ORIGINAL RESEARCH

Cost effectiveness analysis of duration of nonoperative management for adhesive bowel obstruction in a developing country

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Abstract

Background

Adhesive bowel obstruction (ABO) costs billions of dollars in developed countries. Cost is unknown in developing countries. This depends on the type of management and duration of hospital stay. Nonoperative management (NOM) of uncomplicated obstruction is safe for up to 10 days. While it remains cost effective, the most efficient duration of nonoperative management must retain its advantages over operative management.

Aim

To describe cost effectiveness of various durations of nonoperative management of adhesive obstruction in a developing country.

Method

Over 2 year period, Patients who had uncomplicated adhesive obstruction were observed on trial of nonoperative management. Length of hospital stay and success rate were combined as surrogates for Cost effectiveness analysis of 2 to 5 days and ≥7 days nonoperative management.

Results

41 patients (24(58.5%) females) were eligible. Mean age 38.4 ± 14.7 (range 18-80) years. 31 (75.6%) were first time admissions. The most common previous abdominal operations were for appendix and obstetrics and gynecologic pathologies. Median duration of nonoperative management (dNOM) was 4 days, median LOS was 9 days. Nonoperative management was successful in 53.7% (22 patients). Total estimated direct hospital cost of 41 adhesive bowel obstructions was $133,279. Total personnel charges were $112,142. Mean operative and nonoperative management was $4,914 and $1,814 respectively (p <0.0001). Most of successful nonoperative management was within 5 days. 4 days nonoperative management had the highest cost utility.

Conclusion

From this study, without indications for immediate surgical intervention, 4 days nonoperative management is the most cost effective course, after which surgical intervention may be considered if there is no improvement.

Introduction

Adhesive bowel obstruction (ABO) is blockade of luminal flow of bowel content due to trapping or entanglement of bowel loops by fibrous or fibrinous bands between peritoneal surfaces[1,2]. It is the leading cause of intestinal obstruction (IO) in developed countries and it is overtaking strangulated hernia as the most common cause of IO in developing countries[3-9]. ABO is the most common general surgical complication of intra-abdominal adhesions necessitating re-admission and surgical intervention[10,11]. Other complications of intra-abdominal adhesions are chronic pain and infertility10. Unlike strangulated hernia, ABO is difficult to diagnose and decision making on whether to proceed to operative management (OM) or attempt non-operative management(NOM) is more challenging[11,12]. The difficulties in decision making cause high morbidity and exorbitant cost of treatment[13].

Deficit of knowledge about management of ABO raises controversies regarding the best method of diagnosis, decision making on immediate OM or trial of NOM and the most appropriate duration of trial of nonoperative management (dNOM)[2,3,13-16]. The difficulties in decision making escalate the overall cost of management, contribute to poor outcome and increase the suffering felt by patients[10].

The monetary implication of surgical intervention and hospitalization for ABO was estimated at $1.3billion/year in the United States of America in 1994[11]. A more recent report estimates the cost at $2 billion/year[1,11,17]. The monetary implication of management of ABO is unknown in developing centers. The escalating cost of ABO management is related to duration of admission and re-admission, and the morbidity of delayed OM or inappropriate OM. The aim of this study was to describe the cost of management decisions, specifically, the cost effectiveness of various duration of NOM among patients who presented with ABO in a poor resource center in order to facilitate management decision

policies in such patients

Method

This was a prospective cross-sectional study conducted in a government owned tertiary hospital, namely the General Surgery Division of the University of Ilorin Teaching Hospital, northcentral Nigeria between December 2013 and November 2015. After due ethical clearance, patients with provisional diagnosis of ABO were included. Patient requiring immediate OM and those whose final diagnosis was not ABO were excluded.

At the time of this study, the clinical evaluation for fitness for NOM was augmented by plain abdominal X-ray and ultrasound findings. While preference was given to the clinical abdominal examination findings in decision making about patient inclusion, the nonspecific vital signs influenced exclusion; patients whose systolic blood pressure was lower than 100mmhg, whose pulse was persistently higher than 100bpm and whose temperature was higher than 38.00C after initial resuscitation, were excluded. The NOM included nasogastric intubation, intravenous nutritional supplementation via peripheral venous access and close observation of clinical features. There was no consensus yet in the centre about the duration of non-operative management (dNOM). Success of NOM was based on return of normal bowel functions. dNOM was time to discontinuation of suck and drip and commencement of oral feeding or time to decision for surgical intervention.

