sought to characterize the frequency and duration of VOE as well as inpatient and outpatient management strategies but studies involving children remain scarce.⁵ Interventions such as intravenous fluids and analgesics, including combinations and methods of delivery, are not well studied. To our knowledge, no previous research has specifically examined ED treatment of VOE in older children and adolescents with SCD.

Pain relief has not been a primary outcome measured in previous pediatric studies of VOE. In 2001, the Joint Commission on the Accreditation of Health Care Organizations (JCAHO) set forth new standards regarding the assessment of pain. In most health care settings, pain assessment has become the “fifth” vital sign, serving both to quantify a patient’s discomfort and to document efficacy of interventions. Although standardized assessment tools exist, implementation is often inconsistent, and little evidence links change in patient-reported pain with specific interventions or expected outcome.⁶

Our primary objective was to describe the ED management of children with SCD experiencing a VOE. Our secondary objective was to correlate management factors and degree of pain relief with admission or discharge and ED return for the same painful episode.

METHODS

Study Population

We used the ICD-9 codes 282.62, 282.64, and 282.42 to retrospectively identify all patients seen for SCD with crisis in our pediatric ED from January 1, 2003 to December 31, 2003. Institutional Review Board approval at the University of Texas Southwestern Medical Center was obtained. Retrospective data were collected from scanned ED documents, including physician and nursing notes in the electronic medical record and from the Sickle Cell Clinical Database which includes hemoglobinopathy diagnosis, steady state hemoglobin values, previous admissions, and other indicators of disease severity. Steady state hemoglobin values represent a rolling average of hemoglobin concentrations obtained during three previous scheduled outpatient clinic visits.⁷

Patients between 8 and 19 years of age were eligible. The lower age limit was chosen because the data were collected as background for a study using a pain scale not validated in young children. Inclusion criteria were an uncomplicated VOE during which the patient received a least one dose of intravenous (IV) morphine in the ED. Exclusion criteria, meant to eliminate factors other than a VOE that could influence the admission decision, included a documented temperature $>38.5^{\circ}\text{C}$, acute chest syndrome, current chronic transfusion therapy, isolated priapism, pain due to trauma or another reason than VOE, initial treatment at another facility with transfer to Children’s Medical Center Dallas, or pain relieved without administration of IV morphine.

For patients meeting inclusion criteria, the following data were recorded for each ED visit: age and sex, date, SCD genotype, duration of VOE, treatment prior to ED presentation, nature of

analgesia and intravenous fluids received while in the ED, steady state and ED hemoglobin values, pain scale ratings pre- and post-morphine administration, and disposition. Reticulocyte counts were not routinely recorded. Premature discharge was defined as a return ED visit within four days of discharge from either the ED or inpatient unit for the same VOE. Data were not available to assess patients who might have returned to the outpatient sickle cell clinic or their primary physician within four days of discharge.

Emergency Department Management

The Children's Medical Center Dallas ED has over 100,000 visits per year and serves as the major emergency provider for more than 600 sickle cell patients. The Sickle Cell program instructs families to alternate scheduled non-steroidal anti-inflammatory agents (NSAIDs) with combination acetaminophen-opioid analgesics at the beginning of a VOE and to try management at home with hydration and rest for at least 24 hours before coming to the ED. Upon arrival to the ED, patients experiencing a VOE are triaged to level two of five (i.e., "emergent"). Pain is assessed by nurses using the 0–5 Wong-Baker FACES scale or, rarely, a verbal "how much out of ten" scale.^{8–10} Institutional guidelines advise the administration of 15 mg/kg acetaminophen or 10 mg/kg ibuprofen for FACES pain greater than 2 at triage with placement of IV access and a complete blood cell and reticulocyte count.^{9, 10} After physician assessment, IV morphine at 0.1 mg/kg (maximum 8 mg) is administered with IV fluids and additional oral analgesics at the discretion of the ED physician. After the initial IV morphine dose, pain is reassessed every 15–30 minutes using a FACES scale with appropriate intervention until the patient's reported pain is 3 on a scale of 5 or less.¹¹ The decision to admit to the hospital for further therapy is multi-factorial, incorporating ED physician and hematologist assessment of the child's pain relief, number of morphine doses received, and patient/parent comfort level.

Data Analysis

Categorical variables were evaluated by the χ^2 and Fisher exact tests. Pain scores were not normally distributed, so pain relief was evaluated using both Student's t-test and Mann-Whitney U test. In the infrequent case where pain was reported on a 0–10 scale, the recorded value was divided by two to approximate the scores to the predominant 0–5 FACES scale. As the results had similar significance, parametric tests are reported. IVF administration was treated as a dichotomous variable, with either a normal saline fluid bolus given or not given. Hemoglobin change and other continuous variables were examined using Student's t-test. Relative risks (RR) and 95% confidence intervals (CI) were calculated where appropriate.

