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ORIGINAL ARTICLE

Surgical Outcomes after Major Abdominal Surgery in Children: Can Post-Operative Morbidity survey determine relevant Morbidity Domains?

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Abstract

Background: Surgery is associated with considerable potential morbidity and mortality. The study objective was to establish if the post-operative morbidity survey could determine morbidity domains that adversely affect surgical outcomes (in terms of length of hospital stay (LOHS) and mortality) after major abdominal surgery in children.

Material and Methods: This was a one-year prospective cross-sectional study at Ahmadu Bello University Teaching Hospital, Zaria, Kaduna State. Data was collected from 84 consecutive patients seen during the study period. Postoperative morbidity survey (POMS) data were taken on the 1st to the 5th day after surgery, analysed using the IBM Statistical Product and Service Solutions (SPSS) version 24.0.0 software and the statistical relationship between the 5th day POMS findings, LOHS and mortality determined with p-values ≤ 0.05 regarded as statistically significant.

RESULTS: A total of 84 patients (60 males, 24 females with male: female ratio of 2.5:1) were studied with age range of 1 day to 17 years (median age of 8 years). Perforated typhoid ileitis was the most common diagnosis (19.0%). All had derangement in at least one of the POMS domains on the first post-operative day. Sixty-four patients (76.2%) had derangements in the fifth day POMS. Derangements in haematological and wound domains on the fifth post-operative day significantly affected LOHS (p = 0.001 and 0.003 respectively). Mortality occurred in four patients (4.8%). These had fifth day POMS derangement in infectious, gastrointestinal and wound domains and these significantly affected mortality (p = 0.033, 0.038 and 0.010 respectively).

Conclusion: Derangements in haematological and wound domains at fifth post-operative day are significantly associated with LOHS while derangements in infectious, gastrointestinal and wound domains at fifth post-operative day are significantly associated with mortality. Controlling these domains may improve surgical outcome.

Keywords: Major abdominal surgery, children, morbidity

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Introduction

Surgery is associated with considerable potential morbidity and mortality.[1] With over 230 million major surgeries performed worldwide each year,[2] post-operative morbidity has been estimated to vary between 7%[3] and 50%[4] each year, depending on the type of surgery, patient risk factors and how complications are defined.[5,6] Therefore it is not surprising that the demand for good measures of surgical quality is increasing steadily with many surgeons constantly looking for reliable markers of clinical best practices and quality improvement.

Some of these measures of surgical quality have traditionally focused on mortality citing the fact that it is an absolute measure (since a patient's death can objectively be confirmed) as the reason why it should be preferred. [7] However, mortality as a measure of surgical quality is fraught with flaws because studies have shown that it under-estimates short-term patient outcomes following major abdominal surgeries and is also a difficult and poor comparative tool for assessing quality of surgical care and effectiveness of interventions especially between institutions, with the loss of patients to long-term follow-up being an additional confounding factor in our setting.[7,8]

Clinicians, hospitals and healthcare payers are increasingly focusing on reducing 'unnecessary' days of hospitalization after surgery.[9] Significant healthcare resources are used to provide care for patients with prolonged post-operative hospitalization and the economic importance of this is highlighted in the United Kingdom study which revealed that absence from work for more than 7 days was the second most common cause of loss of man-hours at work, after work-absence from cardiovascular disease.[10] These morbidities may also have long-term implications for both the quality and quantity of an individual's life with an associated reduction in median survival.[7]

Length of hospital stay can be affected by medical and non-medical factors, therefore any standard tool for assessing a patient's duration of hospital stay would invariably be a composite tool that would simultaneously assess the processes involved in the patient's management as well as the outcome of such care[5] and would provide a reliable and valid index that would be of enormous value in quality of care, prognosis, and in research.

The Post-Operative Morbidity Survey (POMS) is a nine-domain scoring system that has earned the enviable reputation of being the only published method for prospectively describing short-term morbidity after major abdominal surgery.[9] The nine domains assessed include the pulmonary, infectious, renal, gastrointestinal, cardiovascular,

neurological, operative wound, pain and haematological domains.

