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# Experience of Transfusion Exchanges at the Center for Mixed Medicine and SS Anemia; Kinshasa, Democratic Republic of the Congo

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## Abstract

**Context:** Sickle cell anemia is a genetic and hereditary disease due to the presence of hemoglobin S. The Transfusion exchanges are carried out for preventive purposes or/and curative of certain complications. **Objective:** the assigned objective is to list indications, observed reactions, initial and final hemoglobin rates as well as different blood groups from sickle cell patients homozygous SS who had benefited from transfusion exchanges. **Patients and Methods:** This documentary and descriptive studies were carried out from December the first 2012 to July 31/2020 at the Center for Medicine Mixed and Anemia SS in Kinshasa. The technique of transfusion exchanges was manual. The parameters used were age, sex, pre-exchange hemoglobin level, post-exchange hemoglobin level, blood group, indications, and immediate and late reactions observed. **Results:** Transfusion exchanges have been done on 128 sickle cell patients including 47 males and 81 females with a sex ratio of 0.58. The greatest indication was stroke with 49.2%. The age group 0 - 10 years represents 57.6% of strokes. Observed reactions were urticaria 11.7%, Fever 8.6%, Headaches 6.5%, Vomiting 3.1%, and 70.3% have shown no reactions. The initial average hemoglobin rate is 8.2 g%. The final average hemoglobin is 9.2 with an increase. The most represented blood group is $O^+$ with 32.8%. **Conclusion:** The manual exchange transfusion is adjusted depending upon the medium condition and requires further improvement for better following of patients.

## Subject Areas

Hematology

## Keywords

Sickle Cell Anemia, Transfusion Exchange, Indications, Reactions, Kinshasa

## 1. Introduction

A real public health problem, sickle cell disease is a genetic and hereditary disease that is linked to the presence of hemoglobin S with the manifestations of chronic hemolytic anemia, Vaso-occlusive crises as well as susceptibility to infections [1] [2].

The global situation of sickle cell disease is dramatic. It is estimated that every year in the world, nearly 300,000 newborns are affected by the disease. Most of these are born in Africa or of African descent [1].

In the Democratic Republic of the Congo, on average, 2 out of 100 newborns are SS, and about 27 to 32 out of 100 are AS, potential future parents of other babies with sickle cell disease [1].

For nearly ten years, the therapeutic management of sickle cell disease has improved alongside transfusion programs that prevent or even treat certain complications such as strokes, priapism, intractable Vaso-occlusive crises, acute chest syndrome, and so many more [2].

Blood transfusion plays a considerable role since it makes it possible both to correct the quantitative deficit in oxygen transporters and to provide deformable red blood cells capable of reaching sites ischemic due to vascular occlusions [3] [4].

A transfusion exchange is a technique that involves coupling a bloodletting to a transfusion according to a volume ratio to reduce the percentage of hemoglobin S to less than 30% [5]. It can be manual or automated using an erythrapheresis device. Manual transfusion exchanges are widespread in black Africa.

In a study by Elira *et al.* from 2005 to 2008, the objective was to assess the place of transfusion exchanges during homozygous sickle cell disease at the Brazzaville University Hospital [6].

The manual transfusion method is beneficial in managing complications, especially with a low-income population and limited working conditions [7].

As a result, We have ourselves the objectives of listing the indications, the reactions observed, the initial and final hemoglobin levels and the different blood groups in patients with sickle cell disease who have benefited from transfusion exchanges at the mixed medicine and anemia center SS.

## 2. Patients and Methods

### 2.1. Patients

**Procedure of the transfusion exchange**

The transfusion exchanges took place manually in 3 stages with two venous lines. It starts with bleeding, during which blood is withdrawn from the patient. At the same time, the return route is perfused drop by drop with 0.9% physiological saline (15 to 20 drops) per minute for 30 minutes followed by the replacement of the patient's blood by a transfusion of concentrated red blood cells and readjustment of the hematocrit by an infusion of 0.9% saline. The end of the transfusion occurs when the volume of transfused red blood cells is equal to or greater than the volume of subtracted RBCs.

The volume of blood and the number of sessions depend on the indication [5].

## 2.2. Methods

**Setting and type of study**

We carried out a documentary and descriptive study from December 1, 2012, to July 31, 2020, from the register of transfusion exchanges of the mixed medicine and SS anemia center in Kinshasa (DR Congo) "CMMASS".

