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**Original Research Article**

# A study on the trends and patterns of intestinal obstruction and surgical outcome based on APACHE score II in a tertiary care centre

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## ABSTRACT

**Background:** One of the most common intra-abdominal problems faced by general surgeons in their practice remains bowel obstruction. It is important to identify and analyse the clinical presentation and etiology of patients with acute intestinal obstruction. With its multiple etiologies, intestinal obstruction of either the small or large bowel continues to be a major cause of morbidity and mortality.
**Methods:** An observational study was carried out at Narayana Hrudayalaya Hospital, Bangalore between July 2016 and June 2019 involving 190 patients, after approval from Institutional ethics Committee. Predicted mortality rates were calculated using the APACHE II scoring system by linear analysis method. It was then compared with the actual outcomes. Univariate and multivariate analysis was carried to analyze the collected data.
**Results:** The commonest cause in this study was postoperative adhesions [82 patients (43.2%)]. Frequency of mortality in our study was 7.9%. ROC curve analysis to predict the mortality using APACHE score showed sensitivity (80%), specificity (81.14%) and AUROC=0.796. P value was <0.001 which is highly significant. A positive correlation was found between deaths and complications with higher APACHE scores.
**Conclusions:** Successful treatment of acute intestinal obstruction depends upon early diagnosis, skilful management and treating the pathological effects of the obstruction just as much as the cause itself. The APACHE II score allows for direct comparison between the observed and expected adverse outcome rates. They can also be used to determine prognosis and help family members make informed decisions about the aggressiveness of care.

**Keywords:** Adhesiolysis, CT scan, Gangrene bowel, Intestinal obstruction, Resection anastomosis

## INTRODUCTION

Intestinal obstruction is a common surgical emergency that accounts for at least 20% of all admissions to a surgical service.[1] 12-16% of acute abdominal emergencies may be contributed to intestinal obstruction.[2] The etiology of bowel obstruction has been varied with small intestinal obstruction caused by adhesions in 60%, strangulated hernia in 20%, malignancy in 5% and volvulus in 5%.[2] The timing of surgical intervention putting in mind possibility of Intestinal Ischemia (strangulation) is important which needs urgent exploration.

Intestinal obstruction is failure in normal propulsion of the intestinal contents due to interference with peristalsis in a segment of bowel due to mechanical, neurogenic or vascular causes. Mechanical obstruction is divided into small bowel and large bowel obstruction, partial or complete obstruction. Intestinal obstruction may be classified into two types.[3-5] 1) Dynamic (mechanical) obstruction, 2) Adynamic obstruction. Cardinal features of intestinal obstruction are: abdominal pain, vomiting, distension of abdomen, obstipation.

There are four main measures in management of obstruction.[6] These include GI decompression, fluid and

electrolyte replacement, relief of obstruction usually surgical, antibiotics to prevent complications from associated sepsis.

APACHE II (Acute physiological and Chronic Health Evaluation) is the most widely used ICU mortality prediction score.[7-9] The APACHE II score was designed as a mortality prediction tool but was not intended to influence the medical management of patients during their ICU stay. The APACHE-II score provides an estimate of ICU mortality based on a number of laboratory values and patient signs taking both acute and chronic disease into account. The point score is calculated from a patient's age and 12 routine physiological measurements. These were measured during the first 24 hours after admission, and utilized in addition to information about previous health status (recent surgery, history of severe organ insufficiency, immunocompromised state) and baseline demographics such as age. In this study we have used APACHE II scoring system in patients for predicting the outcome in terms of morbidity and mortality

A study by Wang et al on "value of modified APACHE II score in predicting postoperative complications in 92 patients with acute obstructing colorectal carcinoma" showed twenty-five patients developed postoperative complications including 3 deaths.[10] The APACHE-II score (13.72±4.24), modified APACHE II score (19.28±4.92), intestinal obstruction severity score (5.56±2.20) were significantly higher in patients with complications than those in patients without complications (10.58±3.44, 14.69±3.73, 4.10±1.52, all $p<0.01$).