A child, as defined by the constitution of the Federal Republic of Nigeria, is anyone below 18 years.[11] A child usually manifests significant quantitative differences due to the developing organ-systems and the profound and stereotypic systemic response to illness and surgical stress places unique demands on these evolving organ-systems.[12] These differences become more pronounced as one moves from older children to younger children. Ultimately the assessment and intervention given should be tailored for each child and reviewed regularly to ensure optimal results in the care for the child. The post-operative morbidity survey provides an objective, easily reproducible criteria for assessing such care as well as predicting and comparing outcomes.

Major paediatric abdominal surgery is regarded as one requiring general anaesthesia for more than 1 hour, in which there is blood loss of more than 7.5mls/ kg body weight or following which the patient does not resume oral intake for more than 4 hours after the procedure. These procedures include, but are not restricted to, laparotomies for intra-abdominal sepsis, bowel resections with/without anastomosis, hepatectomies, surgery on the pancreaticobiliary tract, gastric/splenic surgeries as well as renal, ureteric and bladder surgeries.

The aim of this study was to establish whether or not the post-operative morbidity survey could determine the morbidity domains that adversely affect surgical outcomes (in terms of length of hospital stay and mortality) in children after major abdominal surgery.

Material and Methods

This study was a prospective cross-sectional study which was conducted at the Surgery Department of the Ahmadu Bello University Teaching Hospital (ABUTH), Shika, Zaria, Kaduna State. This institution has a total of 162 bed-spaces in its surgical wards which is 22% of the 739 beds in the hospital. Of these beds, the Paediatric Surgical Wards host a total of 72 beds (10% of the total hospital bed-space).

The study population included all children who had major abdominal surgery within the twelve-month study period spanning December, 2018 to November, 2019. Inclusion criteria were patients below 18 years who were scheduled for major abdominal surgery either on elective or emergency basis. Patients who had major abdominal surgery outside the study centre and those who died before the fifth post-operative day were excluded from the study.

Major abdominal surgery, for the purpose of this study, was regarded as any abdominal surgical procedure requiring general anaesthesia for more than 1 hour, in which there was blood loss of more than 7.5mls/kg

body weight or following which the patient did not resume oral intake for more than 4 hours after the procedure while a child was regarded as any patient who was younger than 18 years (as at the last birthday) during the course of the study. These criteria are mutually exclusive and cases were regarded as major abdominal surgery if one or more of these criteria had been met.

Patients had initial assessment with resuscitation and preparation for surgery by the attending doctors; the parameters obtained included pre-, intra- and postoperative clinical information (vital signs, clinical state of the patient, state of the wound and laboratory results) that were required for this study. The post-operative morbidity survey proforma was administered on each patient once each day from the 1st to the 5th post-operative day. The patient's serum biochemical assay (electrolytes, urea and creatinine) was done once in the post-operative period (as part of routine post-operative care), except in cases where the patient's clinical condition warranted more frequent assay. The date the patient was discharged from the hospital or the date the patient died (if mortality occurred after the 5th post-operative day) was also noted. The primary interest of this study was the correlation of the post-operative morbidity survey on the 5th day with length of hospital stay before discharge or death.

This study commenced after approval from the Ahmadu Bello University Teaching Hospital Health Research Ethics Committee, HREC (HREC approval number: ABUTH/HREC/T24/2018). Informed consent was obtained from the patient's parents, guardians and/or caregivers. Assent was also obtained from older children (those who were up to 8 years or older). Both oral and written consents were obtained for each patient. Consecutive children admitted into the Accident and Emergency unit/Emergency Paediatric unit of the institution during the study period, who met the inclusion criteria for the study and whose parents, guardians or caregivers consented to the study, were enrolled into the study.

Data was collected using a structured proforma which consisted of five parts: the first part contained the patient's personal data including the study number, initials, age, gender of the patient as well as the date of admission and the patient's educational status (where applicable). The second set of data included the diagnosis, surgical procedure done and the date of the surgery. The third set of data showed the post-operative morbidity survey table which will be administered on the patient as well as the number of domains with morbidity. Pain in the gastrointestinal domain was assessed in term neonates using the Neonatal Infant Pain Scale, NIPS (assessing variables like facial expression, crying, breathing patterns, arm and leg movements, arousal), in preterm neonates with the Premature Infant Pain Profile, PIPP (utilizing variables like heart rate, oxygen saturation, facial actions),

in infants using the NIPS and in older children using the Faces Pain Scale-Revised (FPS-R). The fourth set of data contained the patient's duration of hospital stay including the date of discharge and the number of days spent on admission. The last set of data displayed the 5th day post-operative morbidity survey score and the length of hospital stay.