**Population study**

Patients with sickle cell disease who have benefited from transfusion exchanges at the mixed medicine and anemia center SS.

**Inclusion criteria**

Patients with all the complete parameters on the register during the study period were considered.

**Parameters of interest**

The parameters used were age, sex, pre-exchange hemoglobin level, post-exchange hemoglobin level, blood group, indications, and immediate and late reactions observed.

After collection, the data were entered into Excel and analyzed using SPSS 20 software on Windows.

# 3. Results

## 3.1. Distribution According to Gender

Table 1 and Figure 1 illustrate the gender.

Table 1. Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa by gender from December 1, 2012 to July 31, 2020. Source: ourselves from our study.

| Gender | Frequency | Percentage |
|---|---|---|
| F | 81 | 63.3 |
| M | 47 | 36.7 |
| Total | 128 | 100.0 |

Comment: A total of 128 sickle cell patients who benefited from transfusion exchanges were collected, including 0.47 males and 81 females. That is a sex ratio of 0.58.

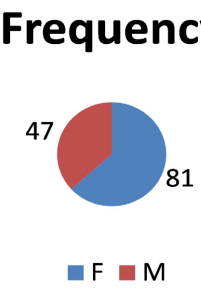


**Figure 1.** Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa by gender from December 1, 2012 to July 31, 2020. Source: ourselves from our study.

### 3.2. Distribution According to Indications

Table 2 and Figure 2 illustrate the indications.

**Table 2.** Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to indications from December 1, 2012 to July 31, 2020.

| Indications | Frequency | Percentage % |
|---|---|---|
| Anemia | 5 | 3.9 |
| Stroke | 63 | 49.2 |
| Intractable Vaso occlusive crisis | 19 | 14.8 |
| Priapism | 21 | 16.4 |
| Acute chest syndrome | 8 | 6.3 |
| Malleolar ulcers | 12 | 9.4 |
| Total | 128 | 100.0 |

Comment: The indications were stroke in 63 cases (49.2%), priapism in 21 cases (16.4%), intractable Vaso-occlusive crises in 19 cases (14.8%), malleolar ulcers in 12 cases (9.4%), acute chest syndrome in 8 cases (6.3%) and recurrent anemia in 5 cases of them (3.9%).

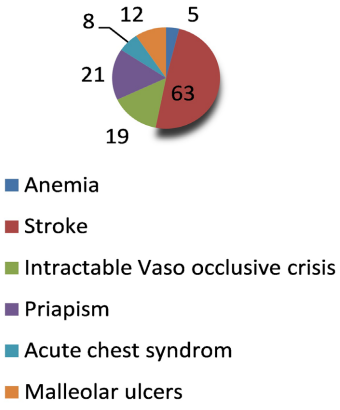


**Figure 2.** Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to indications from December 1, 2012 to July 31, 2020.

### 3.3. Distribution According to Indications and Gender

Table 3 and Figure 3 illustrate the indications and the gender.

Table 3. Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to gender and indications from December 1, 2012 to July 31, 2020. Source: ourselves from our study.

| Indications | Gender | | Total |
|---|---|---|---|
| | F | M | |
| Anemia | 4 | 1 | 5 |
| Stroke | 49 | 14 | 63 |
| Intractable Vaso occlusive crise | 15 | 4 | 19 |
| Priapism | 0 | 21 | 21 |
| Acute chest syndrome | 6 | 2 | 8 |
| Malleolar ulcers | 7 | 5 | 12 |
| Total | **81** | **47** | **128** |

Comment: Stroke represents the greatest complication of the sick cell anemia with a high percentage at the gender female before priapism at gender male.

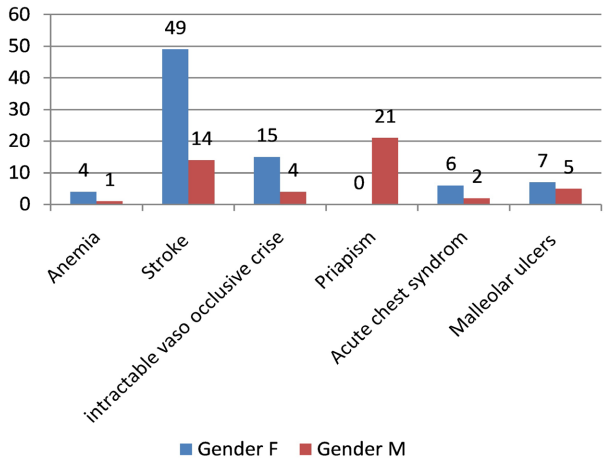


Figure 3. Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to gender and indications from December 1, 2012 to July 31, 2020. Source: ourselves from our study.