Variables of interest were patients' demographics, symptoms at presentation, type of previous abdominal operation(s), and dNOM. The length of hospital stay (LOS) and success rate of NOM (srNOM) were the primary measures of outcome.

Working with the objective that our management decision was to achieve the highest possible success rate in the shortest duration of admission, the LOS and srNOM were combined as surrogates for estimating benefit in the cost effectiveness analysis (CEA) by finding the product of inverse of median LOS and srNOM [benefit =1/(LOS_median)×srNOM]. Cost of treatment was estimated using the resource unit unit (RUU) applied to a simple predictable model of trajectory through the hospital service.

The model of trajectory of care was constructed starting from the emergency room care to the admission ward (via operating theater in the operative group) and to discharge from inpatient care. The personnel involved in patient care, intravenous fluid and nutritional supplementation, laboratory investigations and the medications were standardized with an assumption of uniform homogenous requirement and trajectory of care within the separate groups.

The daily wages of the personnel were derived from the monthly gross emolument of each cadre. The daily cost of intravenous fluid supplementation and nutritional supplementation was estimated from simple mathematical addition of the cost of intravenous fluid, intravenous supplementation of vitamin B-complex, vitamin C, vitamin E, vitamin K and intravenous magnesium-sulphate based on the standard daily requirement which was the protocol for suck and drip in the general surgery division at the time of the study. The cost of laboratory requirement was the exact cost of investigation in the hospital at the time of the study. The total cost of investigation for each patient was dependent on the count of orders made during the duration of admission. It was assumed that each patient required only the services of the direct primary care personnel per day except when operated upon (see table 1). The scope of data collection for each patient and the costing for each patient ended upon discharge from admission for the index presentation. The complications necessitating prolonged admission was not specifically sought because of the prior assumption that the reason for short or long admission was a function of our decision to delay immediate operative intervention i.e. a form of intention to treat analysis. The indirect and intangible costs were excluded because they were difficult to standardize for measurement and extremely variable thus might introduce bias in costing. Cost was expressed in monetary value using the United States Dollars(USD) at the time of the study, and official equivalent of 1 dollar was 198 Nigerian Naira. The costing method used was macro-costing rather than activity based because the assumptions of this study were based on predictable trajectory of care. Also, because the primary measure of outcome was variation in days of admission rather than events within the day, the macro-costing was considered sufficient rather than micro-costing.

Table 1: Estimates of Resource Unit Use charges

Resource Unit	
Primary care personnel	**Unit charge/day(USD)**
Consultant Surgeon	85
Senior Resident	60
Junior Resident	44
Intern	31
Nursing(lowest cadre)	14
Support Staffs	6
Operative care(additional personnel)	**Single Use(USD)**
Anaesthetist (1 consultant and 1 senior resident)	145
Operation Pack	61
Anesthesia Pack	51
Operation fee(including gas)	36
Admission charges	**Unit charge/day(USD)**
Ward Admission	8
Accident and Emergency Room	7
Investigations charges	**Unit charge/use(USD)**
Radiologic Investigations (X-ray and Ultrasound)	21
Metabolic Panel	13
Full blood count	8
Blood Sugar	2
Medications and Nutritional Supplementation	**Unit charge/day(USD)**
Antibiotics and analgesics	6
(fluids, calories, electrolytes, vitamins)	31

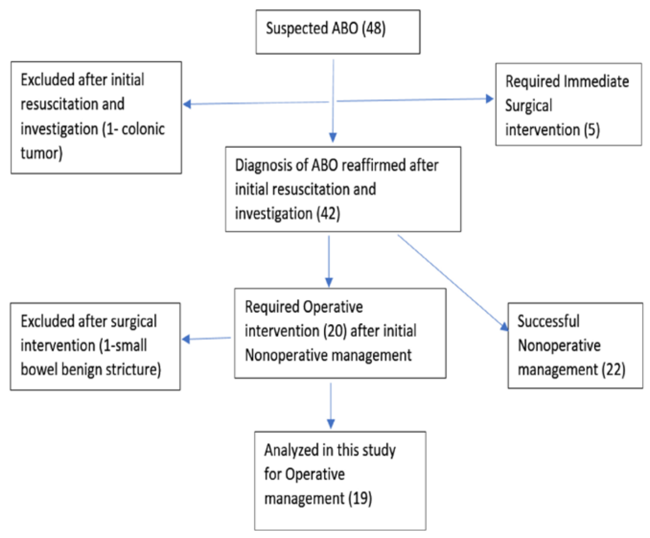

Figure 1: Flow diagram of patient selection

The CEA of 2,3,4,5 and ≥7 days dNOM were estimated and incremental cost effectiveness ratios (ICER) compared where appropriate. The CEA of 3 days dNOM preferred in the Bologna guideline2 was taken as the status quo. A one-tailed exploratory analysis at 99% confidence interval was performed to compare the cost of NOM and OM. Statistical analysis and graphical presentations were produced using SPSS v16 and R-statistical package version 3.2.2.