The pre-operative data was collected by the authors but the post-operative data was collected by 8 trained research assistants (who were Senior Registrars in the Department of Surgery) who were informed about the respective patients immediately following the surgery. These research assistants also followed the patient up from the immediate post-operative period until discharge from the outpatient department. The authors did not participate in post-operative data collection (to minimize bias). The Yamane formula[13] was used to determine the minimum sample size (n) that would satisfy the requirements for significant statistical deduction with 95% reliability coefficient and a confidence interval 10 wide (that is five on each side). Imputing the figure (46) cited by Nuhu A.et al[14] from a study in Bauchi, North-Eastern Nigeria into this formula gave a minimum sample size of 45 for this study.

Data was sorted according to the length of hospital stay and these data were analysed using the IBM Statistical Product and Service Solutions (SPSS) version 24.0.0 software, frequency distribution tables, measures of central tendency and dispersion were generated. The statistical correlation between the 5th day post-operative morbidity survey data and the length of hospital stay was then determined. Categorical data were analysed using the chi square test with p-values < 0.05 regarded as statistically significant.

Results

Eighty-seven patients were recruited into the study. Three patients were later excluded after their parents/caregivers of three patients withdrew consent to the study. Data from the remaining 84 patients were analyzed. There were 60 males and 24 females (M:F = 2.5:1) with age range of 1 day to 17 years (median age of 8 years).

Forty-two (50.0%) of the patients were in the 4 to 12 years (school-age) age group. Thirty-eight of the patients (42.9%) had no formal education while six of them (7.1%) were in secondary school.

Perforated typhoid ileitis was the most common pre-operative diagnosis occurring in sixteen patients (19.0%) with Ladds' procedure, segmental ileal resection plus reconstruction and stoma reversal being the most common surgical procedure, each of these procedures was done in ten patients as shown in table 1.

All the patients had a derangement in at least one of the POMS domains on the first post-operative day. Seventy-eight of the patients (92.9%) had derangements in

gastrointestinal tract (GIT) aspect of the POMS on the first post-operative day which was an isolated event in 2 patients (2.4%) and occurred together with derangements in other domains in 76 patients (90.5%) as shown in table 2.

Sixty-four patients (76.2%) had derangements in the fifth day POMS which was commonest in the infectious domain (40 patients (47.6%)) and least common in the haematological domain (2 patients 2.4%) as shown in table 3. Twenty patients (23.8%) had no derangements in any of the POMS domains on the fifth post-operative day. Seventy percent of the patients without morbidity on the fifth post-operative day were discharged within 7 days of the surgery while the patients with the longest length of hospital stay (LOHS) of 36 days were the two patients (2.4%) with fifth day POMS derangement in the haematological domain (table 3).

Patients who had derangements in the haematological and wound domains of the POMS on the fifth post-operative day had longer LOHS than those with derangements in other domains. Derangements in the haematological and wound domains of the POMS were found to have statistically significant relationship with LOHS with p value of 0.001 and 0.003 respectively.

Eighty patients (95.2%) survived and remained well at six weeks follow-up in clinic visits. Four patients (4.8%) died during the course of the study. These four patients (4.8%) had fifth day POMS derangement in the infectious, gastrointestinal and wound domains. The relationship between derangement in the fifth day POMS in the infectious, gastrointestinal and wound domains and mortality was statistically significant with p values of 0.033, 0.038 and 0.010 respectively.

Discussion

All the patients had a derangement in at least one of the POMS domains on the first post-operative day. This is expected given that the effects of major surgery are not likely to resolve completely within the first 24 hours of the procedure.[15–17] Goodman et al[18] noted that all the patients in their study had a derangement in at least one of the POMS domains on the first post-operative day and Grocott et al[5] noted that 75.1% of their patients still had a derangement in at least one of the POMS domains on the third post-operative day. Therefore, it is expected that the derangement may extend beyond the third day after surgery.