A study on "comparative analysis of APACHE II and P-POSSUM scoring systems in predicting postoperative mortality in patients undergoing emergency laparotomy" by Nag et al where all patients undergoing laparotomy at the Tata Main Hospital, Jamshedpur, India between December 2013 and November 2014 showed APACHE II can be used pre operatively to assess the risk in patients undergoing emergency laparotomy.[11]

### *Objectives*

To study the various etiology, clinical features, surgical procedures, complications and predict the prognosis and outcome of the patients based on the APACHE II score. To assess the correlation between the APACHE II score and the severity of the disease.

## METHODS

### *Study design and study site*

It was an observational study conducted at Department of General surgery, Narayana Hrudayalaya Multispecialty Hospital, Bangalore, India from July 2016-June 2019.

### *Study population*

Patients presenting to the general surgery department and emergency in our hospital with clinical or radiological evidence of intestinal obstruction will be included in this study regardless of the gender of the patient.

### *Sample size*

Based on the previous study expected proportion of intestinal obstruction cases due to adhesions as 32%, precision- 7.5%, confidence interval- 95% sample size was 149.[12,13]

Following formula has been used for the sample size calculation.

$$N = \frac{Z^2_{1-\frac{a}{2}} \times p(1-p)}{d^2}$$

Where, p= expected proportion

D= absolute precision

1-a/2= desired confidence level

Calculation:

Expected proportion=32%; Precision=7.5%; $Z^2_{1-\frac{a}{2}}$=1.96

### *Inclusion criteria*

All patients (19 years and above) with clinical or radiological evidence of intestinal obstruction (both small and large bowel).

### *Exclusion criteria*

Patients with incomplete and inadequate data at the records department for the purpose of analysis. Patients below the age of 19 years.

### Methodology

This was an observational study in which 190 patients admitted in our department with clinical or radiological evidence of acute intestinal obstruction were taken between July 2016 and June 2019. Inclusion and exclusion criteria were applied to patients. Institutional Review Board and Human Ethics Committee clearance were obtained. Written informed consent was obtained from all the participants before starting the prospective study. Criteria for admission were obstipation, abdominal pain, abdominal distension, and nausea and vomiting supplemented with a positive abdominal radiograph or CT abdomen findings. Patients admitted with diagnosis of intestinal obstruction were interviewed with the proforma and details were collected in prospective study.

Immediately after admission, resuscitation was started along with nasogastric decompression and antibiotic prophylaxis. A close observation of all vital parameters was carried out continuously. Patients with clear-cut signs and symptoms of acute and progressive bowel obstruction were managed by appropriate surgical procedure after resuscitation, rest were managed conservatively. During the surgery, the findings and procedure adopted were recorded.

Throughout the postoperative period, the patients were monitored carefully in the post-operative intensive care units or wards depending on the patients' general condition and toxemia. Retrospectively data will be collected from the Discharge summaries and records department. In this observational study, we have used APACHE II scoring system in preoperative diagnosis for predicting the outcome in patients in terms of morbidity and mortality.

### *Statistical analysis*

The statistical software namely SPSS 18.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.[14-17]

### *Significant figures*

+Suggestive significance (p value: 0.05<p<0.10); *modrately significant (p value: 0.01<p<0.05); **strongly significant (p value: p<0.01).

## RESULTS

Table 1 shows that majority of the patients belong to 41-50 age group with 40 patients [22 females (25%) as compared to 18 males (17.6%)].

**Table 1: Age distribution to gender.**

| Age in years | Gender | | Total (%) |
|---|---|---|---|
| | Female (%) | Male (%) | |
| **20-30** | 12 (13.6) | 16 (15.7) | 28 (14.7) |
| **31-40** | 17 (19.3) | 20 (19.6) | 37 (19.5) |
| **41-50** | 22 (25) | 18 (17.6) | 40 (21.1) |
| **51-60** | 19 (21.6) | 16 (15.7) | 35 (18.4) |
| **61-70** | 11 (12.5) | 17 (16.7) | 28 (14.7) |
| **71-80** | 3 (3.4) | 13 (12.7) | 16 (8.4) |
| **>80** | 4 (4.5) | 2 (2) | 6 (3.2) |
| **Total** | 88 (100) | 102 (100) | 190 (100) |

P=0.192, not significant, Chi-square test

Table 2 shows out of 82 postoperative adhesions cases, 61 patients (78.2%) were managed conservatively and 21 patients (18.8%) were operated. P value was <0.001 which is highly significant.

