Isolated Unilateral Orbital Compression Syndrome in A 19-Year-Old Male With Homozygous Sickle Cell Disease

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Abstract

This study aimed to report a rare case of a rapidly progressive isolated unilateral orbital compression syndrome in a male with homozygous sickle cell disease, who presented with proptosis and optic nerve dysfunction. He neither had long bone pain crisis nor fever at the time of presentation that was managed surgically to preserve vision.

Rapidly progressive left orbital swelling is observed in a 19-year-old homozygous sickle cell disease patient associated with severe pain, headache, and impaired vision. Computed tomography of the orbit confirmed the presence of a unilateral large superior sub-periosteal cystic mass. Surgical exploration via anterior orbitotomy revealed a large sub-periosteal hematoma occupying the superior orbit which was evacuated. The patient completely recovered within 14 days post-surgery and regained his vision.

Orbital involvement in sickle cell disease is rare, however, it can occur as a sequela of vaso-occlusive crisis and bone marrow infarctions leading to bleeding and sub-periosteal hematomas in the orbit. Prompt diagnosis and management of orbital compression syndrome are crucial to prevent permanent optic nerve damage. Hence, cautious evaluation and close monitoring are important, especially in cases where surgical evacuation is indicated for quick recovery and prevention of visual loss.

Introduction

Sickle cell disease is a group of inherited monogenic hematological disorders that affect the red blood cells [1,2]. It is caused by the substitution of the amino acid valine for glutamic acid in the β-globin chain [3]. This mutation in gene coding creates inflexible sticky crescent-shaped RBCs; incapable to transverse the capillary bed, causing organs’ ischemia-reperfusion injuries [4].

Sickle cell disease can be divided into five subtypes depending on the inherited genes from both parents [3]. The most common subtype worldwide is the hemoglobin SS, followed by hemoglobin SC disease and hemoglobin Sβ thalassemia. Hemoglobin SD and hemoglobin SE are the other subtypes that are less noticed [5].

Vaso-occlusive process in sickle cell disease comprises all the different systems of the body. People with sickle cell disease mainly experience anemia, bone pain, acute chest syndrome, ischemic stroke syndrome, and sudden death. Others can also suffer from chronic restrictive lung disease, pulmonary hypertension, dysrhythmias, hemorrhagic stroke, venous sinus thrombosis, silent cerebral infarction, cognitive impairment, avascular necrosis, leg ulceration, renal failure, nocturnal enuresis, priapism, cholelithiasis, or mesenteric vaso-occlusion [6].

Moreover, the eye also shows different sickling signs including corkscrew vessels and comma-shaped capillary segment involving the conjunctiva, iris ischemic atrophy, and cataract [7]. The posterior segment can exhibit non-proliferative changes such as tortuous veins, silver-wiring of arterioles, salmon patches, black sunbursts, macular depression sign, peripheral retinal holes, or angioid streaks, in addition to proliferative changes including peripheral arteriolar occlusion, arteriovenous anastomoses, sea-fan shaped neovascularization, auto-infarcted greyish fibrovascular lesions, vitreous hemorrhage, and retinal detachments either rhegmatogenous or tractional [8].

Although orbital involvement in sickle cell disease is rare, when it does occur, it could even be complicated by orbital compression syndrome; this develops when infarction of the microvasculature in the sphenoid bone marrow leads to inflammation and necrosis, which in turn cause subperiosteal hemorrhage [9]. This is
either managed medically or surgically whenever there is optic nerve dysfunction or large hematomas [10]. In fact, 16 case reports exist in the literature describing orbital involvement in the last three decades and only four of them have been managed surgically [10,11]. In this study, we report a unilateral orbital compression syndrome in a homozygous sickle cell disease 19-year-old man, in whom proptosis and eye pain were the only presenting symptoms.

**Case Presentation**

A 19-year-old man with sickle cell disease, cashier by profession, and a hookah smoker presented to the ophthalmic emergency department on June 25, 2021, with a one-day history of frontal headache followed by sudden left eye pain associated with increasing orbital swelling and decreasing vision. The patient denied any history of fever or bone pain at or prior to presentation. However, he reported a history of sudden hearing loss six years ago for which a cochlear implant surgery was performed.

The patient was in severe pain but remained alert. His body temperature was 36.2°C, blood pressure was 126/90, heart rate was 88/min, and oxygen saturation was 98% on room air. Ocular examination showed a vision of 6/6 in the right eye, while examination of the left eye showed a vision of 1.5 m counting fingers, non-axial proptosis with a dystopia of 8 mm to the inferolateral side, vertical palpebral height was 16 mm, with periocular fullness, tenderness on palpation and resistance to retropulsion (Figures 1, 2). Moreover, extraocular muscles were restricted in all gazes with a 3-mm lagophthalmos (Figure 3).

**FIGURE 1: Photograph of both eyes demonstrating apparent left eye proptosis and dystopia.**
Although posterior segment and optic disc examination appeared completely normal, the pupil assessment revealed relative afferent pupillary light reflex defect grade 3 with positive color desaturation.

