

# The Utility of Routine Electrolytes in Patients with Sickle Cell Anemia Presenting with an Acute Pain Crisis

**Bobby K. Desai**

Department of Educational Psychology and Instructional, University of Florida College of Medicine, Gainesville, USA  
Email: [bdesai@ufl.edu](mailto:bdesai@ufl.edu)

Received 29 November 2013; revised 20 December 2013; accepted 28 December 2013

Copyright © 2014 by author and Scientific Research Publishing Inc.  
This work is licensed under the Creative Commons Attribution International License (CC BY).  
<http://creativecommons.org/licenses/by/4.0/>



Open Access

---

## Abstract

**Background:** The evaluation of sickle cell vaso-occlusive crisis may include the measurement of the patient's CBC and reticulocyte count. Twelve clinical criteria have been previously published for patients at risk for electrolyte abnormalities, but a chemistry panel is often ordered as well occasionally without a true indication. **Objectives:** Our objective was to determine whether routine measurement of electrolytes can be safely avoided in patients with SCA who present to the ED with an acute painful crisis. **Methods:** This was a retrospective study of patients with SCA who presented with a painful crisis. All visits were considered separately. All medical records were reviewed for any electrolyte abnormalities and any treatment(s). Patients with an electrolyte abnormality had their medical record screened for the presence of specific criteria, and if any interventions or consultations were performed due to the results. **Results:** One hundred twenty-two unique patients were found to have one or more abnormal laboratory value over a total of 337 distinct patient visits, with a total of 686 abnormal values. Of these, only 2 laboratory values caused a change in treatment or disposition, both of which were replacement of potassium for hypokalemia. There were no consultations from the ED to any service other than the admitting team in any of the 337 distinct patient visits. **Conclusions:** For SCA patients presenting to the ED with a painful vaso-occlusive crisis, measuring electrolytes in the absence of another more specific and established clinical reason, is very likely unnecessary and can be safely avoided.

## Keywords

Sickle Cell Disease; Electrolytes; Pain Crisis

---

## 1. Introduction

Sickle cell anemia (SCA) is the most common hemoglobinopathy, and therefore the most important for Emergency Physicians to be familiar with [2]. It is estimated that there are between 70,000 to 100,000 people in the United States that are affected with SCA, and one in 500 African-American newborns is diagnosed with the disorder every year [3]. Patients with SCA present to Emergency Departments (ED) for a variety of complaints. The most common reason for individuals with SCA to present to the ED is for an acute painful vaso-occlusive crisis [4]. Most of these visits result in the measurement of a complete blood count (CBC) and a reticulocyte count, both of which may be integral in the management of many of the complications of SCA. In addition, measurement of an electrolyte panel is often ordered contemporaneously as well. In examining the body of literature, no studies could be found to substantiate or disputer outline measurement of electrolytes in this patient cohort. There are other patient populations in which the utility of an electrolyte panel has been questioned. These include those patients presenting to the ED with chest pain as well as in children [6] [9].

The objective of this study was to validate previously published clinical criteria for the ordering of serum electrolytes in this patient population by first determining if electrolyte panels ordered in the setting of an acute vaso-occlusive pain crisis since SCA were abnormal. The second objective was to determine if any abnormal laboratory measurements were used in guiding management or disposition decisions, either in the ED or in the hospital setting. Additionally, the study will attempt to determine if it is safe to forgo routine measurement of electrolyte panels in the absence of any specific established criteria.

## 2. Methods

This was a retrospective study of all patients with a history of SCA who presented to the ED with a painful crisis. The setting was an ED with an annual census of 78,000 at the time of the study. The patients were identified by a search through the ED billing records and international classification of diseases (ICD)-9 codes with a diagnosis of sickle cell anemia and pain crisis or vaso-occlusive crisis. For patients that were seen more than once, each visit was considered separately. The ED and hospital medical records were retrieved and retrospectively reviewed by two independent investigators.

Twelve clinical criteria have been previously published for patients that may potentially be at risk for electrolyte abnormalities [1] [7]. These include the following: poor oral intake, vomiting, chronic hypertension, diuretic use, recent seizure of unknown origin, muscle weakness, age 65 or greater, alcoholism, abnormal mental status, recent history of electrolyte abnormality, history of diabetes mellitus, and history of renal insufficiency or failure.

For this study, patients that demonstrated an electrolyte abnormality had their ED and hospital record (if admitted) screened for the presence of any of these criteria, as well as any interventions were performed, or if any consultations were made because of the results. Clinically significant electrolyte abnormalities (CSEA) have been formally defined as those abnormalities that affected diagnosis by firstly “stimulat[ing] a constructive assessment of the patient’s condition, led to further diagnostic studies, or led to a new diagnosis” or secondly whether the abnormality changed or affected therapy [7]. Furthermore, only those abnormalities which affected either Emergency Department or hospital therapy were considered clinically relevant for the purposes of this study. Abnormalities that may ultimately lead to further testing in the outpatient setting (e.g. an elevated glucose leading to testing for diabetes) were not considered clinically significant unless the above definition of CSEA’s were met.

