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Management of oesophageal atresia in a developing country: Is primary repair forbidden?

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ABSTRACT

Background: The aim of the study was to evaluate the outcomes of initial surgical procedures for oesophageal atresia at our institution. Primary repair of oesophageal atresia at our centre was perceived to be associated with a high mortality rate. In view of this, almost all patients seen since January 2014 were offered initial surgery for staged repair. **Materials and Methods:** A retrospective review of records of infants with oesophageal atresia seen at the centre from January 2007 to December 2014 was used in this study. **Results:** Eighty-five cases of oesophageal atresia were seen over the study period. Of these, 74 (87.1) had surgery performed. Surgical outcome was, however, indicated in 67 of the 74, with overall survival rate of 40.3%. Among the 67 patients, early primary repair was performed in 24 (35.8%) with a survival rate of 45.8% (11 patients). Totally, 12 (17.9%) of the 67 had initial procedure for delayed primary repair, with a survival rate of 16.7% (2 patients). The remaining 31 (46.3%) patients had initial surgery for staged repair, with survival rate of 45.2% (14 patients). There was no association between the type of surgery and the surgical outcome (χ^2 = 3.396, df = 2, P = 0.183). **Conclusion:** The overall surgical survival rate of 40.3% for oesophageal atresia at our institution is low. This study did not show any difference in the survival rate of 45.8% and 45.2% associated with primary repair and staged repair respectively.

Key words: Mortality rate, oesophageal atresia, outcome, surgical management, survival rate

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INTRODUCTION

Primary repair of oesophageal atresia is principally the preferred mode of management.[1-5] However, most patients seen lately at our institution have been offered staged repair with an initial surgery involving division of the abdominal oesophagus, placement of a feeding gastrostomy and cervical oesophagostomy during the neonatal period. This is due to perceived high mortality rate associated with primary repair at our centre. This study was, therefore, done to analyse whether there was any significant difference between the survival rate among patients who had primary repair and those who had the initial surgery for staged repair in the neonatal period.

MATERIALS AND METHODS

The clinical records of patients with oesophageal atresia seen at our centre from 1st January 2007 to 31st December 2014 were reviewed. This was done using patients' folders, operation record book and admission and discharge book. The following data were collected retrospectively and entered into a data collection tool: Sex, gestational age, birth weight, history of polyhydramnios, age at presentation, admission weight, type of atresia, associated congenital anomalies, presence of pneumonia at presentation to our unit, Waterston classification, age

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at surgery, type of surgery, surgical complications, length of hospital stay and patient outcome. Patient outcome was defined as either well and discharged or died at first admission.

The data were analysed statistically using IBM Statistical Package for the Social Sciences Windows version 20.0, IBM Corp, Released 2011, Armonk, NY, USA. Patients were categorised into groups using gestational age, age at presentation, admission weight, Waterston classification, age at surgery and type of surgery. The Waterston classification was used to classify patients into three risk groups based on birth weight, pre-operative pneumonia and associated congenital anomalies. Gestational age was grouped into pre-term and term. A term gestational age was defined as 37 completed weeks. Test for associations were done using Chi-square (χ^2) test and Fisher exact test. The significance level was defined as $P \leq 0.05$.

RESULTS

A total of 85 cases of oesophageal atresia were seen over the study period. The sex was not indicated in 2 patients. Males constituted 40 (48.2%) of the remaining 83 patients. Gestational maturity was recorded in 75 patients with 7 (9.3%) of them being pre-term babies. The gestational maturity could be matched with surgical outcome in 62 patients. Of these, 5 were pre-term infants with surgical mortality of 80.0% (4 patients). The remaining 57 patients were term infants with surgical mortality of 57.9% (33 patients). There was, however, no association between gestational maturity and surgical outcome in our study (Fisher's exact test, $P = 0.640$).

The mean birth weight was 2.73 kg with a standard deviation (SD) of 0.54 kg. The minimum birth weight was 1.40 kg and the maximum was 3.70 kg.

A positive history of polyhydramnios was found in 16 (22%) of 70 patients.

The age at presentation was indicated in 78 of the 85 patients. The mean age at presentation was 5.12 days with SD of 4.04 days. Only 6 (7.69%) patients presented within 24 h after delivery. None of our patients was diagnosed prenatally. Fifty-seven patients (73.1%) presented after the age of 2 days while 28 (35.9%) presented after the age of 6 days.

The mean admission weight was 2.33 kg with SD of 0.54 kg. The minimum admission weight was 0.70 kg and maximum admission weight was 3.60 kg.

Eighty-three (97.6%) of the 85 patients had oesophageal atresia with distal tracheo-oesophageal fistula (TOF). The remaining 2 (2.4%) patients had oesophageal atresia with both proximal and distal tracheo-oesophageal Fistula and both patients survived. One had early primary repair while the other had division of the abdominal oesophagus, feeding gastrostomy and cervical oesophagostomy.

