

ORIGINAL ARTICLE

Audit of blood transfusion practice during anaesthesia for spine surgeries in a regional trauma centre in Nigeria

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INTRODUCTION

There exists a parallel between the anaesthetic and surgical challenges of spine surgery. The indications for spine surgery are largely to relieve spinal cord or nerve root compression, stabilize unstable vertebral segments or reduce deformity as in scoliosis. The pathologies necessitating spine surgery may

be congenital, degenerative, traumatic, infective, neoplastic or idiopathic.

The recent widespread availability of imaging facilities such as magnetic resonance imaging, computerized tomography and intraoperative fluoroscopy represent the most significant advancement in spine surgery development.

ABSTRACT

Background: Blood loss during spine surgery is often considerable, necessitating blood transfusion. The elective nature and other peculiarities of most spine surgeries, however, make them amenable to several blood conservation techniques, such that reduction in allogeneic blood transfusion is considered high priority in spine surgery. In view of the rise in spine procedures, facilitated by availability of enhanced imaging services, surgical and anaesthetic manpower, an audit of blood transfusion practice during spine surgeries in a regional trauma centre was deemed necessary.

Objective: To determine the extent of blood usage (autologous and allogeneic) during spine surgeries and evaluate the blood prescription practice in view of optimal utilization of blood cross-match services.

Methodology: A retrospective review of all 107 spine surgeries done over a period of 4¹/₂ years was carried out and the blood transfusion rate, autologous blood usage and blood utilization indices were determined.

Results: Forty-nine (46%) of 107 patients received blood transfusion, and only three patients received autologous blood. The cross-match /transfusion ratio, transfusion index and transfusion probability were 3.4, 0.7 and 45.8%, respectively. The maximum number of units of blood transfused to any single patient was 4 units.

Conclusion: Whereas blood transfusion rate in the series is considerably high, the overall blood utilization is considered optimal. Autologous blood usage is abysmally low and institutional approach to encourage its optimal use is recommended to minimize allogeneic blood transfusion with its attendant complications and cost.

Keywords: Autologous, allogeneic, blood conservation, general anaesthesia, imaging facilities, prone position

They enable the accurate pre-operative and intra-operative identification of anatomical structures which were, hitherto, major constraints to safe spinal procedures. This technological factor has led to an escalation of interest in training and practice of spinal procedures in Nigeria, and globally.

Similar technological advancements had facilitated minimal access surgery in spinal procedures, with the pioneering effort of Obenchain who in 1991 performed a laparoscopic discectomy, and the subsequent laparoscopic spinal fusion by Zuckerman and Zdeblick in 1995.^{1,2} Though general anaesthesia is commonly used for spinal surgeries, spinal anaesthesia may be used in selected cases with obvious advantages.³

ANAESTHESIA FOR SPINE SURGERY:The positions for spine surgeries could be supine, lateral, prone or sitting, depending on whether anterior, posterior or combined approaches to the spine is to be undertaken, the extent of the lesion, as well as the competence and preference of the surgeon. The supine and lateral positions are used for the anterior approach, while the prone and sitting positions are used for the posterior approach, to the spine.

Ogungbo, recently, reported 100% anterior approach to the cervical spine, with the patient in the supine position, in all twenty procedures for surgical management of acute cervical spine injury.⁴ The sitting position, once popular for posterior approach to the cervical spine, has largely been abandoned on account of high incidence of venous air embolism. The reported incidence is highly variable, depending on the sensitivity of the monitoring modality; 9% with capnograph, 50% with praecordial Doppler, and 76% with trans-oesophageal echocardiography.^{5,6,7} By far, majority of spinal surgeries are performed in the prone position with the intrinsic challenges on anaesthetic management.

METHODOLOGY

In this retrospective observational study, all patients who had spinal surgery in the health facility between 1st July, 2008 and 31st

December, 2012 were considered. Data was collected from the theatre operation register, ward records, surgical team records and patients' casenotes extracted from Department of Medical Records.

The anaesthetic charts of all the patients were reviewed and those with documented evidence of spinal surgery during the period under consideration were recruited, while those whose case notes could not be recovered for relevant details, were excluded. The patients' demographic variables such as sex and age were recorded as well as the ASA grade, technique of anaesthesia, position during surgery, vertebral region of the surgery, operation time and surgical procedure that was carried out. Intra-operative transfusion records were reviewed, alongside the number of units of blood prescribed by the surgical teams. The descriptive statistics were presented in tables while means were given as mean (SD). The SPSS version 16.0 statistical software was used for data analysis.

RESULTS

A total of 114 spinal surgeries were carried out during the 4^{1/2}-year period under consideration. Complete data were, however, available for 107 of the patients, representing 94% data capture. Fifty-two of the patients were male, while 55 were female, giving a male:female ratio of 1:1.1. The mean age of the patients was 44.4 (18.5) years, with a range of 5-76years. Forty patients (37%) had co-morbidities such as hypertension, diabetes mellitus and bronchial asthma.