Patients were excluded from the study if they were diagnosed with acute chest syndrome or aplastic crisis.

For all patients with an electrolyte abnormality, the ED and hospital records were independently reviewed by two investigators to determine if the performance of anelectrolyte panel (which included measurements of sodium, potassium, chloride, calcium, blood urea nitrogen, creatinine, carbon dioxide, and glucose) caused any intervention or change in ED or hospital management as defined above. An intervention was defined as any action or treatment required to correct an abnormal electrolyte value, including administration of fluids or medications. Any consultation made to a service other than the admitting physician was noted and also considered an intervention. Furthermore, all patients in this subset had their disposition reviewed to determine whether the presence of abnormal electrolytes had an effect on disposition from the Emergency Department, such as admission to the hospital. The records of any admitted patients were evaluated to determine if any interventions were made based on electrolyte abnormalities found in the ED.

### 3. Results

#### 3.1. Age, Race, Gender, Etc

One hundred seventy nine patients made 605 visits to the emergency department with a complaint of sickle cell disease, sickle cell crisis, or vaso-occlusive crisis—Mean age was 31 years (range 1 - 61 years) and 96 (54%) were male. Of the 605 total visits, 202 encounters resulted in discharge from the ED, and 403 ED encounters resulted in hospital admission.

#### 3.2. Main Results

Fifty-seven patients out of the total of 179 patients (31%) specifically had a diagnosis of diabetes mellitus (DM), hypertension or renal failure and of these patients, 12 had DM alone, 15 had hypertension alone, 5 had renal failure alone, 22 had DM and hypertension, and 3 had renal failure and hypertension. This subset of patients (along with 2 instances of patients presenting with sickle cell crisis and vomiting) accounted for 268 visits to the ED (206 of these visits resulted in admission (77%)), leaving 337 individual visits (by 122 patients) without DM, hypertension or renal failure as a criteria for the appropriate ordering of electrolyte panels; none of the 337 visits met any of the other 9 clinical criteria. Of these 337 visits to the ED, 199 visits (59%) resulted in admission; however, none of these admissions was directly related to electrolyte abnormalities. In these 337 visits, electrolyte panels were drawn in 320 (95%).

There were 686 total electrolyte abnormalities seen in all 605 visits, though the vast majority (630% - 92%) of these electrolyte abnormalities were seen in the 57 patients with known clinical criteria (**Table 1**). Of the total of 686 abnormal electrolytes, there were only 18 CSEA's. However, 16 of these values were from patients that exhibited at least one of the 12 clinical criteria for appropriate ordering of electrolytes. The criteria met included 6 patient visits with chronic hypertension, four patient visits with a history of renal insufficiency, two with vomiting, and the remainder with diabetes mellitus. All of these were acted upon. The patients with hypertension were treated with medications; the patients with renal insufficiency were patients with end-stage renal disease who missed their dialysis due to presentation to the ED for their pain crisis and who required admission, pain control, and dialysis. The patients with vomiting required anti-emetics, and finally the patients presenting with diabetes mellitus required adjustment of their insulin. The other two patient visits to the ED which resulted in an electrolyte value causing a change in management demonstrated no specific criteria for ordering an electrolyte panel. Both abnormalities were found to be mild hypokalemia, and each management change was to replace potassium. The sensitivity of the ordering guidelines to predict an abnormal electrolyte result was 92% (95% CI = 90% to 94%) and the specificity was 11% (95% CI 2% to 36%). The predictive properties of the clinical criteria set are listed in **Table 2**. There were no consultations made.

### 4. Discussion

The purpose of this study was to determine if the routine ordering of electrolyte panels could be safely deferred in patients presenting with SCA presenting to the ED with a painful crisis. The ordering of electrolyte

**Table 1.** Electrolyte abnormalities noted.

Electrolyte	number abnormal	% abnormal
Sodium	50	7.3%
Potassium	29	4.2%
Calcium	9	1.3%
Chloride	127	18.5%
CO <sub>2</sub>	87	12.7%
Glucose	167	24.3%
BUN	99	14.4%
Creatinine	118	17.2%
Total	686	100%

**Table 2.** Predictive properties of the clinical criteria set.

Predictive Properties of the Clinical Criteria Set			
	CSEA	Not CSEA	Total
Criteria Present	16	614	630
Criteria Absent	2	54	56
Totals	18	668	686

panels is ubiquitous, and often reflexive in many clinical scenarios in the ED. This occurs for a number of reasons, but the results of this study demonstrate that for this specific clinical cohort, measurement of electrolytes can be deferred safely, without missing dangerous or clinically significant findings. In our cohort of patients, in those that met none of the previously established guidelines for the ordering of routine electrolytes, only two out of 122 patients required an intervention. This intervention required only the replacement of one electrolyte and required no consultations either in the ED or the hospital setting.

