Open Splenectomy in Jamaican Children with Sickle Cell Disease

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ABSTRACT

A total of 110 patients with sickle cell disease who had open splenectomy at the University Hospital of the West Indies over a 10-year period are reviewed. Patients with homozygous sickle cell disease numbered 94, S β^0 and S β^+ thalassaemias (11 and 4 respectively) and one patient with SC disease. Postoperative acute chest syndrome was the most common complication (9 of 110).There were no life threatening emergencies and no mortalities. Eleven patients received preoperative blood transfusion and operative times were short averaging 60 minutes among the 110 patients. Open splenectomy remains the gold standard for patients with sickle cell disease requiring splenectomy.

Esplenectomía Abierta en Niños Jamaicanos con la Enfermedad de Células Falciformes

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RESUMEN

El presente trabajo revisa un total de 110 pacientes con la enfermedad de células falciformes, que fueran sometidos a una esplenectomía abierta en el Hospital Universitario de West Indies, a lo largo de un período de 10 años. Los pacientes con enfermedad de células falciformes homocigóticas fueron 94, con talasemias S β^0 y S β^+ fueron 11 y 4 respectivamente, y un paciente presentaba la enfermedad por hemoglobina SC. El síndrome torácico agudo postoperatorio resultó ser la complicación más común (9 de 110). No hubo emergencias con riesgo de vida ni mortalidades. Once pacientes recibieron transfusión de sangre en el postoperatorio y los tiempos de operación fueron cortos, con un promedio de 60 minutos entre los 110 pacientes. La esplenectomía abierta sigue siendo la norma de oro para los pacientes con la enfermedad de células falciforme que requieren esplenectomía.

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INTRODUCTION

Splenectomy is performed in patients with sickle cell disease to prevent deaths due to recurrent acute splenic sequestration (ASS) or to enhance the haematological and nutritional status of patients with chronic hypersplenism (CHS) (1–3). Acute splenic sequestration is defined as a sudden increase in splenic size (> 3 cm below the costal margin), associated with falling haemoglobin (> 2 g/dl) and rising reticulocytes, reversible by blood transfusion. Chronic hypersplenism refers to splenic enlargement (> 4 cm below the costal margin) in association with a fall in haemoglobin concentration (> 2.0 g/dl), and high reticulocyte count (> 20%), sustained for greater than three months (1).

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Jamaican patients with homozygous sickle cell (SS) disease are at greatest risk of death from ASS between the ages of 6 and 12 months (4, 5). Open splenectomy has been performed with low morbidity in Jamaican children with the SS genotype (1, 6, 7–9), which occurs once in every 300 Jamaican births (10)

Sickle cell disease includes not only genotypic homozygotes (SS) but also the double heterozygotes (SC, S β^0 and S β^+ thalassaemias) (10, 11). These heterozygotes to varying degrees also develop splenic complications. Haemoglobin SC disease, which occurs once in every 500 Jamaican births, causes splenic complications only rarely (10). The genotypes S β^0 thalassaemia and S β^+ thalassaemia are rare in the Jamaican population, occurring once in every 7000 and once in every 3000 births respectively, but their propensity for splenic complications is high (10).

This paper reviews the recent experience at the University Hospital of the West Indies (UHWI) with open splenectomy, in children with homozygous and heterozygous sickle cell disease.

SUBJECTS AND METHODS

Between November 1994 and October 2004, 114 splenectomies were performed on children with sickle cell disease. The case notes of 110 were located (96.5%). These patients' names and registration numbers were obtained from Ward and Recovery Room Registers. Data on each patient's genotype, gender, weight, haematological indices and indication for splenectomy were retrieved. The amount of peri-operative blood transfusions administered, operative time and postoperative complications were also noted.

All 110 patients had at least one of the two established indications for splenectomy, recurrent ASS or CHS (1, 2). Patients received pneumococcal and haemophilus influenza vaccine prophylaxis prior to splenectomy and also received perioperative antibiotics (amoxicillin and gentamicin).