More than two-thirds of the patients still had derangements in the POMS domains on the fifth post-operative day. This figure is higher than what was reported by Grocott et al[5] who noted that 56.8% of their patients had derangements in the POMS on the fifth post-operative day but is similar to the 76.0% reported Goodman et al.[18] It should be noted that the latter two studies were conducted in adults and may be pointers to the accuracy of the POMS to make

predictions regardless of the age of the study population.

Half of the patients with derangements in the POMS domains had the derangement in the infectious domain. This is similar to what was reported by Grocott et al[5] where 46.5% of their patients had morbidities in the infectious domain.

Table 1: Surgical Procedures done in the Study Population

Procedure	Number of patients	Percentage (%)
Laparotomy + abscess drainage	8	9.5
Abdominoplasty	2	2.4
Adrenalectomy	2	2.4
Appendicectomy	4	4.7
GIT stoma formation	12	14.2
Stoma reversal	14	16.7
Duodeno-duodenostomy	2	2.4
Hernia repair	6	7.1
Ladds' procedure	10	12.0
Nephrectomy	4	4.7
Pyloromyotomy	2	2.4
Repair of gastric perforation	2	2.4
Right hemicolectomy	2	2.4
Ileal resection + reconstruction	14	16.7
Total	84	100.0

Table 2: Post-Operative Morbidity Survey (POMS) Domains with Derangement on the First Post-Operative Day

Domain	Number of Patients	Percentage (%)
GIT	2	2.4
GIT + Pain	2	2.4
GIT + Pain + Infectious	42	50.0
GIT + Pain + Infectious + Haematological	20	23.8
GIT + Pain + Infectious + Haematological + Wound	2	2.4
Pain + Infectious	6	7.0
GIT + Pain + Haematological + Pulmonary	2	2.4
GIT + Pain + Haematological + Pulmonary + Infectious	4	4.8
GIT + Pain + Pulmonary + Infectious	4	4.8
Total	84	100.0

Table 3: Domains with Morbidity on the Fifth Post-Operative Day with the Corresponding Length of Hospital Stay (LOHS) in the Study Population

LOHS (days)	Domain with Fifth Day Morbidity						Total
	Infectious	Infectious + GIT	Infectious + GIT + Wound	Infectious + Wound	Infectious + Wound + Haematological	None	
5-7	8	-	-	2	-	14	24
8-14	28	2	2	2	-	6	42
15-21	4	2	4	4	-	-	14
22-35	-	-	-	2	-	-	2
≥36	-	-	-	-	2	-	2
Total	40	4	6	12	2	20	84

All patients (23.8% of all the patients seen) with no derangements in any of the POMS domains on the fifth post-operative day were discharged within 11 days after surgery; a much higher value was reported by Grocott et al[5] where 80.6% of their General Surgery patients without derangements in any of the POMS on the fifth post-operative day were discharged within the first 10 days of the procedure. Davies et al[7] asserted that administration of the POMS between the 3rd and 5th post-operative days allows a more prompt identification and handling of significant morbidity domains that affect LOHS and that this strengthens the validity of the POMS as an outcome measure.[7]

Patients with derangements in the haematological and wound domains of the POMS on the fifth post-operative day had the longest LOHS with statistically significant relationship between derangements in these domains and LOHS. Howes et al[19] also identified derangements in the haematological and wound domains as well as in the cardiovascular and renal domains as being significantly related to longer LOHS in patients in their study. Davies et al[7] noted that derangements in any of the POMS domains on the fifth post-operative day was associated with an eight-fold increase in the likelihood of the patient having a prolonged LOHS. Grocott et al[5] stated that POMS behaves in a similar way to American Society of Anaesthetists (ASA) score and the Physiologic and Operative Severity Score for the enumeration of Mortality and Morbidity (POSSUM) score and that it also provides evidence of convergent validity.

Mortality was seen in those with derangements in the infectious, gastrointestinal and wound domains of the POMS on the fifth post-operative day with significant relationship between derangement in these domains and mortality. Howes et al[19] noted that derangements in the cardiovascular domain of the POMS was significantly related to

mortality in patients in their study. This discrepancy may be due to the fact that Howes et al[19] used POMS for emergency abdominal surgeries done in adult patients, some of whom may had had underlying cardiovascular co-morbidities.

