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How safe is tourniquet use in sickle-cell disease?

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Summary

Nineteen patients with sickle-cell haemoglobinopathy (HbSS-14; HbSC-5) aged five years to twenty-three years who had twenty orthopaedic operations performed under tourniquet at the Obafemi Awolowo University Teaching Hospital Complex, Ile-Ife between June 1987 and May 1991 were studied. The incidence of complications in these patients were compared with a control group of patients with HbAA who had similar operations under tourniquet and were matched for age and sex. There were seven patients with complications in the sickle cell anaemia group and three in the control group. Only three complications in the study group were significant. These were bone pains, severe post-operative pain and jaundice. Another complication was tissue oedema. The incidence of complications was significantly higher in the sickle cell patients than the normal group ($P < 0.01$). There were no mortalities. All complications resolved within two weeks of non-invasive management.

Résumé

Une Serie de dix-neuf malades atteinte d'hemoglobine SS et SC (HbSS -14, HbSC-5) cinq a age cingt — trois ans; sur lesquelles on avait fait vingt operations orthopediques par l'utilisant de la tourniquet, aux hospitals universitaire d'universite Obafemi Awolowo, Ile-Ife pendant de temp Juin 1987 a Mai 1991 etait etudie. L'incidence de complications dans ces malades etait comparee avec une groupe des malades (Hb AA), qui faites operer les operations similaire, aussi par l'utilisant de la tourniquet, ages et sexes similaire. Il'y avait sept complications dans les malades d'hemoglobinopathie, et trois dans la groupe de controle. Trois complications seulement dans la groupe etudiant avaient une importance statistique — le douleue d'os, le douleue post-operative severe et a jaunisse. Les autres avaient seulement L'oedeme du tissu. L'incidence des complications etait remarquablement en haut entre la groupe des malades d'hemoglobinopathies ($P < 0.01$). Il n'y avait pas des mortalites, et tous les complications etaient resolu au moins de deux semaines de traitements non-invasifs.

Introduction

The use of tourniquet in operations of the limb not only provides a bloodless field, it also reduces the need for blood transfusion. As deadly blood-borne diseases like Acquired Immune Deficiency Syndrome (AIDS) and viral hepatitis again increasing prominence all over the world, blood transfusion is approached more cautiously[1]. The patients with sickle cell anaemia constitute a susceptible group. Unfortunately, sickle cell haemoglobinopathy is commonest in the developing countries where facilities for screening of blood for hepatitis antigen and HIV are often inadequate. The frequent need for blood transfusion in these patients can be minimized by reducing haemolysis and enhancing haemopoiesis (antimalaria and folic acid therapy) and also by reducing blood loss. Blood loss, especially in musculo-skeletal surgery, can be reduced by use of tourniquet. This must, however, be balanced with its safety. Reports on the safety of the tourniquet use in sickle cell patients is very scarce[2,3].

This paper presents the results of a prospective study into the incidence of complications in patients with sickle-cell anaemia when tourniquet is used.

Materials and methods

Nineteen patients with sickle cell haemoglobinopathy were operated upon using tourniquet at the Obafemi Awolowo University Teaching Hospital Complex, Ile-Ife between June 1987 and May 1991. Patients in any form of sickle cell crisis were excluded. A second group of twenty patients with haemoglobin type AA were also operated under similar tourniquet and these acted as control. The controls were matched for age and sex. An Esmarch rubber bandage was used to exsanguinate the limb just after

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skin preparation. The same was used as tourniquet by applying three layers of the bandage in the thigh or upper arm. The incidence of complications in the two groups were studied, and subjected to statistical analysis using the chi-squared test.

Results

Out of the 19 sickle cell patients, 12 were male and 7 were female. Their ages ranged from 5 years to 23 years. Fourteen had haemoglobin SS and five had haemoglobin SC. All patients except the oldest one had been diagnosed as sickle cell patients and were on their routine folic acid and prophylactic anti-malaria therapy. Four of the patients had had previous blood transfusions (table 1). The majority of the patients had sequestrectomy for chronic osteomyelitis. Pre-medication was usually atropine and diazepam, given at induction of anaesthesia with phencyclidine (Ketamine). Sixteen of the control group had sequestrectomy, one had ganglionectomy and three had incision and drainage for acute osteomyelitis.

Table 1: Patients' data

Serial no:	Age (Yrs)	Sex	Hb. Type	Haematocrit %	Diagnosis	Operation	Tourniquet time (Minutes)	Complications
1.	23	F	SC	32	Stiff knee	Quadricepts plasty	45	Severe post-operative pain. Bone pain
2.	5	M	SS	26	Chronic osteomyelitis	Sequestrectomy	25	—
3.	7	M	SS	24	CSO radius	Sequestrectomy	40	Finger swelling
4.	13	M	SS	24	CSO tibia	Sequestrectomy	31	—
5.	8	F	SS	25	CSO tibia	Sequestrectomy	28	Pedal swelling
6.	7	M	SC	29	CSO Femur	Sequestrectomy	45	—
7.	5	M	SS	26	CSO Femur	Sequestrectomy	32	—
8.	5	M	SS	24	CSO Femur	Sequestrectomy	34	—
9.	7	F	SC	30	CSO Ulna	Sequestrectomy	20	—
10.	6	F	SS	24	CSO Tibia	Sequestrectomy	30	Pedal swelling
11.	5	M	SS	23	CSO, Ulna	Sequestrectomy	15	—
12.	8	M	SS	23	CSO Tibia	Sequestrectomy	22	—
13.	14	M	SS	27	CSO Femur	Incision drainge and bone drilling	25	—
14.	7	M	SS	24	CSO Tibia	Sequestrectomy	30	Pedal swelling
15.	5	M	SS	25	CSO Tibia	Sequestrectomy	24	—
16.	8	F	SC	26	CSO Femur	Sequestrectomy	38	—
17.	7	M	SS	23	CSO Radius	Sequestrectomy	35	—
18.	7	F	SS	22	CSO Femur	Sequestrectomy	40	Mild jaundice
19.	10.	M	SS	24	CSO Tibia	Sequestrectomy	28	—
20.	10.	M	SS	23	CSO Ulna	Sequestrectomy	30	—