All patients were considered clinically fit by an anaesthetist. Patients were admitted 24 to 48 hours prior to surgery and intravenous fluids were commenced (5% dextrose in 1/5 normal saline with 20 meq KCl/L) at a rate of 150% of maintenance 12 hours before surgery (12). General anaesthesia involved the inhalational induction agents sevoflurane or halothane. All patients had endotracheal intubation and muscle relaxation (atracurium) and were maintained on halothane, nitrous oxide and narcotic analgesia (pethidine or morphine). Rectal acetaminophen was also given to supplement postoperative analgesia.

Among the 110 patients, pre-operative haemoglobin levels were (3 to < 6g/dl) in 27, (6 < 9g/dl) in 61 and $ 9g/dl in 22 patients. The mean haemoglobin concentration for the 94 patients with SS disease was 7.4 g/dl (range 3.9 – 11.8 g/dl, median 7.0 g/dl).

Preoperative blood transfusion protocol for patients with sickle cell disease, involved giving blood transfusion to raise haemoglobin levels to 10 g/dl when haemoglobin values were greater than 1 g/dl below steady state (1, 13, 14). This practice however was varied in this study. Ten of 33 patients with low haemoglobin concentration were excluded from blood transfusion because they were in excellent health, had clinically mild disease (past history of few vaso-occlusive crises). Eleven were transfused in keeping with the standard protocol and 12 were transfused only after splenic removal, usually while they were in the recovery room.

Splenectomies were performed *via* a transverse left upper quadrant, muscle cutting incision. Splenic artery ligation preceded dissection of the splenic pedicle (1). Postoperatively, standard practice involved administering supplemental oxygen by face mask to all patients for 24 hours (13, 14).

Five patients of the 110 received postoperative blood transfusion. They were given blood as a resuscitative measure for postoperative acute chest syndrome (ACS) which presented as dyspnoea in association with new pulmonary opacities on chest X-ray (9).

RESULTS

Homozygous sickle cell disease patients were predominant and numbered 94 (51 males and 43 females) of the 110 patients. Eleven S β^0 thalassaemias, four S β^+ thalassaemias and one patient with SC disease comprised the total group of patients who did not have SS disease (Table 1). These 16 "non SS disease" patients with average age 6.1 years (Table 1) were older than those with SS disease whose average age was 3.5 years.

Table 1: Clinico-pathological features of heterozygous sickle cell disease patients at splenectomy

Case Number	Genotype	Induction	Age Yrs/ Sex	Wt/kg	Blood Transfusion	Hb/g/dl	Pts/mm^3 X10^3	Spleen weight (g)	Complications	P/O Stay (days)
1	Sβ^o thal	CHS	3 M	13	RR	5.0	147	286	–	3
2	Sβ^o thal	CHS	5 M	21.2	–	7.9	394	320	–	4
3	Sβ^o thal	CHS	5 M	17.0	–	5.6	138	540	–	2
4	Sβ^o thal	CHS	5 F	23.2	–	4.7	201	840	–	4
5	Sβ^o thal	CHS	7 M	21.4	–	5.8	200	780	–	3
6	Sβ^o thal	CHS	7 M	20.8	–	8.6	188	450	ACS	7
7	Sβ^o thal	ASS	7 F	22.0	–	7.6	285	313	–	3
8	Sβ^o thal	CHS	7 F	22.0	RR	4.6	125	643	–	3
9	Sβ^o thal	CHS	8 F	20.0	RR	4.8	224	680	–	4
10	Sβ^o thal	CHS	9 F	25.5	RR	5.4	117	276	–	3
11	Sβ^o thal	CHS	12 F	32.0	–	7.5	125	640	–	2
12	Sβ$^+$ thal	ASS	2 F	13.5	–	8.4	302	142	–	3
13	Sβ$^+$ thal	ASS	2 F	21.4	–	8.5	304	106	–	3
14	Sβ$^+$ thal	CHS	5 M	18.0	RR	4.7	79	336	–	3
15	Sβ$^+$ thal	ASS	6 F	19.2	–	8.9	248	196	–	3
16	**SC**	**CHS/ASS**	**7 M**	**27.8**	**–**	**9.9**	**200**	**487**	**–**	**3**

Pts = Platelets; ACS = Acute chest syndrome; P/O = Postoperative stay; RR = Recovery room;
CHS = Chronic hypersplenism; ASS = Acute splenic sequestration; Wt = Total body weight

Of the 94 patients with SS disease, 67 had ASS (71.3%) as the indication for splenectomy while in 27 the indication was CHS (28.7%). Chronic hypersplenism was the main indication for splenectomy among the cases of S β^0 thalassaemias (10 of 11) but ASS was the predominant indication among S β^+ thalassaemias patients (3 of 4) and the sole case of SC disease suffered from both CHS and recurrent attacks of ASS (Table 1).