A complete blood cell count (CBC) and reticulocyte count can be valuable tools for measuring potentially life-threatening conditions associated with SCA (e.g. aplastic crisis). However, the literature lacks studies either proving or disproving the need for electrolyte panels in this cohort. Tests including a CBC, electrolyte panel, chest radiograph and urinalysis are often ordered together, though it is uncertain whether the electrolyte portion of the information obtained was of any significant clinical utility in SCA patients with a painful crisis. For our study, there a few abnormal values found in the study population, however many of these could be seen as clinically insignificant for the emergent issue of a sickle cell pain crisis, such as a random serum glucose measurement in an patient without complaints other than pain.

With the exception of the two patients treated for mild hypokalemia (greater than 3.0), this study revealed that the electrolyte panel did not change any patients' management (either treatment or disposition) who had no clinical reason for measuring electrolytes, as described previously.

At our institution, a typical basic metabolic profile costs approximately \$80. A cost savings could be obtained from phasing out routine measurement of electrolytes in SCA patients with a painful crisis, especially at institutions with a large SCA patient population, and in institutions where it is common practice to order electrolytes with a CBC. It is thought that there are many such institutions that fit into one or both of these categories, and if the results of this study were broadly applied, a significant amount of medical spending could be safely avoided.

## 5. Limitations

This study was conducted as a retrospective chart review, and as such represents a limitation. Although the data seem compelling, it would be prudent to perform a prospective trial to confirm these results are indeed accurate before being broadly applied. However, based on current evidence, our conclusion seems to be a reasonable one.

Furthermore, it can also be argued that the small size of the study and the fact that it was conducted at one institution, further limit the results. It is possible that the sample population does not accurately represent that of other regions.

## 6. Conclusion

Our study has shown that in the setting of SCA patients presenting to the ED with a painful vaso-occlusive crisis, measuring electrolytes in the absence of another more specific and established clinical reason, is very likely unnecessary and can be safely avoided.

## References

- [1] Cantrill, S.V. and Karas, S. (1994) The Appropriate Utilization of Chemistry Profiles, In: Cantrill, S.V. and Karas, S. Eds., *Cost Effective Diagnostic Testing in Emergency Medicine*, American College of Emergency Physicians, Dallas, 67-73.
- [2] Marx, J.A., Hockberger, R.S., Walls, R.M., *et al.* (2010) *Rosen's Emergency Medicine. Concepts and Clinical Practice*. Mosby Elsevier, Philadelphia, 1557-1577.

- [3] Solomon, L.R. (2010) Pain Management in Adults with Sickle Cell Disease in a Medical Center Emergency Department. *Journal of the National Medical Association*, **102**, 1025-1032.
- [4] Embury, S.H. (2004) Sickle Cell Disease. In: Hoffman, R., *et al.*, Eds., *Hematology: Basic Principles and Practice*, 4th Edition, Churchill Livingstone, New York.
- [5] Lopez, B.L., Griswold, S.K., Navek, A. and Urbanski, L. (1996) The Complete Blood Count and Reticulocyte Count—Are They Necessary in the Evaluation of Acute Vasoocclusive Sickle-Cell Crisis? *Academic Emergency Medicine*, **3**, 751-757. <http://dx.doi.org/10.1111/j.1553-2712.1996.tb03510.x>
- [6] Desai, B. and Seaberg, D.C. (2001) The Utility of Routine Electrolytes and Blood Cell Counts in Patients with Chest Pain. *Academic Emergency Medicine*, **19**, 196-198. <http://dx.doi.org/10.1053/ajem.2001.21716>
- [7] Lowe, R.A., Arst, H.F., Ellis, B.K., *et al.*, (1991) Rational Ordering of Electrolytes in the Emergency Department. *Annals of Emergency Medicine*, **20**, 16-21. [http://dx.doi.org/10.1016/S0196-0644\(05\)81111-4](http://dx.doi.org/10.1016/S0196-0644(05)81111-4)
- [8] Pollack Jr., C.V., Jorden, R.C. and Kolb, J.C. (1991) Usefulness of Empiric Chest Radiography and Urinalysis Testing in Adults with Acute Sickle Cell Pain Crisis. *Annals of Emergency Medicine*, **20**, 1210-1214. [http://dx.doi.org/10.1016/S0196-0644\(05\)81473-8](http://dx.doi.org/10.1016/S0196-0644(05)81473-8)
- [9] Rothrock, S.G., Green, S.M., McArthur, C.L., DeLuca, K. and Detection of Electrolyte Abnormalities in Children Observational National Study (DEACONS) Investigators (1997) Detection of Electrolyte Abnormalities in Children Presenting to the Emergency Department: A Multicenter, Prospective Analysis. *Academic Emergency Medicine*, **4**, 1025-1031. <http://dx.doi.org/10.1111/j.1553-2712.1997.tb03674.x>