Twenty-six (32.5%) of 80 patients had associated congenital anomalies [Table 1]. Six patients had two or more congenital anomalies.

Of the 85 patients, 73 had records on their chest findings at admission. Forty-four (60.3%) of them had pneumonia at presentation. Among the 73 patients, 63 had their surgical outcome indicated. Of these, 35 had pneumonia at presentation, and their survival rate was 34.3% (12 patients). The survival rate among the remaining 28 patients who had no pneumonia at admission was 46.4% (13 patients). There was no association between the presence of pneumonia at presentation and surgical outcome ($\chi^2 = 0.958$, df = 1, $P = 0.328$).

Among the 85 patients, 74 had surgery done. However, surgical outcome was indicated in 67 patients. Early primary repair was performed in 24 (35.8%) of the 67 patients. Fifteen (17.9%) had thoracotomy with division of TOF and insertion of feeding gastrostomy with the aim of performing a delayed primary repair. The remaining 31 (46.3%) patients had an initial procedure

Table 1: Associated congenital anomalies

Type of anomaly	Number of patients (%), *n*=80
All congenital anomalies	26 (32.5)
CHD	9 (11.3)
VSD	1 (1.3)
PDA	2 (2.5)
Dextrocardia	3 (3.8)
CHD (not specified)	5 (6.3)
Renal	1 (1.3)
Bilateral hydronephrosis	1 (1.3)
ARM	14 (17.5)
Persistent cloaca	4 (5.0)
ARM with rectovestibular fistula	1 (1.3)
ARM with rectoperineal fistula	2 (2.5)
ARM (not specified)	7 (8.8)
Musculoskeletal	5 (6.3)
Vertebral anomaly	3 (3.8)
Limb anomaly	3 (3.8)
Duodenal atresia	1 (1.3)
Malrotation	1 (1.3)
Merkel's diverticulum	1 (1.3)

ARM: Anorectal malformation, CHD: Congenital heart disease, VSD: Ventricular septal defect, PDA: Patent ductus arteriosus

for staged repair, with division of the abdominal oesophagus, insertion of a feeding gastrostomy and cervical oesophagostomy.

The overall post-operative survival rate was 40.3% (27 patients). The survival rate among those who had early primary repair was 45.8% (11 out of 24 patients). Among those who had thoracotomy with division of TOF and feeding gastrostomy, the survival rate was 16.7% (2 of 12 patients). Division of the abdominal oesophagus with the insertion of a feeding gastrostomy and cervical oesophagostomy yielded a survival rate of 45.2% (14 out of 31 patients). There was no statistical association between the type of surgery and the surgical outcome ($\chi^2 = 3.396$, df = 2, $P = 0.183$)

The yearly distribution of the cases, the types of surgery and their surgical outcomes are shown in Table 2. There was no association between the year of admission and surgical outcome ($\chi^2 = 6.408$, df = 7, $P = 0.493$).

The age at surgery was indicated in 72 of the 74 patients who had surgery. The mean age at surgery was 10.38 days with SD of 6.29 days. Only 1 (1.4%) of the patients had surgery within 24 h after delivery. The maximum age at surgery was 27 days. The age at surgery could be marched with surgical outcome in 67 of the 72 patients. Of these, 10 had surgery within the first 3 days of life with survival of 3 (30%). Another 10 patients had surgery at the age of 4–6 days with survival of 5 (50%). The remaining 47 had surgery after 6 days of life with survival of 19 (40.4%). There was no statistical association between the age at surgery and the surgical outcome ($\chi^2 = 0.832$, df = 2. $P = 0.660$).

Waterston's classification could be determined in 63 out of the 67 patients who had their surgical outcome indicated [Table 3]. There was no statistical association between Waterston's classification and surgical outcome ($\chi^2 = 3.327$, df = 2, $P = 0.190$).

The age at presentation marched with surgical outcome in 66 patients as shown in Table 4. There was no statistical association between the 2 ($\chi^2 = 4.346$, df = 2, $P = 0.114$).

The overall mean duration of hospital stay was 20.99 days with a SD of 16.632 days. The minimum length of hospital stay was 2 days, and the maximum was 105 days. The mean duration of hospital stay for those who survived was 30.74 days with a SD of 20.316 days. The minimum length of hospital stay was 12 days, and the maximum was 105 days. The type of surgery and the duration of hospital stay for the survivors are shown in Table 5. There was no association between the type of surgery and the duration of hospital stay among the survivors ($\chi^2 = 0.797$, df = 2, $P = 0.671$).

Among the 74 patients who had surgical intervention, 4 did not have any documentation on post-operative surgical complication(s). Twenty-two (31.43%) out of the remaining 70 patients had post-operative surgical complications as shown in Table 6.