Of the 23 patients transfused electively, 18 with SS disease were transfused preoperatively (11) or in the recovery room post splenectomy (7). The other five patients transfused were S β^0 thalassaemias (4) and S β^+ thalassaemias (1); all received blood in the recovery room post splenectomy (Table 1). All 110 patients remained haemodynamically stable throughout splenectomy with estimated intra-operative blood loss being insignificant. Operative time averaged 60 minutes, ranging between 45 and 90 minutes.

The average splenic weights of all 16 heterozygotes was high 422 g (106–840 g) (Table 1) but operative time averaged only 65 minutes. While the spleens of 11 patients with S β^0 thalassaemias averaged 524 g (range 276 g – 840 g), that of the 4 S β^+ thalassaemias patients averaged 195 g (range 106 g – 304 g) (Table 1). SS disease patients exhibited a wider variation in splenic weights than heterozygotes, (55 – 860 g) and a lower average weight, 260 g.

Postoperative ACS was the commonest documented complication post splenectomy affecting 9 of 110 cases (8.2%), of which eight were patients with SS disease (8.5%) (Table 4). Postoperative ACS occurred more commonly after CHS (6 of 39 patients, 15%) than after ASS (3 of 71, 4.2%) (Table 2). The ACS preponderance in CHS was also evident in patients with SS disease (5/27,18.5% *vs* 3/67, 4.5%) (Table 4). All postoperative complications apart from ACS developed in patients with SS disease, including painful crises (3/94, 3.2%) and superficial wound infections (2/ 94, 2.1%). There was no mortality among the 110 splenectomies.

Table: 2: Age and gender distribution and indications for splenectomy of all patients

Age (years)	M	F	ASS	CHS	Total
< 1	6	0	6	–	6
1 – < 2	23	7	29	1	30
2 – < 6	22	28	27	23	50
6 – < 10	6	14	8	12	20
$ 10	1	3	1	3	4
Total	**58 (5)**	**52 (4)**	**71 (3)**	**39 (6)**	**110 (9)**

M = Male; F = Female; ASS = Acute splenic sequestration; CHS = Chronic hypersplenism; Brackets = Number of postoperative acute chest syndrome cases.

Postoperative blood transfusions were administered therapeutically in five of nine cases who developed ACS; four with minimal chest symptoms were not transfused.

Table 3: Age and gender distribution and indications for splenectomy in beta thalassaemia patients

Age (years)	M	F	ASS	CHS	Total
< 1	–	–	–	–	
1 – < 2	–	–	–	–	
2 – < 6	3	3	2	4	6
6 – < 10	3	5	2	6	8
$ 10		1		1	1
Total	**6 (1)**	**9**	**4**	**11 (1)**	**15 (1)**

M = Male; F = Female; ASS = Acute splenic sequestration; CHS = Chronic hypersplenism; Brackets = Number of postoperative acute chest syndrome cases

Table 4: Indications for splenectomy and frequency of acute chest syndrome in homozygous sickle cell disease patients

Indication	No	ACS	Percentage
CHS	27	5	18.5%
ASS	67	3	4.5%
Total	**94**	**8**	**8.5%**

ACS = Acute chest syndrome; ASS = Acute splenic sequestration; CHS = Chronic hypersplenism

Postoperative stay averaged 3.8 days (range 2 – 14 days median 3 days) among the 110 patients. Among the 101 patients who did not develop ACS, postoperative stay averaged 3.4 days (range 2–5 days, median 3 days) while the average postoperative stay among the 9 cases who developed postoperative ACS was 7.7 days (range 5 – 14 days, median 7 days).

