Bahrain Medical Bulletin Vol.27, No. 3, September 2005

Acute Chest Syndrome in Children with Sickle Cell Disease

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Background: Acute chest syndrome (ACS) is a known complication of sickle cell disease (SCD). It carries high morbidity and mortality.

Objective: To study the pattern of ACS among children with SCD in our region in a descriptive manner, and to compare our local experience with international experiences.

Method: We conducted a retrospective study of 28 children with ACS, to evaluate the frequency, clinical, laboratory, and radiological features of this complication among children with sickle cell disease in the Southern Province of Saudi Arabia.

Results: Our results revealed that the frequency of ACS episodes are age dependent, which occurred more frequently in young children, more than 4 years of age (n = 16) 57%. Fever and cough were the most frequent symptoms; (n = 26) 93 % and (n = 24) 86% respectively. Most of the cases experienced respiratory distress such as tachypnea (n = 24) 86%, chest retraction (n = 18) 64%, and decreased breath sounds (n = 16) 57%. Small number of patients (n = 3) 11% had complete normal chest examination. In our study, painful crisis was the most commonly associated complication along with ACS (n = 22) 79%. All of the chest X-rays were positive at different anatomical sites; bilateral involvement was observed frequently (n = 33) 36%.

Conclusion: This retrospective study demonstrates the clinical presentation of ACS in children with SCD in this part of Saudi Arabia. It is of great value as baseline study. Nevertheless, further studies of such condition are required to clearly understand this important complication of SCD.

Bahrain Med Bull 2005; 27(3):

Acute chest syndrome is an acute pulmonary illness in patients with sickle cell disease. It is defined as an acute episode associated with clinical and radiological evidence of new pulmonary abnormalities in patients with sickle cell disease (SCD) and often accompanied by fever, bone pain, pleuritic chest pain, cough, dyspnea, hypoxia, leukocytosis and decline in hemoglobin below the usual steady-state level[1-3]. It is a common problem, causing significant morbidity and mortality. Many factors may cause this syndrome. It is the second most common cause of hospitalization in

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patients with SCD and is responsible for up to 25 % of deaths. It accounts for more than 90 % of hospital admission[4-7].

The term "acute chest syndrome" was first suggested by Charache *et al* in 1979, acknowledging the difficulties in determine its pathogenesis. Treatment is primarily supportive[8]. Therapy includes hydration, analgesia, supplemental oxygen, antibiotics, blood transfusion and mechanical ventilation. Early detection and aggressive management may limit its severity and prevent its complications.

It is estimated that ACS will occur in nearly one third of patients at risk[9]. It occurs in 5 - 45% of individuals with SCD[1,10,11].

METHODS

This is a retrospective study performed at Kamis Military Hospital and Assir Central Hospital, Southern province, Saudi Arabia. Medical records of a total of 28 children with SCD who were diagnosed with acute chest syndrome between 1995-2001 were carefully reviewed. The following information was extracted: Sex, age, presenting symptoms, presenting signs, laboratory values, radiological findings as well as associated complications. Patients were divided into three groups on the basis of age (less than 4 years, 4 - 8 years, and 9 - 12 years) with a view to assessing clinical presentation. The incidence of symptoms, physical signs, laboratory and radiological findings were studied. Treatment including; simple blood transfusion, exchange transfusion, antibiotics, course of the patients, intensive care admission, intubations and duration of hospital stay.

Data was entered into IBM compatible computer at the Department of Family and Community Medicine, College of Medicine, King Khalid University. The well-known Statistical Package for Social Sciences Software (SPSS-version 10) was used for analysis of the data.

Results

Patients: Most of the episodes occurred in young children less than 4 years of age (n = 16) 57% and least common in older children more than 9 years (n = 3) 11%. ACS noted to occur in both sexes with slight male predilection (n = 15) 54% compared to (n = 13) 46% in females. Most of the patients in the study had single episode of ACS (n = 20) 71%, while repeated episodes (second or more) have occurred in (n = 8) 29% (Table 1).

Table 1: Patient Characteristic

Age Group	No. of Patient	%
< 4 year	16/28	57
4 – 8 year	9/28	32

9 – 12 year	3/28	11
Male	15/28	54
Female	13/28	46
Single episode	20/28	71
Repeated episodes	8/28	29

Presenting symptoms: The most common presenting symptoms were fever, cough, and chest pain, while less common, many patients experienced, shortness of breath, wheezing, chills and productive cough. Fever was the most common presentation, (n = 26) 93%, cough and chest pain were found in (n = 24) 86% and (n = 20) 71% respectively which were the second common presentation after fever while dyspnea was recognized in (n = 17) 61%. The frequency of presenting symptoms was age-dependent with fever and cough being more common in young children (age 2-4 years) and the incidence of chest pain, shortness of breath, productive cough occurred in less than quarter of patients (Table 2).

Table 2: Presenting symptoms

	Number	**%**
Fever	26/28	93
Cough	24/28	86
Chest pain	20/28	71
Productive cough	16/28	57
SOB*	17/28	61

*SOB: shortness of breath

Physical findings: Vital signs at the time of hospitalization were age dependent with young children experiencing higher temperature, pulse rate, and respiratory rate than older children. The most frequent physical exam findings were an abnormal chest examination in the form of signs of respiratory distress, decreased air entry, rales and dullness to percussion, whereas normal chest examination was observed in only (n = 3) 11% of the cases (Table 3). Painful vaso-occlusive crisis was associated with (n = 22) 79% of patients. It has been considered the most common associated event with ACS followed by an underlying bacterial infectious process (n = 15) 54% (Table 4).