One of the 11 patients who did not have any surgical intervention was taken home by parents against medical advice. The remaining 10 patients died before any surgery could be performed.

DISCUSSION

The sex distribution from our results showed a slight female preponderance of 51.8% (43 females, 40 males). This is at variance with data reported from other centres with a male preponderance ranging from 53% to 80%.[6-12] Nwosu and Onyekwulu in 2013 reported a male preponderance of 80% from University of Nigeria

Table 2: Year of admission, type of first surgery and surgical outcome

Year of admission	Number of patients	Number of patients operated	Type of initial surgery, number of patients with documented outcome (survival rate) (%)			Overall surgical outcome (%)	
			Primary repair	(T + DTOF + FG)*	(DAO + FG + CO)†	Survived	Died
2007	5	5	4 (50.0)	1 (0)	0	2 (40.0)	3 (60.0)
2008	10	7	2 (50.0)	0	5 (40.0)	3 (42.9)	4 (57.1)
2009	14	14‡	2 (50.0)	5 (20.0)	4 (0)	2 (18.2)	9 (81.8)
2010	13	11§	3 (100.0)	4 (25.0)	0	4 (57.1)	3 (42.9)
2011	10	9	3 (33.3)	1 (0)	5 (80.0)	5 (55.6)	4 (44.4)
2012	6	6	5 (60.0)	0	1 (0)	3 (50.0)	3 (50.0)
2013	11	7	4 (0)	1 (0)	2 (50.0)	1 (14.3)	6 (85.7)
2014	16	15	1 (0)	0	14 (50.0)	7 (46.7)	8 (53.3)
Total	85	74	24	12	31	27	40

*T + DTOF + FG: Thoracotomy + division of tracheo-oesophageal fistula + feeding gastrostomy, †DAO + FG + CO: Division of abdominal oesophagus + feeding gastrostomy + cervical oesophagostomy; ‡14 patients were operated, but surgical outcome was indicated in 11; §11 patients were operated, but surgical outcome was indicated in 7

Table 3: Waterston's classification and surgical outcome

Waterston's classification	Outcome after surgery (%)		Total
	Survived	Died	
A	7 (58.3)	5 (41.7)	12
B	8 (28.6)	20 (71.4)	28
C	10 (43.5)	13 (56.5)	23
Total	25 (39.7)	38 (60.3)	63

Table 4: Age at presentation and surgical outcome

Age at presentation	Outcome after surgery (%)		Total
	Survived	Died	
0-2 days	5 (29.4)	12 (70.6)	17
3-5 days	8 (30.8)	18 (69.2)	26
≥6 days	13 (56.5)	10 (43.5)	23
Total	26 (39.4)	40 (60.6)	66

Table 5: Type of first surgery and length of hospital stay

Type of first surgery	Number of patients who stayed for <15 days (%)	Number of patients who stayed for 15 or more days (%)	Total
Primary repair	3 (27.3)	8 (72.7)	11
T + DTOF + FG*	1 (50.0)	1 (50.0)	2
DAO + FG + CO†	6 (42.9)	8 (57.1)	14
Total	10 (37.0)	17 (63.0)	27

*T + DTOF + FG: Thoracotomy + division of tracheo-oesophageal fistula + feeding gastrostomy, †DAO + FG + CO: Division of abdominal oesophagus + feeding gastrostomy + cervical oesophagostomy

Table 6: Post-operative surgical complications

Type of complication	Number of patients (%), *n*=70
Overall complications	22 (31.4)
Anastomotic leakage	8 (11.4)
Leaking feeding gastrostomy	4 (5.7)
Abdominal wound dehiscence	2 (2.9)
Gastric perforation	1 (1.4)
Leaking distal oesophageal stump	1 (1.4)
Pneumothorax	4 (5.7)
Surgical site infection	4 (5.7)

Teaching Hospital.[10] Similarly, in 2012, Davari *et al.* reported a male preponderance of 61.7% from a centre in Iran.[8]

The incidence of pre-term babies among our patients was <50% of what were reported by Davari *et al.* from Iran and Narasimman *et al.* from Alor Star in Keda.[8,13] The lack of association between gestational maturity and surgical outcome in our review may be due to the small number of the pre-term babies. Besides, the positive impact of term gestation may have been eroded by the lack of Neonatal Intensive Care Unit (NICU) and total parental nutrition (TPN) services. Late presentation of the patients may also be a contributing factor. Narasimman *et al.* reported significant statistical relationship, with mortality of 43.0% and 13.0% among 16 and 31 pre-term and term babies respectively.[13] Similarly, Davari *et al.* also showed a significant effect of prematurity on outcome.[8]

Mean age at presentation (5.12 days, SD = 4.04 days) in our study is comparable with reports from Nigeria.[6,10] Verma *et al.* reported a mean age of 3.12 ± 1.87 days from a centre in India.[14] In a review of oesophageal atresia without fistula over a 24-year period, Holland *et al.* in 2009 reported, from Great Ormond Street Hospital for Children in the United Kingdom, a prenatal diagnosis of 77% ($n = 24$).[7] Even though our results did not show any significant association between the age at presentation and surgical outcome, we still believe the high percentage of late presentation might have contributed to our low survival rate. This is because late presentation from late diagnosis is likely to cause aspiration pneumonitis, pneumonia and malnutrition.