Secondly out of 35 neoplasm patients 3 (3.8%) were managed conservatively and 32 patients (28.6%) were operated. P value was <0.001 which is highly significant.

Thirdly out of 18 hernias, all were operated (16.1%). P value was highly significant

**Table 2: Etiology distribution according to conversion to surgery.**

| Etiology | Conversion to surgery | | Total (%) | P value |
|---|---|---|---|---|
| | No (%) | Yes (%) | | |
| **Postop adhesions** | 61 (78.2) | 21 (18.8) | 82 (43.2) | <0.001** |
| **Neoplasm** | 3 (3.8) | 32 (28.6) | 35 (18.4) | <0.001** |
| **Stricture** | 3 (3.8) | 10 (8.9) | 13 (6.8) | 0.172 |
| **Mesenteric ischemia** | 3 (3.8) | 8 (7.1) | 11 (5.8) | 0.338 |
| **Adhesive bands** | 0 (0) | 6 (5.4) | 6 (3.2) | 0.038* |
| **Hernia** | 0 (0) | 18 (16.1) | 18 (9.5) | <0.001** |
| **Abdominal tb** | 2 (2.6) | 4 (3.6) | 6 (3.2) | 0.696 |
| **Abdominal cocoon** | 1 (1.3) | 2 (1.8) | 3 (1.6) | 0.784 |
| **Crohns** | 2 (2.6) | 1 (0.9) | 3 (1.6) | 0.363 |
| **Intussuception** | 0 (0) | 2 (1.8) | 2 (1.1) | 0.235 |
| **Sigmoid volvulus** | 0 (0) | 1 (0.9) | 1 (0.5) | 0.403 |
| **Meckels diverticulitis** | 0 (0) | 2 (1.8) | 2 (1.1) | 0.235 |
| **Others** | 3 (3.8) | 5 (4.5) | 8 (4.2) | 0.835 |
| **Total** | 78 (100) | 112 (100) | 190 (100) | - |

Chi-Square/Fisher exact test; *Moderately significant (p value: 0.01<p<0.05); **Strongly significant (p value: p<0.01)

Table 3 shows that majority of patients underwent operation out of which laparotomy and stoma formation was seen in majority (47 patients, 24.7%) followed by laparotomy adhesiolysis (21 patients, 11%). Out of 190 patients 111 patients underwent operation. 58 were underwent elective surgery (30.5%) and 53 underwent emergency operation (27.9%).

**Table 3: Type of operation.**

| Type of operation | No. of patients (n=190) | % |
|---|---|---|
| **No** | 79 | 41.6 |
| **Yes** | 111 | 58.4 |
| **Laparotomy+adhesiolysis** | 21 | 11.01 |
| **Laparotomy+resection+ anastomosis** | 16 | 8.4 |
| **Laparotomy+hernia repair** | 18 | 9.5 |
| **Laparotomy+stoma** | 47 | 24.7 |
| **Laparotomy+ ileosigmoid bypass** | 1 | 0.5 |
| **Laparotomy+appendectomy** | 2 | 1.1 |
| **Laparotomy+ on table sigmoidoscopy** | 1 | 0.5 |
| **Laparotomy+Ladd's** | 1 | 0.5 |
| **Laparotomy+palliative jejuno-ileal bypass** | 1 | 0.5 |
| **Laparotomy+lavage+closure** | 3 | 1.6 |

**Table 4: Complications.**

| Complications | No. of patients (n=190) | % |
|---|---|---|
| **Pre-operative** | | |
| Nil | 77 | 40.5 |
| Yes | 113 | 59.5 |
| Sepsis | 80 | 42.1 |
| Dyselectrolytemia | 66 | 34.7 |
| AKI | 36 | 18.9 |
| Peritonitis | 12 | 6.3 |
| Metabolic acidosis | 5 | 2.6 |
| Paralytic ileus | 3 | 1.6 |
| SepticShock | 1 | 0.5 |
| LRTI | 1 | 0.5 |
| Pneumonia | 1 | 0.5 |
| MODS | 1 | 0.5 |
| **Post-operative** | | |
| Nil | 93 | 48.9 |
| Yes | 97 | 51.1 |
| Dyselectrolytemia | 54 | 28.4 |
| Paralytic lieus | 45 | 23.6 |
| Surgical site infection | 23 | 12.1 |
| AKI | 11 | 5.7 |
| Sepsis | 6 | 3.2 |
| Metabolic acidosis | 9 | 4.7 |
| Enterocutaneous fistula | 2 | 1.1 |
| LRTI | 2 | 1.1 |
| Pneumonia | 2 | 1.1 |
| Septic shock | 2 | 1.1 |
| Burst abdomen | 2 | 1.1 |
| DVT | 1 | 0.5 |
| MODS | 1 | 0.5 |
| Anastomotic leak | 1 | 0.5 |