Table 3: Presenting Signs

Signs	Number	%
Temperature		
> 39° C	20/28	71
< 39° C	8/28	29
Tachypnea	24/28	86
Retraction	18/28	64
Tachycardia	26/28	93
Dullness to percussion	15/28	54
Decreased breath sound	16/28	57
Crepitation	20/28	71
Wheezing	7/28	29
Bronchial breathing	9/28	32
Normal exam	3/28	11

Table 4: Associated problem with ACS

Problems	Number	%
Painful Crisis	22/28	79
Infection		
- Bacteria	15/28	54
- URTS	10/28	36
- UTI	2/28	7
- Acute Cholecystitis	2/28	7
Post-operative	4/28	14
Sequestration crisis	2/28	7
Bronchial asthma	4/28	14

Laboratory findings: Blood count documented during acute chest syndrome was compared with steady state value. Hemoglobin and white blood counts showed significant changes with the severity of the disease (Table 5).

Table 5: Baseline and ACS laboratory values

Test	Mean	*CI
Hemoglobin (g/dl)	7.6	6.41-8.90
WBC ($x10^9$/L)	18.9	16.70-20.81
Platelet ($x10^9$/L)	345.7	321.91-393.50
Reticulocytes (%)	9.8	7.40-10.60

*CI: confidence interval

Table 6: Radiological Findings

CXR*	Number	%
Upper zone involvement	2/28	7
Middle zone involvement	8/28	29
Lower zone involvement	4/28	14
More than one zone in one side	6/28	21
Bilateral involvement	10/28	36
Pleural effusion	7/28	25

*CXR: chest X-ray

Radiographic findings: Radiographic findings vary by age. The predominant radiological findings were bilateral lungs involvement (n = 10) 36%. Young children had isolated upper and middle lobe disease significantly more often and lower disease less often than older children (Table 6).

DISCUSSION

Episodes of acute chest pain in patients with SCD associated with a new infiltrate on chest film are called “acute chest syndrome” (ACS). These episodes are second only to acute painful episodes in term of incidence and need for hospitalization. These episodes are more common in children than adults and more common in patients with low levels of fetal hemoglobin and high level of total hemoglobin[12].

Acute chest syndrome consists of combination of signs and symptoms. It is a form of lung injury that can lead to adult respiratory distress syndrome (ARDS). Pulmonary disease is the leading cause of death in sickle cell disease[13]. There are both acute and chronic pulmonary manifestations of sickle cell disease. The acute syndrome consists of dyspnea, chest pain, fever, tachypnea, pulmonary infiltrate on radiography and leukocytosis. It affects approximately 30% of patients with sickle cell disease and may be life-threatening[14]. There is scanty data about the acute chest syndrome among Saudi children with SCD. Al-Dabbous *et al.* reported the frequency of ACS in Qatif (a medium-size city in the Eastern Province of the Saudi Arabia) in the order of 5-7.7%[11,15]. It affects both boys and girls, there may be a predominance of males[11,16]. The process is usually due to infection or vaso-occlusion but may also be the result of non-cardiogenic pulmonary embolization from a distant thrombus or infracted bone marrow[14,17]. Approximately 50% of patients experience at least one episode of ACS-and they ultimately have a higher chance of dying at an early age, and the mortality rate after such an event can be as high as 10-12%[18-20].

It is important to recognize and treat these events aggressively which is underscored by the observation that it was the leading cause of death among sickle cell patients[21].

This retrospective study of 28 patients with sickle cell disease who developed ACS is a representative sample of such patient in a descriptive way. Our data revealed that the incidence of ACS was strongly influenced by patient age, being most common in younger children and least frequent in older children. The association of ACS with young children could also be explained by reasoning that the increased susceptibility to viral respiratory infection in young children could precipitate ACS in children who are also more likely to have significant abnormal respiratory finding on chest exam at presentation[22].

Other factors associated with a high ACS incidence were a higher steady-state leukocyte counts. The reason for the association between high leukocyte counts and ACS incidence is not clear. It could be explained by the increasing susceptibility to viral respiratory infection in young children as a precipitating factor for ACS[23].

The predominant radiological findings in our study revealed diffuse lung involvement, unlike what has been reported by other workers of the lower lobes being involved[24,25]. This difference in the site of the lung involvement could be attributed to the fact that most of the cases in this study are very young children and the possibility of an associated infectious process rendering both lungs to be affected.

This is the first study in Assir Central Hospital to record the experience of ACS in children with SCD, and to the best of our knowledge, it has not been reported from the Southern Province of the Kingdom of Saudi Arabia.

CONCLUSION

Our results were generally comparable to international published data among similar population. This study is unique being the first description of such problem in children in the Southern Province of Saudi Arabia. It will serve as a base for subsequent studies. This retrospective study demonstrates the clinical presentation of ACS in children with SCD in this part of Saudi Arabia. It is of great value as baseline study. Nevertheless, further studies of such condition are required to clearly understand this important complication of SCD.

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