Laboratory results showed white blood cell count was 3.78 x 10^9/L (normal range: 3.6-9.6), hemoglobin level was 10.7 g/dL (normal range: 12.0-14.5), mean cell volume was 85.1 fl (normal range: 80.0-97.0), mean corpuscular hemoglobin was 27.8 pg (normal range: 27.0-33.0), and mean platelets volume was 10.1 fl (normal range: 8.0-11.5). Liver function test revealed a total bilirubin of 198 µmol/L (normal range: 5-21), direct bilirubin of 36 µmol/L (normal range: 0-5), indirect bilirubin of 162 µmol/L (normal: <18), and alkaline phosphatase of 315 U/L (normal range: 50-156). Coagulation profile was measured to be prothrombin time of 16.9 seconds (normal range: 10-14), international normalization ratio of 1.42 (normal range: 0.6-1.17), activated partial prothrombin time of 24.1 seconds (normal range: 28-45), and thrombin time of 13.1 seconds (normal range: 15.6-18.4). The erythrocyte sedimentation rate was 15 mm/h (normal < 20), and C-reactive protein was 151.22 mg/dL (normal range: 0-3). The kidney function test was normal. Hemoglobin electrophoresis showed sickle hemoglobin (HbS) 78.1%, fetal hemoglobin (HbF) 15.8%, and hemoglobin A2 (HbA2) 5.5%, which are compatible with homozygous sickle cell disease.

Computed tomography scan of the orbit was obtained and revealed a large cystic extraconal mass lesion in...
the upper part of the left orbit, measuring 2.8 x 3.3 x 1.3 cm. The mass was compressing and displacing the globe and optic nerve infero-laterally, resulting in marked proptosis and orbital edema suggestive of subperiosteal hematoma (Figures 4, 5).

FIGURE 4: Axial computed tomography scan of both orbits showing left eye proptosis caused by nasal extraconal cystic mass (red arrow) and a kinked optic nerve (blue arrow).
FIGURE 5: Sagittal computed tomography scan showing left superior extraconal cystic mass (red arrow) compressing the globe causing dystopia and proptosis.

The patient was started on intravenous methylprednisolone 1 g once daily along with intravenous Co-amoxiclav 1.2 g every 8 h. The decision was made to surgically intervene on the day of admission, so the patient was immediately prepped for surgical exploration under general anesthesia.

A sub-brow approach was performed through a 2-cm incision. When periosteum was incised, a large subperiosteal hematoma with blood clots was seen and entirely evacuated (Figure 6). Immediate improvement of proptosis was noticed on the table and the globe was back to normal position (Figure 7). Hemostasis was achieved and the incision was sutured in two layers with interrupted 6-0 vicryl sutures. The evacuated material was sent for histopathology and confirmed blood products.
FIGURE 6: Intra-operative photograph showing the evacuated blood clot via sub-brow incision.

FIGURE 7: Pre-operative and post-operative photographs showing immediate resolution of proptosis after evacuation of hematoma.

The patient had immediate resolution of proptosis, pain and visual acuity improved to 6/18 on the first post-
operative day with mild lid edema. He regained full range of extraocular movements in all directions of gaze with no lagophthalmos. The patient received a total of three doses of daily intravenous methylprednisolone and was discharged home on oral antibiotics on the fourth post-operative day. He was advised of a follow-up visit to the outpatient department after one week. Two weeks later, the patient had a full recovery with the restoration of visual acuity to 6/6 in the affected eye (Figures 8-10).

FIGURE 8: Two weeks post-operative photograph after removal of sutures showing clean wound with good healing and no lagophthalmos.

FIGURE 9: Two weeks post-operative photograph showing central light reflex in primary gaze with normal palpebral fissure height.

FIGURE 10: Two weeks post-operative photograph showing no apparent proptosis.

Discussion
Orbital compression syndrome rarely presents as a complication of sickle cell disease. To the best of our knowledge, 16 previous case reports exist describing orbital compression syndrome in the last three decades. All previous articles reported having either acute pain crisis preceding the orbital compression event, documented fever, or a rise of white blood cells on admission (Tables 1-3) [10-19].