Results

41 patients fit the eligibility criteria over a 2 year study period (figure1). There were 17 males and 24 females. The age range was 18-80 years (38.4 ± 14.7). 30 patients were first time admissions for ABO, 9 were second time and 2 were third time admissions. The most common indication for the previous abdominal operations was appendicular pathology (table 2). The median interval between the ultimate abdominal operation and the index ABO was 18 months (table 2). All patients had abdominal pain at presentation. Other symptoms were vomiting, constipation, distension and fever (figure 2).

Table 2: Indications for previous abdominal operation

Region of pathology/indication for previous abdominal surgery	Frequency
appendix	11
obstetrics	9
gynecologic	9
Obstetrics and gynecologic	1
Small bowel	6
Gastric	3
Colonic	2

	min	max	median	Mean
Interval from Previous surgery(months)	1	360	18	54.9 ±85
Duration of Suck_and_drip(days)	1	15	4	5±3.4
Length of hospital Stay(days)	3	35	9	11.1 ±7.8

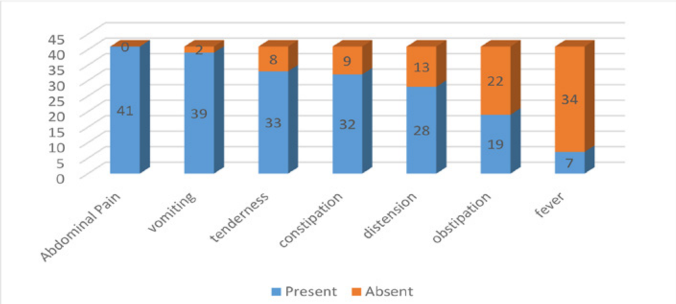

Figure 2: Frequency of clinical findings

personnel charges accounted for $112,142(84.1%). The RUU charges are shown in table 1 . The maximum and minimum cost for NOM and OM were $794 and 3,641, and $1,126 and $10,243, respectively. The mean cost of OM was $4,914, while the mean cost of NOM was $1,814. The total cost of NOM in 22 patients was $39,924, while the total OM for 19 patients was $93,356. The exploratory one-tail t-test at 99% confidence limits hypothesizing that the cost of OM was higher than the cost NOM returned p value < 0.0001. There was a direct relationship between duration of suck and drip and cost of treatment (figure 3).

All patients were commenced on initial trial of NOM. OM was instituted after failure of NOM. All patients were managed and discharged. There was no mortality. Most of the success recorded on NOM was within 5 days, and the rate of successful NOM was 53.7%. The benefit of 3 dNOM, which was considered the status quo for ICER analysis, was 5.9. The 4 days NOM had the highest benefit. From 3 dNOM to 4 dNOM, 4 additional patients were successfully managed non-operatively at ICER of USD 246 (table 3).