Table 4 shows that 77 patients (40.5%) did not suffer from any complications preoperatively and 93 patients (48.9%) did not suffer from any complications postoperatively. Among 113 patients (59.5%) with preop complications, sepsis (80 patients, 42.1%) was common followed by dyselectrolytemia (66 patients, 34.7%).

Among 97 patients (51.1%) with postop complications, dyselectrolytemia (54 patients, 28.4%) followed by paralytic ileus (45 patients, 23.6%).

**Table 5: Comparison of APACHE II score according to management.**

| Apache score | Management | | Total | P value |
|---|---|---|---|---|
| | Conservative | Operative | | |
| **Apache II score** | 5.53±4.61 (4.5, 2.0-7.25) | 4.80±3.76 (4, 2-7) | 5.10±4.13 (4, 2-7) | 0.237 |

Student t test (number in brackets are median and inter quartile range)

Table 5 shows that mean score for conservative cases was 5.53 and that for operative cases was 4.80 which is less than conservative cases. Median score for conservative cases was 4.5 and range was 2-7.25, median for operative cases was 4 and range was 2-7. P value was 0.237 which is not significant.

**Table 6: Apache II score distribution according to outcome.**

| Apache II score | Outcome | | Total (n=190) | P value |
|---|---|---|---|---|
| | DC (%) (n=175) | Death (%) (n=15) | | |
| **0-4** | 98 (56) | 3 (20) | 101 (53.2) | <0.001** |
| **5-9** | 62 (35.4) | 3 (20) | 65 (34.2) | |
| **10-14** | 12 (6.9) | 7 (46.7) | 19 (10) | |
| **15-19** | 2 (1.1) | 1 (6.7) | 3 (1.6) | |
| **20-24** | 1 (0.6) | 1 (6.7) | 2 (1.1) | |
| **25-29** | 0 (0) | 0 (0) | 0 (0) | |
| **30-34** | 0(0) | 0 (0) | 0 (0) | |
| **>34** | 0 (0) | 0 (0) | 0 (0) | |

**Strongly significant (P value: p<0.01)

Table 6 shows that majority of the patients came under 0-4 score with 98 patients (56%) discharged and 3 patients (20%) were declared dead. 10-14 score showed high mortality rate with 7 (46.7%) out of 19 cases were declared dead. P value was highly significant.

Table 7 shows APACHE score sensitivity was 80%, specificity was 81.14%, AUROC=0.796.

APACHE postop mortality (%) was sensitivity=60%. Specificity=92.57%, AUROC=0.786 APACHE non operative mortality (%) was Sensitivity=53%, Specificity=91.43%, AUROC=0.751.

P value was <0.001 which is highly significant.

**Table 7: ROC curve analysis to predict the mortality using APACHE II score.**

| Variables | ROC results to predict mortality | | | | Cut-off | AURO C | SE | P value |
|---|---|---|---|---|---|---|---|---|
| | Sensitivity | Specificity | LR+ | LR- | | | | |
| **APACHE II score** | 80 | 81.14 | 4.24 | 0.25 | >7 | 0.796 | 0.079 | <0.001** |
| **APACHE II- postop mortality (%)** | 60 | 92.57 | 8.08 | 0.43 | >3 | 0.786 | 0.072 | <0.001** |
| **APACHE II- non- operative mortality (%)** | 53.3 | 91.43 | 6.22 | 0.51 | >8 | 0.751 | 0.072 | <0.001** |

*Moderately significant (P value: 0.01<p<0.05); **Strongly significant (P value: p<0.01)