RESULTS

Study Population

During 2003, our ED documented 680 visits by patients with SCD, an average of 1.9 each day. All patients were among the 613 children actively followed according to the 2003 Sickle Cell Clinical Database. Patients aged eight to 19 years accounted for 416 (61%) of the visits. During 320 (77%) of these visits, the patient reported a chief complaint of pain, and 279 (87%) met our criteria for uncomplicated VOE. Forty-one others were excluded for the following reasons: acute chest syndrome (10), no IV morphine given (10), fever $>38.5^{\circ}\text{C}$ (5), trauma (5), constipation (4), transfer from another hospital (3), cholecystitis (2), spontaneous abortion (1), and tuberculous abscess of the clavicle (1).

All analyzed patients received their first dose of IV morphine in the Children's ED. Demographic information for the 105 unique patients is presented in Table I. Management factors, including IVF administration, type of analgesic, and number of morphine doses, were analyzed based upon ED disposition and presented in Table II. Overall, 78% of patients

(218/279) received an IVF bolus (generally 20ml per kg) at the time of IV placement and were more likely to be admitted (151/218, 69%) than those not given an IVF bolus (27/61, 44%) $p < 0.001$. No seasonal differences were seen in the number of patients presenting to the ED experiencing a VOE. A decline in hemoglobin concentration from baseline was statistically significant, with a greater than 5% decrease associated with admission ($p = 0.033$, Table II).

Pain and Treatment

The average number of IV morphine doses administered regardless of disposition was 2.5. Admitted patients received 1.5 more doses of morphine than those discharged (admitted mean 3, range 1–7, SD 1.1 vs. discharged mean 1.5, range 1–4, SD 0.7, $p < 0.0001$). For the 11 visits where the patient was prematurely discharged, an average of 1.8 (range 1–4) doses of morphine was dispensed. Average time between first and second doses of morphine was 52 minutes (range 15–120 minutes). The relationship between number of doses of morphine and patient disposition is depicted in Figure 1. After receiving two doses of morphine, 33/79 (42%) patients were successfully discharged without premature ED return. After one dose of morphine, a reduction in pain score of 1 or less increased the likelihood of being admitted (RR 1.99, 95% CI 1.6, 2.5), although a reduction in pain score of at least 2 resulted in decreased likelihood of admission (sensitivity 73%, specificity 73, c-statistic 0.78).

Return Visits for Continued Pain after Premature Discharge

Twelve patients made a total of 14 return visits for pain within 96 hours. Eleven had been discharged from the ED (i.e., prematurely discharged). Five of them returned to the ED for persistent VOE pain within 24 hours of initial ED discharge, four within 48 hours, and two others within 72 hours. Three other children were admitted from the ED during their first visit, and shortly thereafter (average 30 hours) discharged from the inpatient service. They returned to the ED 48, 72 and 96 hours later because of continued pain. Mean change in pain score after the first dose of morphine was similar for both patients prematurely discharged and those admitted on their initial visit (Figure 2).

Patients with ≥ 5 Visits Annually

A subgroup of 16 patients accounted for 115 of the 279 ED visits for VOE. Eight patients had five visits, four had between 6 and 10 visits and four had more than 10 visits. The 115 visits resulted in 80 admissions (70% admission rate) compared to a 60% admission rate in those who had fewer than five visits ($p = 0.1$).

DISCUSSION

Although survival of children with SCD has increased in recent years^{7, 12, 13}, management of the painful episode has improved little if at all. In the largest epidemiologic study of sickle cell pain, Platt et al. found VOE incidence rate increased over time, with those 10–30 years old experiencing the highest rates.² Franck et al., found greater self-reported pain intensity in adolescent sickle cell patients than in post-operative pediatric patients.⁶ More recent descriptive studies have found that sickle cell patients experience pain to a greater extent and more frequently than previously reported.¹⁴

Patient self-report of pain has become an important component of treatment of children in both inpatient and outpatient settings.¹⁵ Multiple pain instruments, including the Wong-Baker FACES, the visual analog, and the African-American Oucher scales have been validated in sickle cell patients.⁸ We could identify no published studies that assessed the change in patient-reported pain during a VOE or its role in evaluating patient response to medical interventions. Although baseline pain scores were similar between groups in our study, patients who were successfully discharged experienced greater pain relief after one dose of IV morphine than

those admitted or prematurely discharged. Careful attention to severity of patient-reported pain and its lack of improvement after an initial dose of morphine could help predict the need for admission of sickle cell patients, prevent premature discharge and allow early initiation of patient controlled analgesia (PCA).

The decision to admit a patient with VOE for further management is multi-factorial. In a survey of ED physicians treating both pediatric and adult sickle cell patients, Silbergeit et al. reported that pain was considered refractory to outpatient therapy after two doses of intravenous opioids by 23% of respondents and after 3 doses by 53%. Respondents also reported pain was more likely to be labeled refractory after two doses in pediatric patients (41%) than in adults (21%). (16) In our experience, a substantial number of patients receiving two doses of IV opioid were discharged without a subsequent ED return. The number of morphine doses given is an indirect measure of the physician's pain assessment which takes into account patient self-report and observation. Although patient self-reported pain scores are subjective, our results suggest corroboration between the increased number of morphine doses prescribed and overall higher self-reported pain scores seen in the patients admitted compared to those discharged.