DISCUSSION

Early reports from Jamaica on splenectomy in sickle cell disease have focussed on patients with the SS genotype because of its severe manifestations and high prevalence in the Jamaican population. These reports were offshoots of the Jamaica Sickle Cell Cohort Study (1, 6, 8, 9) which followed SS disease patients from birth. Patients with Sβ^0 thalassaemias also have a severe illness, with a high propensity for splenomegaly and CHS (10). Data from Table 3 show that patients with beta thalassaemia presenting for splenectomy were generally older than age two and so were outside the age range when ASS is most lethal (4, 5). Although the average splenic weight of heterozygotes (422 g) (Table 1) was high, it did not lead to lengthened operative times, which in this group averaged 65 minutes. Also, the postoperative outcomes of heterozygotes were no worse than homozygotes. Patients with the SC genotype (1 in 500 Jamaican births) had such mild disease that only the exceptional among them came to surgical attention (1 of 110 splenectomies).

Recurrent ASS was the indication for splenectomy in 67 of the 94 (71.3%) patients with SS disease. Previous

Jamaican reviews on splenectomy in SS disease, report ASS affecting a minority of patients, 23% and 35.5% respectively (1, 9). The higher percentage of CHS in one study (1) arose because splenectomies reported were performed mainly, prior to 1974 (1) and CHS was the sole recorded indication for splenectomy prior to 1974. More recently, acute awareness of the lethality of ASS (4, 5) has led to patients with this diagnosis being given priority on surgery lists. This has contributed to the predominance of ASS over CHS cases in this review.

Acute chest syndrome occurred in 8.5% (Table 4) of patients with SS disease. North American reports, which include laparoscopic procedures, indicate ACS occurring in approximately 20% of post splenectomy patients (15, 16). All SS disease patients who developed ACS after open splenectomy had non-life threatening illnesses, which is in sharp contrast to reports on those developing ACS post open cholecystectomy (19%–33%) (13, 14, 17). Post cholecystectomy, ACS patients have been shown to manifest a range of clinical severities, with pulmonary sequestration, ventilatory failure and demise being consistently reported (13, 14, 17). The finding in this study of fewer ACS cases with milder disease post splenectomy may be related to the fact that unlike cholecystectomies (13, 14), open splenectomies were routine elective procedures with short operative times.

Wales *et al* found that laparoscopic abdominal procedures were associated with longer operative times than open procedures in sickle cell disease and did not reduce the incidence of ACS attacks compared to open surgery (15). The fact that both operative time and technical difficulty are considerably increased by massive spleens makes laparoscopic splenectomy a relative contraindication for many with sickle cell disease (16). Taking the above facts into consideration, it is the authors view that open splenectomy continues to be the gold standard for patients with sickle cell disease presenting for splenectomy (16, 18).

The high average splenic weight of Sβ^o thalassaemias patients (524 g) reflected our finding of CHS preponderance in this genotype. The wide range of splenic weights in SS disease (55 g – 860 g) indicated patient variation with respect to body size and indication for splenectomy, while the low average splenic weight (260g) reflected the high proportion of ASS cases (67/94, 71%) relative to CHS.

While many centres managing patients with sickle cell disease routinely gave preoperative exchange blood transfusion before abdominal surgery (12), this practice has been in decline since the multi-centre transfusion study of Vichinsky *et al* (19). In that study, a conservative transfusion protocol was found to be just as effective in preventing perioperative complications as routine exchange transfusion. The authors have never held the view that, by reducing haemoglobin S concentration one can provide a safety net for surgical patients, so selective preoperative blood transfusion has always been the practice at UHWI (1, 7, 11, 13, 14, 17).

Only 11 of 110 splenectomy patients (10%) in this study were transfused preoperatively, but that does not give the full picture of the preoperative transfusion status of splenectomy patients, because some patients had high pre-operative haemoglobin levels because they were recently transfused for an attack of ASS.

The practice of transfusing 12 patients who had low haemoglobin concentrations, only after splenic removal, was geared towards optimizing blood usage in an environment of scarcity. By foregoing pre-operative transfusion in these patients, the sequestering of blood products by spleens about to be removed is avoided.

In conclusion, splenectomy was undertaken with limited morbidity and no mortality, in 110 children with sickle cell disease. A flexible selective transfusion protocol was applied, in which a low preoperative haemoglobin concentration was not an automatic trigger for blood transfusion. The low rate of ACS and mild nature of these attacks emphasize the fact that children of wide ranging ages and splenic sizes tolerate open splenectomy well. The authors wish to restate their view, that open splenectomy remains the gold standard for patients with sickle cell disease presenting for splenectomy.

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