| Case report          | Curran et al. [12]                  | Ganesh et al. [13]                  | Khouri et al. [11]                  | Prociunoy et al. [14]                |
|----------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Year of publication  | 1997                                | 2001                                | 2002                                | 2008                                |
| Age                  | 8 years                             | 6-15 years                          | 11 years                            | 11 years                            |
| Gene                 | Sickle β thalassemia                | 4 patients: Homozygous sickle cell disease; 1 patient: Sickle cell-β-thalassemia | Homozygous sickle cell disease      | Not mentioned                       |
| Laterality           | Bilateral                           | 4 patients: Unilateral; 1 patient: Unilateral | Bilateral                           | Unilateral                          |
| Bone pain            | Yes                                 | Yes                                 | Yes                                 | No                                  |
| Fever                | Yes                                 | Yes                                 | No                                  | No                                  |
| Trauma               | No                                  | No                                  | No                                  | Yes, minor one                      |
| Other                | -                                   | -                                   | Cerebrovascular accident            | -                                   |
| WBCs                 | Increased                           | Not mentioned                       | Increased                           | Not mentioned                       |
| Optic nerve function | RE normal, LE: RAPD + Decrease in vision | Decrease in vision                  | No RAPD                             | Decrease vision RAPD                |
| Treatment            | Both eyes orbital decompression + intravenous analgesics, fluids, and antibiotics, and packed erythrocyte transfusion | intravenous fluids, analgesics, antibiotics and steroids, and exchange transfusion | Surgical Evacuation (misdiagnosed first as abscess) | Surgical intervention twice         |
| Outcome              | Regained vision                     | All regained vision 6/6             | The swelling resolved               | Regained vision                     |

**TABLE 1: Summary of previous case reports (1/3)**

RE: right eye; LE: left eye; RAPD: relative afferent pupillary defect
| Case report | Soko et al. [15] | Helen et al. [16] |
|-------------|------------------|------------------|
| **Year of publication** | 2008 | 2013 |
| **Age** | 22 years | 16 years | 10 years | 11 years |
| **Gene** | All homozygous sickle cell disease | Homozygous sickle cell disease |
| **Laterality** | All unilateral | Bilateral |
| **History** | | |
| Bone pain | No | No | Yes | Yes |
| Fever | No | No | Not mentioned | Yes |
| Trauma | No | No | No | No |
| Other | - | URTI | - | - |
| **WBCs** | Increased | Not mentioned | Increased | Not mentioned |
| **Optic nerve function** | Decrease in vision + Compressive optic neuropathy | Normal | Decrease in vision + No RAPD | Loss of vision due to bilateral bullous retinal detachment |
| **Treatment** | All Intravenous antibiotics and steroid | Systemic and topical steroid, intravenous fluid, and analgesics |
| **Outcome** | Resolution of edema | Improved swelling but vision remained NPL |

**TABLE 2: Summary of previous case reports (2/3)**

URTI: upper respiratory tract infection; RAPD: relative afferent pupillary defect; NPL: no perception of light
| Case report          | Year of publication | Age | Gene                              | Laterality   | History | Trauma | Other | WBCs | Optic nerve function | Treatment                                                                 | Outcome                                      |
|---------------------|---------------------|-----|-----------------------------------|--------------|---------|--------|-------|------|----------------------|--------------------------------------------------------------------------------|-----------------------------------------------|
| Yateem et al. [10]  | 2015                | 10  | Sickle cell-β-thalassemia         | Bilateral    | Yes     | No     | -     | Normal | MRI showed small optic nerve, displaced with loss of its surrounding cerebrospinal fluid | -Hydration, intravenous antibiotics, and steroid -Urgent drainage of sub-periosteal hematoma | RE 6/6, LE PL + Gradual improvement with reduction in swelling |
| Sundu et al. [17]   | 2017                | 14  | Not mentioned                     | Bilateral    | Yes     | Yes    | -     | Not mentioned | Minimal decrease in vision + No RAPD | Intravenous antibiotics and steroid | Totally recovered |
| Alhamdi [18]        | 2018                | 12  | Sickle cell-β-thalassemia         | Unilateral   | Not mentioned | No   | -     | Increased | Decrease in vision + No RAPD | Intravenous fluid, antibiotics, systemic anti-inflammatory agents, and opioid analgesia | Condition was stabilized, Nothing mentioned about vision |
| Onyeama and Jain [19]| 2020                | 2   | Homozygous sickle cell disease    | Unilateral   | Yes     | No     | -     | Not mentioned | Not mentioned | - | Dramatic improvement |

**TABLE 3: Summary of previous case reports (3/3)**

RAPD: relative afferent pupillary defect; RE: right eye; LE: left eye; PL: perception of light

Unlike the previous case reports, detailed history taking, vital signs checking, and complete blood count workup all turned to be unremarkable, and proptosis and eye pain were the only presenting symptoms. Although the patient and his parents denied any previous significant sickling attacks, the necessity of undergoing both ears cochlear implantation following sensorineural hearing loss six years prior to the presentation can be explained by having a sickle cell crisis at that time.

Moreover, only four of the previously reported cases have required surgical intervention, while the rest improved with conservative management. Our case sets a good example of early recognition and prompt surgical intervention which proved crucial in regaining vision in cases with optic nerve dysfunction.

**Conclusions**

Orbital compression syndrome, although rare, can occur in patients with sickle cell disease. As shown in our case, prompt surgical management is crucial for successful resolution and recovery of vision, especially in those cases complicated by optic nerve dysfunction due to large sub-periosteal hematoma. We suggest that future studies should focus on comparing different sickle cell disease variants and their association with orbital compression syndrome occurs.

**Additional Information**

**Disclosures**

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