

Original Research Article

PROGNOSTIC ROLE OF TOTAL LEUKOCYTE COUNT AND SERUM ALBUMIN IN PREDICTING SURGICAL OUTCOMES IN PATIENTS WITH PERFORATION PERITONITIS, A RETROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Perforation peritonitis is a surgical emergency characterized by massive bacterial contamination of the peritoneal cavity, leading to severe systemic inflammatory response syndrome (SIRS), septic shock, and high mortality. While comprehensive scoring systems like the Mannheim Peritonitis Index or APACHE score provide prognostic value, they are complex and frequently rely on intraoperative data, limiting their utility in hyper-acute emergency triage. There is a critical need to identify low-cost preoperative biomarkers to accurately predict the patient outcomes. This study evaluates the prognostic values of preoperative total leukocyte count (TLC) and serum albumin levels in predicting postoperative complications, duration of hospital stay, and mortality.

Materials and Methods: A retrospective observational cohort analysis was conducted on 66 acute surgical patients who underwent emergency laparotomy for perforation peritonitis. patient data, including demographics, preoperative TLC, preoperative serum albumin, and postoperative clinical outcomes (duration of hospital stay, specific complications, re-operation, and mortality), were extracted and systematically analyzed.

Results: The cohort comprised 52 males (78.8%) and 14 females (21.2%), with an overall mortality rate of 30.3% (20 deaths). Advanced age proved to be a baseline risk factor; the mean age of non-survivors was 68.65 years (range 60-95), compared to 38.91 years for survivors. Preoperative serum albumin demonstrated a binary correlation with mortality. Every non-survivor presented with severe, life-threatening hypoalbuminemia (i.e 2.6 g/dL, mean 2.06 g/dL), indicative of massive capillary leak syndrome and endothelial degradation. Conversely, survivors maintained a preserved mean albumin of 3.43 g/dL. Preoperative TLC exhibited a profound, non-linear bimodal distribution relative to mortality. While functional leukocytosis (mean 13,293 cells/mm³) correlated heavily with survival, non-survivors presented with either extreme hyper-inflammatory leukocytosis (> 20,000 cells/mm³) or profound sepsis-induced leukopenia (< 4,000 cells/mm³), denoting complete bone marrow exhaustion. The duration of hospital stay was also paradoxically bimodal; non-survivors died rapidly within 1 to 3 days (mean 1.9 days) to primary systemic morbidities like septic shock and acute kidney injury. In contrast, survivors endured significantly prolonged hospitalizations (mean 19.34 days) dominated by secondary, localized morbidities including paralytic ileus, severe anemia, and wound infections.

Conclusions: In the setting of perforation peritonitis, preoperative serum albumin and total leukocyte count transcend their roles as standard laboratory indices, acting as critical, real-time parameters of endothelial integrity and immunological competence. The combination of severe hypoalbuminemia (i.e 2.6 g/dL) and extremes of TLC (hyper-inflammation or catastrophic leukopenia) in elderly patients identifies a physiological death. The utilization of these simple, inexpensive biomarkers facilitates instantaneous risk stratification at the moment of admission, mandating early goal-directed intensive care resuscitation prior to surgical source control.

Keywords: Perforation Peritonitis; Serum Albumin; Total Leukocyte Count; Hypoalbuminemia; Leukopenia; Emergency Laparotomy; Sepsis; Prognostic Biomarkers.

INTRODUCTION

Perforation peritonitis is one of the most common surgical emergencies in developing countries, resulting from a breach in the gastrointestinal tract that leads to contamination of the peritoneal cavity. It typically presents with acute abdominal pain, sepsis, and hemodynamic instability.

Despite advancements in surgical techniques and critical care, the condition continues to carry a high risk of morbidity and mortality, particularly when diagnosis or intervention is delayed. Early identification of prognostic markers can significantly influence clinical decision-making, patient stratification, and outcome prediction.

Among routinely available laboratory parameters, total leukocyte count (TLC) serves as an indicator of systemic inflammatory response, while serum albumin reflects the nutritional and physiological reserve of the patient.

An elevated TLC is associated with poor outcomes, while hypoalbuminemia correlates with increased morbidity, prolonged hospital stay, and higher mortality. Both markers are inexpensive, easily accessible, and may provide critical prognostic insights in emergency settings.

While comprehensive scoring systems like the Mannheim Peritonitis Index or APACHE score provide prognostic value, they are complex and frequently rely on intraoperative data, limiting their utility in hyper-acute emergency triage. There is a critical need to identify low-cost preoperative biomarkers to accurately predict the patient outcomes. This study evaluates the prognostic values of preoperative total leukocyte count (TLC) and serum albumin levels in predicting postoperative complications, duration of hospital stay, and mortality.

Review of Literature

Perforation peritonitis remains one of the most common causes of emergency laparotomy in developing countries and continues to be associated with considerable morbidity and mortality despite advances in surgical techniques, antibiotics, and intensive care. Mortality rates reported in the literature range from 10% to 40%, depending on the patient's age, delay in presentation, physiological status, and the severity of sepsis.