### 3.4. Distribution According to Age Groups

Table 4 and Figure 4 illustrate the age groups.

Table 4. Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to age groups from December 1, 2012, to July 31, 2020. Source: ourselves from our study.

| Age range | Stroke | Intractable Vaso occlusive Crisis | Priapism | Acute Chest Syndrome | Anemia | Malleolar Ulcers |
|---|---|---|---|---|---|---|
| 0 - 10 | 45 | 2 | 2 | 0 | 0 | 2 |
| 11 - 20 | 13 | 7 | 6 | 4 | 6 | 1 |

**Continued**

| | | | | | | |
|---|---|---|---|---|---|---|
| 21 - 30 | 4 | 4 | 9 | 3 | 3 | 1 |
| 31 - | 1 | 6 | 4 | 1 | 3 | 1 |
| Total | 63 | 19 | 21 | 8 | 12 | 5 |

Comment: The age group 0 - 10 years represents 57.6% of strokes, 11 - 20 represents 16.6%, Priapism represents 7% in 21 - 30 years, intractable Vaso occlusive crisis 5.4% The age group 11 - 20 years, Malleolar ulcers 4.6% in the range 11 - 20 years.

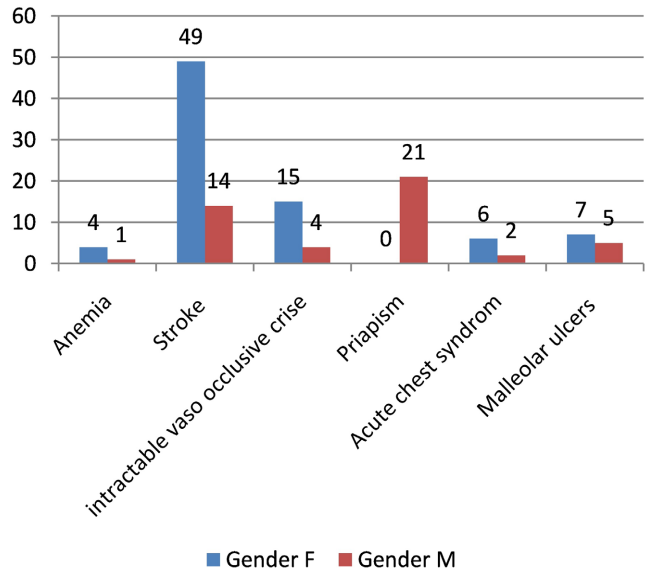


**Figure 4.** Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to age groups from December 1, 2012, to July 31, 2020. Source: ourselves from our study.

## 3.5. Distribution According to Reactions

Table 5 and Figure 5 illustrate the reactions.

**Table 5.** Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to reactions from December 1, 2012 to July 31, 2020. Source: ourselves from our study.

| Reaction | Frequency | Percentage (%) |
|---|---|---|
| Nothing | 90 | 70.3 |
| Headaches | 8 | 6.3 |
| Fever | 11 | 8.6 |
| Urticaria | 15 | 11.7 |
| Vomiting | 4 | 3.1 |
| Total | 128 | 100.0 |

Comment: The reactions observed were urticaria: 15 cases or 11.7%, Fever: 11 cases or 8.6%, Headaches: 8 cases or 6.3%, Vomiting: 4 cases 3.1%, 90 cases or 70.3% had no reactions.

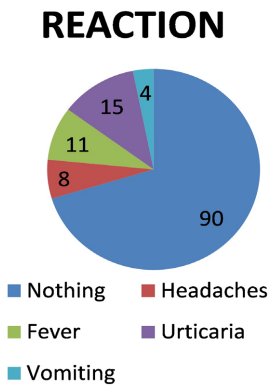


**Figure 5.** Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to reactions from December 1, 2012 to July 31, 2020. Source: ourselves from our study.

### 3.6. Hemoglobin Levels

Table 6 and Figure 6 illustrate the hemoglobin levels.