General anaesthesia with relaxant technique was administered to all the patients and surgical approach to the spine was either posterior or anterior; none was combined. The surgeries were carried out by four different orthopaedic surgeons, while, a neurosurgeon carried out three of the procedures. Blood prescription was done empirically by the surgical teams, while blood transfusion was instituted by the anaesthetist based mainly on estimated intraoperative blood loss.

Forty-nine (46%) patients who had spine surgery received blood transfusion. Those who received blood transfusion got an average of 1.4units each. The maximum transfusion in the series was 4units transfused to a patient who had anterior spinal decompression with bone grafting for Pott's disease of the lumbar spine.

Out of the 70units of blood transfused, only 3units were autologous blood, and of the two patients that were not cross-matched, one was a Jehovah's Witness who had spinal decompression for spinal stenosis secondary to lumbar disc prolapse, while the other had a syringo-peritoneal shunt for syringomyelia. The mean surgical time was 139minutes (range 60-263minutes). Posterior approach with the patient in the prone position was adopted in 96 out of the 107 spine surgeries, representing 90%. No patient had any intraoperative blood salvage or blood component therapy.

Table 1. American Society of Anesthesiologists (ASA) physical status grade of the patients

ASA Grade	No. (%)
I	37 (34.6%)
II	55 (51.4%)
III	13 (12.1%)
IV	2(1.9%)
Total	107 (100%)

Table 2. Spinal region of the surgical procedures†

Site of Surgery	No.
Cervical	7
Thoracic	29
Lumbar	81
Sacral	12

Legend †: Some patients had surgery involving multiple spinal regions

Table 3. Type of surgical procedure carried out ‡

Surgical Procedure	No.
Laminectomy	79
Harrington's instrumentation	16
Spinal fusion	14
Excision biopsy	5
Bullet extraction	2
Implant removal	1
Syringo-peritoneal shunt	1
Discectomy	1

Legend‡: Some surgeries involved multiple procedures e.g. Harrington's instrumentation plus spinal fusion

Table 4. Blood request and transfusion record

Variable	Unit
Number of units of blood cross-matched	240
Number of patients operated on	107
Number of patients cross-matched	105
Number of patients transfused	49 (3 autologous)
Units of blood transfused	70 (3 autologous)

Table 5. Distribution of spinal surgeries per year

Year	No. of Surgeries
2008	7
2009	10
2010	26
2011	34
2012	30
Total	107

From Table 4, we can derive the **transfusion probability (%T)** of the spinal surgeries by:

$$\frac{\text{Number of patients transfused} \times 100}{\text{Number of patients cross-matched}} = \frac{49 \times 100}{107} = 45.8\%$$

The **Transfusion Index (Ti)** can similarly be derived by;

$$\frac{\text{Number of units of blood transfused}}{\text{Number of patients cross-matched}} = \frac{70}{107} = 0.7$$

The **Cross-match Transfusion (C/T) ratio** is derived by;

$$\frac{\text{Number of units of blood cross-matched}}{\text{Number of units of blood transfused}} = \frac{240}{70} = 3.4$$

DISCUSSION

Reduction in allogeneic blood transfusion is high priority in spine surgery since most cases are elective and amenable to various blood conservation modalities. From a simplistic standpoint, intra-operative transfusion requirement parallels intra-operative blood loss. Majority of blood transfusions are administered in the operating room (OR) where the prescription for blood is often empirical unlike in pre-surgical, post-surgical or medical patients where blood is prescribed in response to a demonstrable anaemia and, therefore, almost always transfused.

Cross-matched but non-transfused blood wastes human and material resources of the blood bank, as well as those of patients and

their relatives, while providing ample avenue for underhand practices by blood bank Staff. That non-transfused blood units were re-cross-matched 3-10times for different patients, is indicative of the magnitude of wastage inherent in inefficient blood prescription practice.⁸

The high economic cost of such inefficient OR blood prescription practice led to the development of indices for assessing appropriate blood ordering practice such as transfusion index (Ti), transfusion probability (%T) and cross-match/transfusion (C/T) ratio. Transfusion index of 0.5 or greater, %T of 30% and above, and C/T ratio of ≤ 2.5 are considered indicative of judicious blood prescription practice and utilization.

Enosolease and Imarengiaye, in their prospective audit of blood utilization by different specialties in a tertiary health institution, found that the probability that cross-matched blood may not be used was highest in surgery/orthopaedics.⁹ This dismal finding was supported by Clarke, *et al.* who found a C/T ratio of 16.6:1 for elective spine surgeries.¹⁰ For our series, overall C/T ratio, Ti and %T were 3.4, 0.7 and 45.8%, respectively; as such, considered efficient blood prescription and utilization practice.