More males were seen in this study than females. The higher immune function in females may result in lower infection and predisposition to infection-related surgical pathologies.[20–22] Abdul-Rahman et al[23] reported a similar male:female ratio of 2.5:1 from a review of emergency surgeries conducted in north-central Nigeria. Chukwubuike et al[24] and Ademuyiwa et al[25], from reviews of emergency surgeries conducted in south-eastern Nigeria and south-western Nigeria respectively, both reported male:female ratios of 4:1. This discrepancy in the male:female ratio in the studies above may be related to differences in health-seeking behavior of populations in the southern part of Nigeria from those in the northern part of the country and may be related to the practice of the Almajiri system in the northern part of the country that makes it obligatory for custodians of the male-child dominated system to seek medical attention for children under their care when pressing health challenges arise.[26]

Half of the patients (50.0%) seen in this study were school-age children within the range of 4-12 years. This may be due to the fact that children within this age group are more susceptible to acquired infections coupled with the fact that their immune systems may still be developing.[25] Abdul-Rahman et al[23] similarly noted that 59% of the patients in their study who had abdominal surgeries were in this age group.

Perforated typhoid ileitis was the commonest indication for surgery in this study accounting for 19.0% of all the surgeries performed. This may related to the fact that perforated typhoid ileitis is one of the commonest indications for presentation of cases requiring surgical intervention at the surgical accidents and emergency unit in the study center.[27,28] Abubakar et al[29] noted that perforated typhoid ileitis was the commonest indication for emergency abdominal surgery in children older than 1 year. Furthermore, Abantanga et al[30] reported similar findings that perforated typhoid ileitis was the commonest indication for surgery accounting for 68% of their cases seen; conversely, Chukwubuike et al[24] reported that perforated typhoid ileitis accounted for 19.7% of the cases of abdominal surgical emergencies seen in their study but was the second commonest cause of such conditions, the first being intussusception. This discrepancy between pathologies in the north and south may be due to the fact that access to portable water supply is generally better in the south than in the northern part of the country.[27-29]

The commonest procedures done were segmental ileal resection plus end-to-end ileo-ileal anastomosis done in 12.0% of the cases and ileostomy reversal following laparotomy for perforated typhoid ileitis

done in 12.0% of the cases seen. This may be explained by the fact that typhoid ileitis is a segmental disease and so segmental resection offers the most logical opportunity of treating the condition following perforation.[27,31,32] Those patients who were stable enough subsequently had ileo-ileal anastomosis while unstable patients received a stoma and subsequently had reversal of the stoma when they were more stable. Abantanga et al[30] reported that 63.6% of their patients had segmental resection and anastomosis for perforated typhoid ileitis. Ekpemo et al[33] noted that simple repair and segmental ileal resection and anastomosis were done in equal number of patients in their study with similar outcomes after the procedures.

Conclusion

All the patients on the first day after surgery had at least a derangement in the POMS domains, majority occurring in the gastrointestinal tract (GIT). Derangement in the haematological and wound domains of the POMS on the fifth day after surgery significantly prolonged LOHS compared with other domains. The study findings indicate that mortality can be predicted by derangement in the fifth day POMS in the infectious, gastrointestinal and wound domains. Further predictive analysis may be required to validate these findings.

Recommendations

1. In as much as a wholistic approach to post-operative patient care is important, particular attention should be paid to the aspects highlighted in the haematological and wound domains of the POMS as these can adversely affect LOHS and to the aspects outlined in the infectious, gastrointestinal and wound domains of the POMS as these can increase the risks of mortality after major abdominal surgery in children if they are not appropriately addressed.
2. Surgeons should encourage the use of POMS in the post-operative management of their patients given the fact that it behaves in a similar way to more popular scores (ASA score and POSSUM score) with evidence of convergent validity.
3. Further studies with larger populations and involving multiples centers, is necessary to confirm the validity of POMS in predicting surgical outcomes in major abdominal surgery in children.

Conflict of Interests

The authors declare no conflict of interests.

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