The utility of laboratory tests such as complete blood count, reticulocyte count and blood cultures upon ED presentation for an uncomplicated VOE remains controversial and anecdotal.^{4, 16–18} Although a complete blood count is useful in detecting acute splenic sequestration or an aplastic crisis, the frequency of these events, in the absence of splenomegaly, pallor or fever, is much lower in older patients with SCD such as those included in this study.¹⁹ Chapman et al. reported a decline in hemoglobin concentration of 0.2 gm/dl from steady state was associated with hospital admission, and a 0.2 gm/dl rise was associated with discharge.²⁰ On the contrary, Lopez et al. found that changes in hemoglobin or reticulocyte count from steady state values did not correlate with admission or discharge.³ Our results suggest that a decrease in hemoglobin of greater than 5% was associated with need for admission.

Our study had several limitations. First, a retrospective review of medical records is highly dependent upon the quality and thoroughness of the records themselves. Although six charts were incomplete and did not appropriately document pain scores, the majority were evaluable for our study endpoints. The ED goal for frequency of pain assessment is every 15–30 min. However, it is likely that some evaluations were performed at less frequent intervals after administration of analgesic doses. Therefore pain relief following the first dose of IV morphine may not always have been measured. Our outcome measure of discharge could be a direct result of the independent variable, change in pain score, but the variability in number of morphine doses received prior to admission indicates the decision to admit was not based solely on initial pain score. For patients prematurely discharged, the decision was often made despite a minimal initial change in pain score. Finally, psychosocial factors could impact our results as some patients might desire admission for secondary gain, manifested by falsely reporting pain scores.

In summary, our results suggest that change in self-reported pain score after an initial morphine dose more accurately predicts the need for admission than absolute number of morphine doses received. In addition, using pain assessment to determine disposition would prevent delay in the admission decision, and allow for the early institution of patient controlled analgesia for severe painful episodes. Prospective investigation of self-reported pain of patients with SCD during a VOE while in the ED is clearly warranted.

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Figure 1. DOSES OF IV MORPHINE

Of patients who received only one dose of intravenous morphine during their ED visit, 9/69 (13%) were admitted for further pain management. When two doses of intravenous morphine were administered, about half of the patients required admission 46/79 (58%). The highest admission rate was seen in patients receiving three or more doses, 123/131 (94%).

Figure 2. PAIN RELIEF AFTER ONE DOSE OF IV MORPHINE

Initial FACES scores for admitted patients was 4.4 and for those discharged 3.9 ($p = 0.002$)
 Change in score following morphine administration for admitted patients was -1.1 ± 0.14 and
 for discharged -2.5 ± 0.16 ($P < 0.0001$.)

Table 1**PATIENT DEMOGRAPHICS AND EMERGENCY DEPARTMENT VISITS**

Number of Patients	105
Mean Age (Range)	14.5 years (8–19 years)
Gender	M 55 (52%) F 50 (48%)
SCD Genotype	74 (70%)
SS	23 (22%)
SC	6 (6%)
S β^+ Thalassemia	2 (2%)
S β^0 Thalassemia	
Median ED Visits per Patient (range)	2 (1–12)
Total ED Visits per Patient	45
1 Visit	25
2 Visits	13
3 Visits	16
>5 Visits	

Table 2
EMERGENCY DEPARTMENT VISIT CHARACTERISTICS

	PATIENT ADMITTED N = 178 (64%)	PATIENT DISCHARGED N = 101 (36%)	p Value
DEMOGRAPHICS			
Mean age (years)	14.4	13.6	0.88
M = 123 (44%)	M 85 (69%)	M 38 (31%)	0.1
F = 156 (66%)	F 93 (60%)	F 63 (40%)	
SS	144 (81%)	77 (76%)	0.17
SC	29 (16%)	15 (15%)	
S β^+ Thalassemia	4 (2%)	7 (7%)	
S β^o Thalassemia	1 (0.5%)	2 (2%)	
VASO-OCCLUSIVE EPISODE			
Mean duration of pain prior to ED visit (hours)	49.7	53.2	0.69
Home medications			
Opioid with or without NSAID	140 (79%)	70 (69%)	0.08
NSAID only	21 (12%)	14 (14%)	
None	17 (9%)	17 (17%)	
Hemoglobin upon presentation			
≥ 5% Increase above steady state	85 (48%)	48 (48%)	0.21
≥ 5% Decrease below steady state	87 (49%)	45 (45%)	0.033
EMERGENCY DEPARTMENT MANAGEMENT			
Initial pain score	4.4	3.9	0.002
Pain decrease after first morphine	1.1	2.5	<0.0001
Mean morphine doses per visit	3.5	1.5	<0.0001
Intravenous fluids			
None (N=61)	27 (44%)	34 (56%)	<0.001
IVF Bolus (N=218)	151 (69%)	67 (31%)	