Early identification of high-risk patients enables prompt resuscitation, intensive monitoring, and timely surgical intervention. Several prognostic scoring systems have therefore been developed to predict outcomes.

The Mannheim Peritonitis Index, introduced by Wacha and Linder, is among the most widely accepted scoring systems for secondary peritonitis. It incorporates factors including age, organ failure, malignancy, duration of perforation, origin of sepsis, and nature of peritoneal contamination. Studies by Notash et al. and Demmel et al. demonstrated that MPI scores greater than 26 are associated with significantly higher mortality. However, MPI requires intraoperative findings and therefore has limited utility during the initial emergency assessment.

The APACHE II scoring system has also been extensively used in critically ill surgical patients. Bosscha et al. and Rogy et al. reported that APACHE II accurately predicts mortality in peritonitis but requires multiple physiological variables, making it relatively cumbersome in emergency settings. Similarly, the POSSUM and P-POSSUM scoring systems provide good predictive accuracy but require detailed physiological and operative parameters.

Serum albumin is synthesized by the liver and serves as an indicator of nutritional status, systemic inflammation, and endothelial integrity. During sepsis, increased capillary permeability results in albumin leakage into the extravascular space, leading to hypoalbuminemia.

Hypoalbuminemia has consistently been associated with increased postoperative complications, Surgical site infections,

Delayed wound healing, Prolonged hospital stay and Increased mortality

Rai et al. (2022) evaluated emergency laparotomy patients with perforation peritonitis and reported that low preoperative serum albumin significantly predicted postoperative ICU admission, complications, and 30-day mortality. Patients with albumin levels below 3 g/dL had markedly worse outcomes.

Similarly, Moller et al. identified hypoalbuminemia as one of the strongest independent predictors of mortality in perforated peptic ulcer disease.

The total leukocyte count reflects the systemic inflammatory response to infection. Leukocytosis develops because of cytokine-mediated bone marrow stimulation during bacterial infection. Conversely, profound leukopenia reflects severe sepsis with bone marrow exhaustion and impaired immune response.

Singh et al. (2011) studied preoperative predictors of mortality in perforation peritonitis and identified Leukocyte count $>20,000/\text{mm}^3$ or Leukocyte count $<4,000/\text{mm}^3$, Advanced age, Hypotension,

Elevated serum creatinine as significant predictors of mortality. Their study demonstrated that both marked leukocytosis and leukopenia are associated with poor outcomes, suggesting a U-shaped relationship between TLC and mortality.

Jhobta et al. (2006) reviewed 504 consecutive cases of perforation peritonitis in India and reported peptic ulcer perforation as the commonest cause. Delay in surgery, advanced age, and septic shock significantly increased mortality.

Gupta and Kaushik (2006) emphasized that perforation peritonitis in developing countries differs from Western populations because upper gastrointestinal perforations predominate, while colonic perforations are relatively uncommon.

Afridi et al. (2008) reported similar findings in Pakistan and concluded that delayed presentation remains the principal determinant of adverse outcomes

Several investigators have highlighted the importance of simple laboratory parameters in predicting outcomes. Unlike complex scoring systems requiring operative findings or numerous biochemical variables, serum albumin and TLC are inexpensive, rapidly available, routinely performed, reproducible, suitable for emergency triage. Their combined use provides valuable prognostic information before surgery and facilitates early aggressive resuscitation, intensive care planning, and counselling of patients and relatives.

Although numerous studies have validated complex prognostic indices such as MPI, APACHE II, and PULP scores, there is limited evidence regarding the combined prognostic significance of preoperative serum albumin and total leukocyte count in perforation peritonitis, particularly in Indian tertiary care hospitals. Therefore, evaluating these simple, inexpensive biomarkers may provide an effective

alternative for early risk stratification in emergency surgical practice.

MATERIALS AND METHODS

A retrospective observational study was conducted at the Department of General Surgery, Government Villupuram Medical College and Hospital. Following Institutional Ethics Committee approval, 66 consecutive adult patients presenting with perforation peritonitis and scheduled for emergency laparotomy were studied. Patients aged 18 years and above with complete medical and follow-up records were included. Patients were explicitly excluded if they had pre-existing conditions known to alter the primary biomarkers (e.g., chronic liver disease, nephrotic syndrome, hematological malignancies), were on immunosuppressive therapy, or were pregnant.

Patient data were extracted from hospital medical records and operation theatre registers without direct patient contact. The parameters studied included demographic details (age, sex), preoperative laboratory investigations (specifically TLC and serum albumin), and postoperative outcomes. Postoperative clinical endpoints evaluated included the duration of hospital stay, the incidence of specific morbidities (such as septic shock, acute kidney injury, wound infection, and paralytic ileus), surgical re-exploration, and 30-day in-hospital mortality.

Statistical compilation and data cleaning were performed utilizing Microsoft Excel, while definitive analysis was executed via SPSS version 21. Data were summarized using means, and associations between preoperative biomarkers and binary clinical outcomes (survival vs. non-survival) were systematically analyzed to identify independent predictors of mortality.