**Table 6.** Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to the hemoglobin level from December 1, 2012 to July 31, 2020. Source: ourselves from our study.

| | N | Minimum | Maximum | Mean |
|---|---|---|---|---|
| HB POST | 128 | 6.8 | 11.9 | 9.284 |
| HB PRE | 128 | 4 | 12 | 8.23 |
| Total | 128 | | | |

Comment: Initial average Hb rate: 8.2 g% Final average Hb rate: 9.2 g%, *i.e.* a gain of around 1.0 g%.

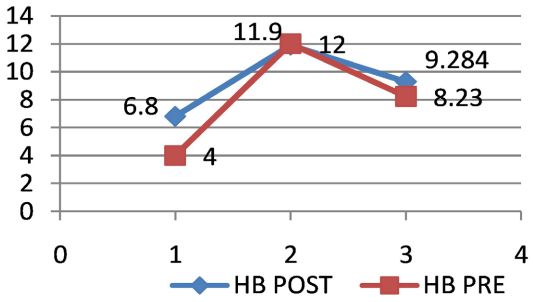


**Figure 6.** Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to the hemoglobin level from December 1, 2012 to July 31, 2020. Source: ourselves from our study.

### 3.7. Distribution According to Blood Group

Table 7 and Figure 7 illustrate the blood group.

**Table 7.** Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to blood group from December 1, 2012 to July 31, 2020. Source: ourselves from our study.

| Blood Group | Frequency | Percentage |
|---|---|---|
| $A^-$ | 5 | 3.9 |
| $A^+$ | 25 | 19.5 |
| $AB^-$ | 6 | 4.7 |
| $AB^+$ | 10 | 7.8 |
| $B^-$ | 11 | 8.6 |
| $B^+$ | 22 | 17.2 |
| $O^-$ | 7 | 5.5 |
| $O_+$ | 42 | 32.8 |
| Total | 128 | 100.0 |

Comment: The most represented blood group is $O^+$ with 42 patients or 32.8% followed by $A^+$ with 25 patients or 19.5%.

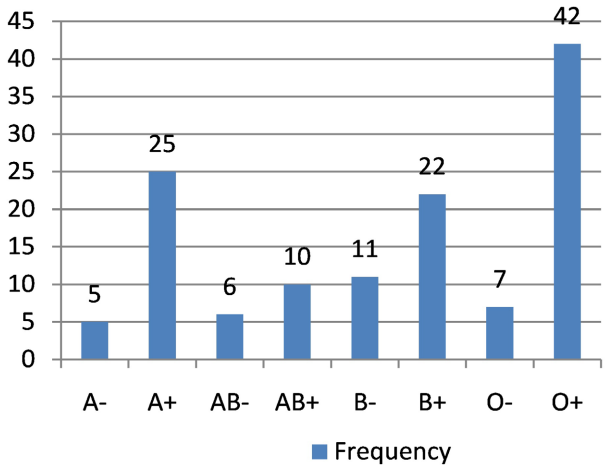


**Figure 7.** Distribution of patients who benefited from transfusion exchanges at the SS anemia and mixed medicine center in Kinshasa according to blood group from December 1, 2012 to July 31, 2020. Source: ourselves from our study.

## 4. Discussion

A total of 128 SS homozygous sickle cell patients underwent manual transfusion exchange at the SS anemia and mixed medicine center. With around 400 consultations per month ranging from a simple routine check to the follow-up of a complication, the CMMASS is considered a reference for the management of sickle cell disease.

The average age of the patients was 14 years compared to a study carried out by Aimee olivat in Madagascar which had an average age of 10.2 years for 54 patients with sickle cell disease who benefited from transfusion exchanges [7].

Indications included stroke, priapism, intractable Vaso-occlusive crises, acute chest syndrome, and malleolar ulcers compared to Elira at CHU Brazzaville in 42 sickle cell patients [6].

None of our pregnant women benefited from transfusion exchanges.

The stroke is often serious, at risk of sequelae or death. An American study carried out between 1978 and 1988 on a cohort of 4082 sickle cell patients shows that the risk of stroke of ischemic origin is higher in patients under 20 and over 30 [8].

The age group that was most represented was that of 0 to 10 years for strokes, *i.e.*, 57.6%, followed by that of 11 - 20 years, which has 16.6%.

Sickle cell disease multiplies by 220 the risk of stroke in children with a cumulative risk of 17% at 20 years [9].

Transcranial Doppler ultrasound is not done systematically in our center, hence the difficulty of early detection of cerebral vasculopathy and patients who have strokes that are already established for the most part.