As part of the effort to reduce improper and wasteful blood prescription in surgical settings, a *Patient-Specific Blood Ordering System* [PSBOS] which takes into consideration the patient, surgery and surgeons variables in predicting transfusion requirement has been recommended above the earlier *Maximum Surgical Blood Ordering System* [MSBOS] which considers surgical procedures alone.¹¹ This recommendation is supported by the work of Ayantunde, *et al*; who found a C/T ratio of 4, re-use rate of 65.2% and wastage rate of 6.3% in their series.¹²

Forty-nine patients (46%) received blood transfusion in this series, whereas, Idowu and colleagues reported blood transfusion in only two out of twenty-six (8%) spinal surgeries in their series, despite a mean operation time of 217minutes; range 90-310minutes.¹³ In

another series involving 1,596 spine surgical procedures, 414 (25.9%) patients were transfused with allogeneic blood.¹⁴

Thus, it is acknowledged that wide variability exists in the blood loss and actual transfusion rate of different patients undergoing spine surgery with Moller and Hedlund reporting blood loss of 800mls [range 100-3100mls], and 1517mls [range 360-7000mls], for non-instrumented and instrumented lumbar fusion surgeries, respectively.¹⁵ This variability depends on the interplay of several factors such as the approach to the spine, the number of vertebral segments involved, type and duration of surgery, positioning of the patient, anaesthetic and surgical techniques.

Neuromuscular scoliosis, instrumented fusions, higher number of vertebral levels and patients receiving combined anterior and posterior fusions are associated with greater blood loss. Posterior spinal fusions tend to cause more blood loss than anterior procedures mainly due to the greater number of vertebral levels fused in the former, whereas, patients with combined anterior and posterior fusions tend to have the most blood loss.¹⁶ Similarly, patients with neuromuscular scoliosis have been reported to have a seven-fold higher risk of complications from enormous intra-operative blood loss.¹⁷ In a series of complex, combined anterior and posterior spinal fusions, average intra-operative blood loss was 3566mls; average number of levels fused were 7 anterior and 13 posterior, fusions.¹⁸

Besides patient and surgical factors, the anaesthetist's attitude towards blood conservation could impact on his choice of technique, use of plasma expanders and level of "transfusion-trigger" with remarkable effect on both blood loss and actual amount of blood transfused. The influence of such attitudinal differences of the blood therapist on blood transfusion rate has been highlighted.¹⁹

Hypotensive anaesthesia has been proven as a safe and effective technique to reduce blood loss during surgery. This effect is brought

about by a combination of reduced operating time and reduced blood loss per minute. Paul, *et al*, in a review of 17 randomized orthopaedic trials, reported a significant reduction in blood loss in patients that were treated with controlled hypotension.²⁰ This is supported by a recent finding by Verma and colleagues, that controlled hypotension reduced operative blood loss by as much as 33% during spine surgery.²¹

In a study by Joseph, *et al*, 19 Jehovah's Witness patients who refused blood transfusion on account of their religious faith, had undergone spinal deformity surgery under blood conservation techniques involving hypotensive anaesthesia, haemodilution and erythropoietin use, with minimal complications.²² Nevertheless, adults with medical co-morbidities such as hypertension and ischaemic heart disease often cannot tolerate the decreased perfusion to vital organs, placing caution on hypotensive anaesthesia.

Only 3 out of 70 units (4%) of blood transfused to the patients were autologous blood. This level of substitution is considered too low and contrasts poorly with the autologous substitution rate of 71% in the study by Verma and colleagues.²¹ In another study, pre-operative autologous donation resulted in avoidance of allogeneic blood transfusion in three quarters of patients undergoing spinal deformity surgery.²³ Patients transfused with allogeneic blood have higher infection rates and longer hospital stays, added to the exorbitant cost of the scarce cellular commodity and other complications of blood transfusion.²⁴

The remarkable amount of blood loss commonly associated with spine surgeries and the resultant need for allogeneic blood transfusion demands the use of several blood conservation techniques, in combination, to minimize exposure to allogeneic blood. In a prospective study by Rampersaud, *et al* allogeneic blood transfusion rate was found to be inversely related to the number of blood conservation modalities employed; being 74% with no modality, 32% with one modality,

17% with two modalities, and 7% with the three modalities of pre-operative autologous donation, erythropoietin therapy and cell saver.²⁵

An obvious limitation of this study is the non-consideration of some units of blood that were quite probably transfused post-operatively in the wards, even days after the surgery, in the computation of transfusion rate and blood utilization indices.

CONCLUSION

This audit reveals a dismal level of autologous blood use, with excessive exposure of patients to allogeneic blood. Overall, blood utilization is deemed optimal despite the use of empirical blood prescription practice in the series. A positive attitude towards increased autologous blood usage is strongly advocated in view of its proven utility in spine surgeries and its better profile over allogeneic transfusion with respect to patients' safety.

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