The lack of association between the presence of pneumonia and surgical outcome in our study may be due to the complete treatment of pneumonia before surgery. This result is in contrast with what was reported by Narasimman *et al.* where there was a significant association ($P = 0.025$).[13]

Age at surgery in our study did not show any association with surgical outcome. This may be due to the fact that almost all our patients presented late. Narasimman *et al.* also reported no significant association between age at surgery and surgical outcome.[13]

The type of initial surgery did not also show any association with surgical outcome in our study. This is comparable with what was reported by Narasimman *et al.*[13] In a nationwide analysis of clinical outcomes in the United States of America, Wang *et al.*, however, reported a lower mortality among patients who had primary repair as their initial surgery compared with those who had staged repair.[11]

Our review did not show any association between Waterston's classification and surgical outcome. This may be due to the complete treatment of pneumonia that placed 81% of our patients in Class B and C. However, Verma *et al.* reported significant association between Waterston's classification and outcome.[14] They, therefore, re-echoed the importance of Waterston's classification in stratifying patients in developing countries.

The mean duration of hospital stay (30.74 days, SD = 20.32 days) for our patients who survived is high

compared with other centres. Osia *et al*. reported mean hospital stay of 16.5 days with SD of 11.7 days.[9] A mean duration of hospital stay of 18.08 days ± 3 (range 15–22 days) was reported by Verma *et al*.[14] The short duration of hospital stay in these centres may be due to primary repair that is, offered to virtually all their patients. Even though our review did not show any association between the type of surgery and duration of hospital stay, the longer length of hospital stay at our centre is likely to impact negatively on the parents and our institution by increasing costs.

The surgical complication rate of 31.4% seen in our review is lower than the 59.5% reported in 2014 by Osia *et al*. from a centre in Iran.[9] In spite of their high surgical complications, their mortality rate (29.7% of 37 patients) is much lower than ours (59.7% of 67 patients).

The overall post-operative survival rate of 40.3% at our institution is very low. This low survival rate could be attributed to the lack of an effective NICU, unavailability of paediatric TPN and lack of post-operative ventilatory support at our centre. Late presentation of most of our patients could be causally related. These problems, indeed, appear to exist at most centres in developing countries. In 2001, Ameh *et al*. reported a mortality of 80% from a Teaching Hospital in Nigeria due to similar reasons.[15]

In advanced countries, however, there has been dramatic improvement in the survival of patients with oesophageal atresia since the first successful primary repair.[16] The first successful primary repair was achieved in 1941 by Cameron Haight.[1,16-19] This happened after numerous unsuccessful primary repair by other surgeons.[1,20] Waterston treated 113 infants in the early 1950's and reported a 56.7% survival rate.[16,21] By mid-1980's, mortality had fallen below 15%, with some centres reporting a survival rate of over 90%.[16]

The improvement in survival rate in developed countries is attributed to advances in neonatal intensive care (including ventilatory and nutritional support), advances in neonatal anaesthesia, antibiotics and surgical techniques.[1,18,22-24] Indeed, in spite of increased number of patients with severe associated anomalies, survival rates as high as 95% have been reported in centres offering the best neonatal care.[1,25]

CONCLUSION

The survival rate of patients with oesophageal atresia managed at our centre is very low. The absence of post-operative ventilatory support, lack of an effective NICU and paediatric TPN are likely to be significant causal factors. Late presentation of most of the patients could also be a contributing factor. It is, therefore, imperative to have an effective NICU and paediatric TPN established at our centre. Besides, efforts should be made to create public health awareness among physicians and midwives to ensure prompt and early referral.

The shift from primary repair toward staged repair, where the initial operation is division of the abdominal oesophagus, insertion of feeding gastrostomy and cervical oesophagostomy, at our centre needs to be re-examined. This is because, our study did not show any significant difference in the mortality rate of 54.2% and 54.8% associated with primary repair and staged repair respectively. Establishment of post-operative ventilatory support, an effective NICU and paediatric TPN, coupled with early referral, could lead to significant survival rate in primary repair. Strict stratification of our patients based on Waterston's classification may also help in achieving better results from primary repair.

A prospective study is indicated for a more comprehensive assessment of the various initial surgical procedures and their outcomes.

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Conflicts of interest
There are no conflicts of interest.

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