+ CSO — Chronic Septic Osteomyelitis

Table 2: Incidence of complications

Complications	Sickle cell patients	Normal patients
Swelling of the extremity	4	3
Severe post-operative pain	1	0
Bone pains	1	0
Jaundice	1	0
Total	7	3

In the patients with sickle cell anaemia, tourniquet time ranged from fifteen minutes to forty-five minutes, average — thirty-one minutes. Seven patients developed complications and these were — (i) swelling of the extremity in four patients, (ii) severe post-operative generalised pain which included bone pains in one patient and (iii) jaundice in one patient (table 2). The tourniquet provided a bloodless operating field in all cases. Blood transfusion was not necessary in any of the patients. In the control group only three cases of swelling of the extremity were recorded (table 2). The average tourniquet time was thirty- three minutes.

Illustrative cases

Case 1: This twenty-three year old girl presented with bilateral knee stiffness following twelve years of chronic osteomyelitis of both femur. She had had sequestrectomy at another hospital three, and five years before presentation. She had blood transfusions peri-operatively then, though a diagnosis of sickle cell disease was not made. She looked clinically normal and was not pale or jaundiced. Both knees were very stiff with a range of flexion of 0-50° on the right and 0-15° on the left. The gait was awkward. The haematocrit was 32%. She had haemoglobin SC. She had left quadriceps plasty at which time the adhesions were freed from the rectus femoris and a range 0-120° flexion was achieved. A plaster of Paris cylinder was applied with the knee flexed at 30°. Tourniquet was used for forty-five minutes. She had very severe post-operative pain at the operation site. There was a little improvement when the plaster cylinder was cut into a back slab. Parenteral pethidine only gave very transient relief. She was kept well hydrated. The pain improved slowly after about thirty-six hours post-operatively. On the seventh post-operative day she developed mild generalised bone pains. Malaria parasite was present in her peripheral blood film. She improved with chloroquine, analgesics and oral rehydration.

Case 18: This seven-year old girl had sequestrectomy for chronic osteomyelitis of the femur. She had the lowest haemoblogin concentration of 7gm (haematocrit 21%) but the anaemia was not symptomatic. Her haemoglobin type was SS. Tourniquet time was 40 minutes. Three days after operation she developed a mild jaundice (serum bilirubin 2.7mg/100ml) and haematocrit of 19%. The jaundice persisted for two weeks during which liberal fluids and routine folic acid were given.

Discussion

Sequestrectomy is probably the commonest orthopaedic operation performed on patients with sickle cell anaemia in our area of study. This operation is often associated with more bleeding than is imagined. Using tourniquet reduces primary bleeding. There is however, increased blood flow, as well as tendency to bleed in the limb after the tourniquet is removed[3,4]. Post-operative bleeding is adequately reduced by the application of firm crêpe bandage, proper haemostasis during surgery and elevation of the limb during the period of reactive hyperaemia — five minutes after the release of tourniquet. The application of tourniquet produces acidosis, hypoxaemia and circulatory stasis in the ischaemic tissues. These are three of the common factors that precipitate a crisis in patients with sickle-cell anaemia. This has probably discouraged the use of tourniquet in these patients. Stein and Urbaniak noted a higher incidence of complications in patients with sickle-cell anaemia compared with normal control when tourniquet was used[1].

In this study, the overall incidence of seven (35%) complications were seen in the sickle-cell patients. This is significantly higher than an incidence of three (15%) in the control group ($P < 0.01$). Of the seven complications only three are closely related to sickle cell and tourniquet. These were bone pains, severe post-operative pain and jaundice. The pain complications may be explained by ischaemia in the affected tissues due to capillary obstruction by sickled red blood cells. This is particularly likely in infective conditions where total exsanguination of the limb is not possible because the inflamed area is skipped during exsanguination with the Esmarch

bandage. Whether the jaundice was due to the tourniquet or the stress of the operation that precipitated haemolytic crisis is uncertain.

In the control group only peripheral oedema was recorded as complications in three patients. This is similar to the occurrence of peripheral oedema in four sickle cell patients. Thus, oedema formation seems to be more related to the tourniquet than the haemoglobin type. It is noteworthy also that there are other factors that contribute to the oedema formation. These include severity of the surgical trauma, duration of surgery and tourniquet, and promixity of the operation site to the extremity. Although the pneumatic tourniquet is safter than the Esmarch rubber bandage by design, an ill-maintained pneumatic tourniquet with inaccurate guage may be dangerous[5].

In conclusion, the use of tourniquet in sickle cell patients is risky. Adequate care should be taken whenever it has to be used in patients with sickle cell anaemia. All patients must have their haemoglobin electrophoresis done before operation. Adequate hydration must be maintained in the patient all through the peri-operative period. The patient should have good pre-anaesthetic oxygenation before induction of anaesthesia and post-operatively. Careful exsanguination of the limb before tourniquet application must be done. The tourniquet time should be kept as short as possible[5]. The patient must be closely watched in the post-operative period for any complications.

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