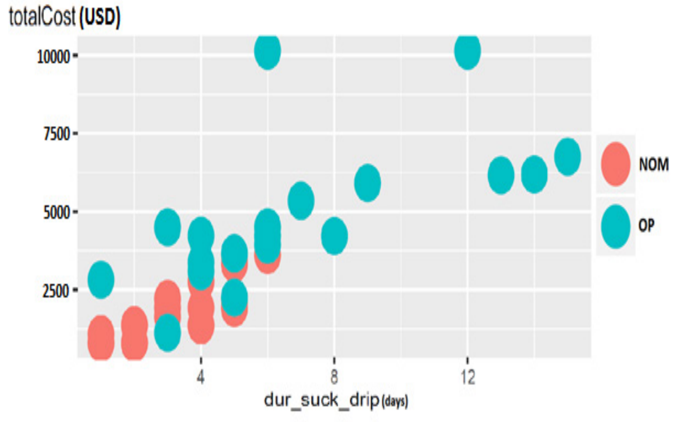

Figure 3: Correlation of cost of treatment with duration of suck and drip

Table 3: Utility values

dNOM	No of Success (rate)	Mean cost (USD)	LOS_*median*	$\frac{1}{LOS\_median}$	Benefit	ICER
2days	8 (19.5%)	1,177	3	0.33	6.4	
3days	11 (26.8%)	1,576	4.5	0.22	5.9	
4days	15(36.6%)	1,920	5	0.20	7.3	246 USD for one additional day NOM and 4 additional successes.
5days	21(51.2%)	2,258	7	0.14	7.2	
≥7days	22(53.7%)	2,672	9.2	0.11	5.9	

Discussion

When there are competing options, the most cost effective among viable alternatives will to be preferred especially in a climate of limited resources. If the provisional clinical diagnosis of intestinal obstruction is ABO and the patient shows no signs of bowel strangulation or other complications, trial of NOM is safe[3,11,15]. The best duration of NOM before instituting surgical intervention is debatable[3]. One important point to remember is that the most efficient duration of NOM must sustain the advantages of NOM over OM by preventing inadvertent unnecessary suffering and at the same time remain cost effective.

The aim of this study was to describe the cost effectiveness of various duration of NOM before opting for operative management in a patient with ABO. 41 patients were managed by initial trial of NOM in a resource poor centre. There were more females than males in tandem with previous reports[3],[18]. Also in tandem with previous reports, the most frequent causes of ABO were abdominal surgeries for appendicular pathologies and obstetrics or gynecologic conditions[3,19]. Abdominal pain (100%), vomiting (95%) and abdominal tenderness (80%) were the most frequent clinical findings also in conformity with previous reports. About 54% of the ABOs were successful on NOM. Majority of the success was recorded within 5 days of NOM. In a report by Lawal et al[7] in Nigeria, there was failed NOM in about 85% of patients, necessitating operative intervention. This was higher than the rate of failures recorded in this study. Mortality rate in the Lawal et al study was about 6%, while in this study, there was no mortality.

The overall cost of treatment was about $134,000 for treatment of 41 patients with ABO in the study centre. The highest cost of treatment was incurred on personnel charges which accounted for about more than two-thirds of the direct hospital charges in a government owned not for profit hospital.

As expected, in the exploratory analysis, the cost of treatment for patients who had OM was significantly higher than those who were successfully managed by NOM. There was a direct relationship between cost of treatment and the duration of suck and drip irrespective of the outcome of NOM (figure 2). The cost of OM could have been escalated because all patients had initial trial of NOM. This implies that if we can select patients who are unlikely to succeed on NOM, then early OM should minimize their overall cost of treatment. So, research describing methods of accurately identifying patients unlikely to benefit from NOM are required.

If there are no reasons for immediate surgical intervention, continuing NOM for 4 days, after which OM should be considered if there is no significant improvement, was found to be the most cost effective course of action. The cost utility analysis showed that for an additional day of dNOM beyond 3 days, the benefit score was higher and an additional 4 successes were recorded at about $62 extra cost per success. Compared to the status quo, the 5 dNOM also had higher benefit score and additional 10 successes for additional 2 days beyond 3 days of NOM. However, the 5dNOM compared unfavorably with the 4 dNOM.

It is important to discuss limitations of this study as will be expected for studies on economic analysis. To start with, we assumed homogeneity of illness progression and course of treatment. We also assumed that the length of hospital stay is directly related to the morbidity and cost of treatment. Hence, the effectiveness of NOM was estimated by simple mathematical combination of endpoints, namely the LOS and the srNOM. These endpoints are intermediate endpoints limited to the outcome of index admission in contrast to the commonly used measures such as quality adjusted life years (QALY) which considers the effect of the intervention beyond the current intervention and over the duration of continued existence of patients.

Although we have found 4 dNOM to be most cost effective, interpretation of finding on economic analysis should not be in a vacuum. It should depend on the costing method, the context of analysis and the limits of willingness to spend. Finally, the cost of managing ABO can be highly variable. The costing method in this study employed the less stringent and rather narrower macro-costing of the direct hospital charges, excluding the indirect hospital charges and the non-hospital and intangible charges.

Conclusion

With respect to the management of an index admission only, when there are no reasons for immediate surgical intervention, continuing NOM for 4 days, after which OM should be considered if there is no significant improvement, was found to be the most cost effective course of action in this study.