**Table 8: Comparison of APACHE II score in relation to mortality.**

| APACHE II | Mortality | | Total | P value |
|---|---|---|---|---|
| | No | Yes | | |
| **Apache II score** | 4.67±3.74 | 10.07±5.28 | 5.10±4.13 | <0.001** |
| **APACHE II postoperative mortality (%)** | 2.26±2.01 | 7.40±7.42 | 2.67±3.12 | <0.001** |
| **APACHE II nonoperative mortality (%)** | 6.64±4.43 | 13.20±9.45 | 7.16±5.28 | <0.001** |

**Strongly significant (P value: p<0.01).

Table 8 shows mean APACHE score for mortality cases was 10 which is high compared to non-mortality. P value was <0.001 which is highly significant.

## DISCUSSION

It is important to point out that most of the previous investigators quoted in this study looked at different isolated aspects of intestinal obstruction and not intestinal obstruction in when comparing.

### *Age incidence of intestinal obstruction in different studies*

Our study shows peak incidence in the age group 41-50 with 40 patients (21%) which is comparable with the previous study group Souvik et al in which the incidence for age group 41-50 is almost similar to our clinical study which is 24%.[18]

### *Sex incidence*

The occurrence of intestinal obstruction was common in males=102 (54%) as compared to females=88 (46%) with male:female ratio =1.2:1 whereas in Souvik et al study, it was 4:1.[18]

### *Comparison of etiology with other studies*

Out of 190 patients, 180 patients were of dynamic type and 10 were of adynamic type (5.3%). Out of dynamic type of obstruction 152 were due to small bowel obstruction (80%) and 28 were due to large bowel obstruction (14.7%). In our study adhesions due to previous surgeries (43.2%) was the commonest cause of intestinal obstruction (Figure 1 and 2), which is comparable with the other study groups- Jahangir et al with 49%.[19] Neoplasm was the second most common cause (18.4%) which is comparable with Souvik et al study (17%).[18]

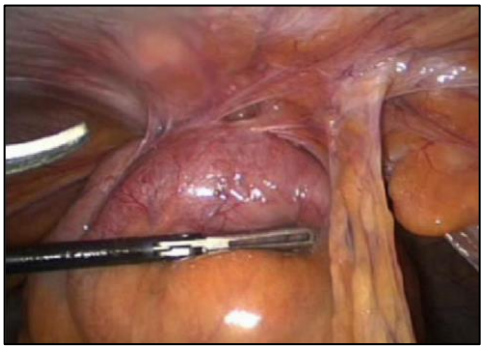

**Figure 1: Post-operative adhesions (small bowel adhered to anterior abdominal wall).**

**Figure 2: Abdominal cocoon.**

### *Management*

Majority underwent operation (111 patients, 58.4%) while only 79 were managed conservatively (41.6%). 58 underwent elective surgery (30.5%) and 53 underwent emergency operation (27.9%). Patients who had operation, majority underwent Laparotomy and stoma formation (47 patients, 24.7%). The number of operative cases were more than conservative cases as this study was conducted in a tertiary care centre where majority of cases were referral cases from other hospitals.

Out of 82 postoperative adhesions cases, 61patients (78.2%) were managed conservatively and 21 patients (18.8%) were operated. P value was <0.001 which was highly significant. Out of 6 adhesive bands cases, all were operated (3.2%). P value was 0.038 which was moderately significant.

Secondly out of 35 neoplasm patients 3 (3.8%) were managed conservatively and 32 patients (28.6%) were operated. P value was <0.001 which was highly significant. Three cases which were managed conservatively were inoperable as they were metastatic neoplasm.

Thirdly out of 18 hernias, all were operated (16.1%) as they were either obstructed or strangulated. P value was highly significant. While comparing clinical variables with management of patients studied, mean duration of symptoms for conservative cases was 3.13 and for operative cases was 6.75. P value for the same was <0.001 which was highly significant.

***Complications***

77 patients (40.5%) did not suffer from any complications preoperatively and 93 patients (48.9%) did not suffer from any complications postoperatively.

Among 113 patients (59.5%) with preop complications-majority had sepsis (80 patients, 42.1%) followed by dyselectrolytemia (66 patients, 34.7%).