According to Amadou Kassogué *et al*., in Mali, patients with SS anemia are particularly at risk of priapism. Of 36 cases at the CHU de TOURE, 34 sickle cell patients were noted. The most represented age groups were between 11 - 20 and 21 - 30, *i.e.*, 58% [10].

On the other hand, in our study, we had 11.7% for the two age groups combined.

Acute chest syndrome is the leading cause of death in sickle cell patients. This pathology is widespread, especially in the pediatric population, with a frequency that decreases with age, the peak incidence being between the ages of 2 and 4 years (25 out of 100 people/year for this age group), reaching 8.8/100 person/year for adults [11].

Our study had 4 cases for 10 - 20-year-olds, 3 points for 11 - 20-year-olds, and 1 claim for 31-year-olds and over.

Intractable Vaso-occlusive crises are severe crises that do not respond to any analgesic treatment we can use in our environment. We had 19 cases or 14.8%.

The pain may persist or worsen despite correct treatment. It would then be necessary to check the oxygen saturation, put on oxygen if necessary, and start a broad-spectrum antibiotic therapy under certain conditions [12].

It marks an increased presence of circulating sickle cells in the body.

Malleolar ulcer is a chronic complication that affects young adults whose average age is in their twenties [12].

We had 9.4% with a peak in the age group of 11 - 20 years compared to Ngolet LO *et al.* at CHU Brazzaville where the frequency of malleolar ulcers was 27.46% [13].

As reactions observed during manual transfusion exchanges, we had a fever, hives, headaches and vomiting.

For Kevin H.M. Kuo, *et al*., with manual transfusion exchanges there was a fever, dizziness and a hypotension. In the automated transfusion exchanges using a cell separator there were hivesand dizziness[14].

For Elira *et al*., there were no reactions attributable to manual transfusion exchanges at the Brazzaville University Hospital [6].

In our study, the initial hemoglobin level was an average of 8.2 g/dl and the final rate was 9.2/dl, *i.e.* an average gain of 1.05 g compared to a study by NGOLE *et al.* of 8.03 g and a final rate of 9.7 g/dl, an average gain of 1.67 [15].

The percentage of hemoglobin S was not noted in the register,

We are just referring to the fact that one unit of red blood cell concentrate reduces the rate of hemoglobin S between 6% to 12%. Hence with 4 to 6 sessions, we estimate that the rate of SS is reduced to less than 40% [2].

It is necessary to repeat transfusion exchanges in the absence of improvement or in the event of the persistence of signs of severity or increased need for oxygen therapy [16].

The ideal would be to use AA phenotypes blood to hope for excellent results. Still, blood donations, according to our national policy, do not make any difference between AS and AA donors. Extended phenotyping is done on request, and the price is not within everyone's reach, given the urgency.

The major transfusion problems during sickle cell disease concern iron overload and post-transfusion hemolytic reactions.

Hemolysis by the conflict between the donor's red blood cells via its antigens and the recipient's antibodies can result clinically in the absence of transfusion yield, evidenced by a hemoglobin level that does not increase after the transfusion [2].

All this can explain the repeated anemia with 3.9%, even though it is rare in black Africa since donors and recipients have the same erythrocyte antigens [1].

The control of hemoglobin S. post-transfusion exchange is carried out for a category of patients, given the cost and the lack of suitable equipment to carry out this examination.

For blood grouping, we had 32.8% of group O rhesus positive compared to Françoise Ngo Sack *et al.* where group O is the most represented with 54.2% with a rhesus positive at 51.6% [17].

Most of the patients were put on hydroxyurea except those with malleolar ulcers. The dose was adjusted according to their weight and their tolerance.

Currently, hydroxyurea is the only drug treatment that can improve the quality of life and life expectancy of sickle cell patients [18].

For Charache *et al.*, hydroxyurea was an essential drug for sickle cell patients because it would reduce the number of painful sickle cell crises, the frequency of hospitalization, and the length of stay in intensive care [19].

## 5. Conclusions

Transfusion exchanges are an essential treatment for sickle cell disease. Punctual and vital interest in certain situations is both acute and chronic.

The manual method is adapted to the conditions and standard of living of D.R. Congo's environment.

It becomes essential to think about strategies to find enough immunologically compatible blood products, medical staff and qualified nurses to perform the procedures and prevent complications.

## Conflicts of Interest

The authors declare no conflicts of interest regarding this work.

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