References

1. Attard JAP, MacLean AR. Adhesive small bowel obstruction: epidemiology, biology and prevention. Can J Surgu. 2007;50(4):291-300.

2. Di Saverio S, Coccolini F, Galati M, Smerieri N, Biffl WL, Ansaloni L, et al. Bologna guidelines for diagnosis and management of adhesive small bowel obstruction (ASBO): 2013 update of the evidence-based guidelines from the world society of emergency surgery ASBO working group. World J JEmerg Surg. 2013;8:42.

3. Eren T, Boluk S, Bayraktar B, Ozemir IA, Yildirim Boluk S, Tombalak E, et al. Surgical indicators for the operative treatment of acute mechanical intestinal obstruction due to adhesions. Ann Surg Treat and Res. 2015;88(6):325-33.

4. Malik AM, Shah M, Pathan R, Sufi K. Pattern of acute intestinal obstruction: is there a change in the underlying etiology? Saudi Journal of Gastroenterology. Saudi J Gastroenterol. 2010;16(4):272-4.

5. Ameh EA, Nmadu PT. Adhesion intestinal obstruction in children in northern Nigeria. Trop Doct. 2004;34(2):104-6.

6. Agodirin O, Oguntola A, Adeoti M, Agbakwuru A, Oladiya K, Olofinbiyi B. Preoperative pain treatment in acute abdomen in Osogbo, Nigeria: a randomized double-blind placebo-controlled study. Int J Emerg Med. 2013;6(1):3.

7. Lawal OO, Olayinka OS, Bankole JO. Spectrum of causes of intestinal obstruction in adult Nigerian patients. S Afr J Surg. 2005;43(2):34, 6.

8. Ohene-Yeboah M, Adippah E, Gyasi-Sarpong K. Acute Intestinal Obstruction in Adults in Kumasi, Ghana. Ghana Med J. 2006;40(2):50-4.

9. Ojukwu OA, A. causes and management of intestinal obstruction at the University of Nigeria Teaching Hospital Enugu. IJMHDEV. 2002;7(1):57-8.

10. ten Broek RP, Issa Y, van Santbrink EJ, Bouvy ND, Kruitwagen RF, Jeekel J, et al. Burden of adhesions in abdominal and pelvic surgery: systematic review and met-analysis. BMJ . 2013;347:f5588.

11. Catena F, Di Saverio S, Kelly MD, Biffl WL, Ansaloni L, Mandalà V, et al. Bologna Guidelines for Diagnosis and Management of Adhesive Small Bowel Obstruction (ASBO): 2010 Evidence-Based Guidelines of the World Society of Emergency Surgery. World J Emerg Surg. 2011;6:5.

12. Lin LH, Lee CY, Hung MH, Chen DF. Conservative treatment of adhesive small bowel obstruction in children: a systematic review. BMJ Open. 2014;4(9).

13. van Oudheusden TR, Aerts BA, de Hingh IH, Luyer MD. Challenges in diagnosing adhesive small bowel obstruction. World J Gastroenterol. 2013;19(43):7489-93.

14. Wadani HA, Al Awad NI, Hassan KA, Zakaria HM, Alaqeel FO. Role of water soluble contrast agents in assigning patients to a non-operative course in adhesive small bowel obstruction. Oman Med J. 2011;26(6):454-6.

15. Chen XL, Ji F, Lin Q, Chen YP, Lin JJ, Ye F, et al. A prospective randomized trial of transnasal ileus tube vs nasogastric tube for adhesive small bowel obstruction. World J Gastroenterol. 2012;18(16):1968-74.

16. Shih SC, Jeng KS, Lin SC, Kao CR, Chou SY, Wang HY, et al. Adhesive small bowel obstruction: how long can patients tolerate conservative treatment? World J Gastroenterol. 2003;9(3):603-5.

17. Ugare G, Osakwe G, Djunda E. Mucin as possible cause of early adhesional intestinal obstruction. Afr Health Sci. 2014;14(4):954-8.

18. Ibekwe PE, V. Okidi, O. Intestinal Obstruction from an adhesion band mimicking peritonitis due to a complicated induced unsafe abortion: a case report. Afr j reprod Health. 2006;11:111-4.

19. Al-Salem AH, Oquaish M. Adhesive intestinal obstruction in infants and children: the place of conservative treatment. ISRN Surgery. 2011;2011:645104.