Preop complications were attributed to late presentation in our hospital as this is a tertiary care hospital.

Among 97 patients (51.1%) with postop complications, majority had dyselectrolytemia (54 patients, 28.4%) followed by paralytic ileus (45 patients, 23.6%).

Postop complications were managed conservatively.

***Conversion to surgery***

Out of 82 postop adhesions cases, 61 patients (78.2%) were managed conservatively and 21 patients (18.8%) were operated. P value was <0.001 which was highly significant.

7 patients (3.7%) who were managed conservatively initially were converted to surgery following their course in hospital. And out of 7 cases, 5 postop adhesions patients (2.6%) who were managed conservatively initially were converted to surgery due to failed conservative treatment and worsening clinical parameters.

***Apache II score and mortality***

Out of 15 cases that died (7.9%), 7 cases had a neoplasm. As the malignancy was more common in the old age group and the surgeries were done to the patient with an unprepared bowel in view of emergency, it led to septicemia and resulted in death. 4 cases were managed conservatively who died due to old age with comorbidities and complications due to late presentation. Mortality rate of our study is comparable to Souvik et al at 7.35% and Jahangir et al which is 7%.[18,19]

Comparing APACHE score II to the outcome of the patients, majority of the patients came under 0-4 score with 98 patients (56%) discharged and 3 patients (20%) were declared dead. 10-14 score showed high mortality rate with 7 (46.7%) out of 19 cases were declared dead. P value was highly significant.

ROC curve analysis showed: APACHE II score-sensitivity=80%, specificity=81.14% AUC=0.796. APACHE postop mortality (%), sensitivity=60%, specificity=92.57%, AUC=0.786. APACHE non operative mortality (%)- sensitivity=53%, specificity=91.43%, AUC=0.751. P value was <0.001 for all three which is highly significant.

Comparing APACHE II score to mortality of the patients studied, mean APACHE score for mortality cases was 10 which was high compared to non-mortality. P value was <0.001 which is highly significant. Thus the present study showed a highly significant statistical difference, p value <0.001 between the observed and predicted mortality denoting that higher the apache II score, more the number of complications and more the number of deaths.

In a previous study done by Thomas et al titled "on risk stratification in emergency surgical patients: is the apache ii score a reliable marker of physiological impairment?", the APACHE score was calculated for 85 consecutive emergency surgical patients admitted to the surgical ICU in 1999 which showed p value of 0.002 which is highly significant.[20]

Another study conducted by Chen et al on "outcome of colon cancer initially presenting as colon perforation and obstruction at Tzu Chi General Hospital, Hualien, Taiwan, between 2009 and 2015 showed similar results.[21]

Limitations of study were that most studies in the current literature were based on one unit within a defined geographical location. Meta-analysis of similar studies across many different populations will aid determination of validity of the APACHE score. The score was derived in a general ICU population and may be less precise when applied to specific populations such as liver failure or HIV patients. The APACHE II score is calculated at the beginning of the ICU admission to help determine the patient's mortality risk for the admission. It is not calculated sequentially and is not meant to show improvement or effect of interventions. As such it should not be used to direct medical management. Since APACHE II was studied on patients newly admitted to the ICU, it is not accurate when dealing with patients transferred from another unit or another hospital. This is known as lead time bias and is addressed in APACHE III.

## CONCLUSION

Acute intestinal obstruction remains a commonly encountered emergency in the surgical field. It continues to be one of the most common abdominal problems faced by general surgeons. Successful treatment of acute intestinal obstruction depends largely upon early diagnosis, skillful management and treating the pathological effects of the obstruction just as much as the cause itself. Early recognition and aggressive treatment are crucial in preventing irreversible ischemia and transmural necrosis and thereby in decreasing mortality and long-term morbidity. Certain severity indicators and scoring systems can help to optimize the timing of surgery and prevent mortality. This study tries to use a severity scoring system (apache II score) to help determine the predictive mortality and compare with final outcome; hence identify the ideal time to intervene in a case of intestinal obstruction. Despite multiple recent advances in diagnostic imaging and marked advances in our treatment armamentarium, intestinal obstruction will continue to occur. Hence, our search for such severity markers is necessary to prevent delay in operative intervention and thus prevent mortality and improve outcome of patients.

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