RESULTS

Out of the 66 patients studied, 52 (78.8%) were males and 14 (21.2%) were females. The overall mortality rate within the cohort was 30.3% (20 patients). Advanced age proved to be a critical determinant of survival; the mean age of the survivors was 38.91 years, compared to a significantly elevated 68.65 years in the non-survivor group.

Table 1: Demographic Characteristics and Mortality (n = 66)

Variable	Number of Patients	Percentage
Total Patients	66	100
Males	52	78.8
Females	14	21.2
Survivors	46	69.7
Non-survivors	20	30.3

Preoperative serum albumin demonstrated a stark, binary correlation with mortality. Every non-survivor presented with profound preoperative

hypoalbuminemia, with levels ≤ 2.6 g/dL and a calculated mean of 2.06 g/dL. In absolute contrast,

the survivor cohort exhibited largely preserved albumin levels with a mean of 3.43 g/dL. Analysis of the preoperative Total Leukocyte Count (TLC) revealed a highly bimodal distribution relative to mortality. The surviving cohort predominantly exhibited a moderate, functional leukocytosis with a mean of 13,293 cells/mm³. The non-surviving cohort, while possessing a higher arithmetic mean (18,235 cells/mm³), was divided into two extreme phenotypes: severe hyper-inflammatory leukocytosis (> 20,000 cells/mm³) or catastrophic, sepsis-induced leukopenia (< 4,000 cells/mm³). Every patient presenting with leukopenia (< 4,000 cells/mm³) died rapidly within 1 to 2 days of admission.

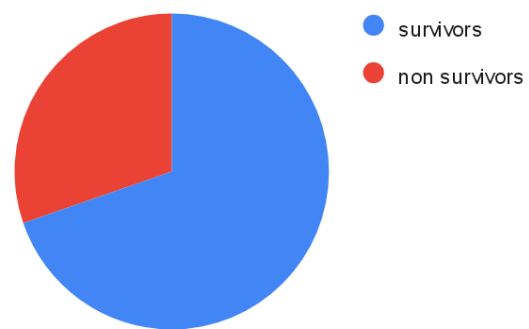


Chart 1: 46 Survivors 20 Non survivors

Table 2: Preoperative Total Leukocyte Count (TLC) and Outcome

Parameter	Survivors (n = 46)	Non-survivors (n = 20)
Mean TLC (cells/mm ³)	13,293	18,235
Predominant TLC Pattern	Moderate leukocytosis	Severe leukocytosis (>20,000) or leukopenia (<4,000)

Table 3: Major Postoperative Complications Among Survivors (n = 46)

Complication	Number of Patients
Severe anaemia	15
Wound infection	11
Paralytic ileus	8
Other complications	12

Table 4: Hospital Stay According to Outcome

Outcome	Mean Hospital Stay (Days)
Survivors (n = 46)	19.3
Non-survivors (n = 20)	1.9

Table 5: Causes of Mortality Among Non-Survivors (n = 20)

Cause of Death	Number of Patients
Septic shock	11
Acute kidney injury	4
Other causes (ARDS, MODS cardiac events, etc.)	5

Table 6: Major Postoperative Complications Among Survivors (n = 46)

Complication	Number of Patients
Severe anaemia	15
Wound infection	11
Paralytic ileus	8
Other complications	12

The duration of hospital stay was paradoxically inverted. Non-survivors exhibited exceptionally short admissions (mean 1.9 days), indicating presentation in irreversible shock, succumbing rapidly to systemic complications such as Septic Shock (11 cases) and Acute Kidney Injury (4 cases). Survivors, conversely, endured prolonged hospitalizations (mean 19.34 days) to recover from secondary, localized morbidities including wound infections (11 cases), paralytic ileus (8 cases), and severe anemia (15 cases).

DISCUSSION

Perforation peritonitis remains a frequently encountered and highly lethal surgical emergency, primarily affecting male patients and carrying immense systemic physiological consequences. While literature such as Singh et al. reported a baseline mortality rate of 17.86%, our cohort exhibited an elevated mortality rate of 30.3%. This elevation is directly attributable to the extreme advanced age distribution and profound biochemical derangement observed within our deceased cohort, confirming that age serves as the ultimate, unmodifiable baseline risk factor. Singh et al. similarly noted a near 20-year age gap between

survivors and non-survivors (36.52 years vs 56.2 years).

Survivors and Non-Survivors

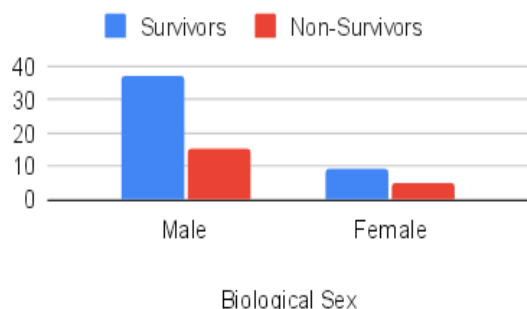


Chart 2: Mortality based on sex

The dataset firmly establishes preoperative serum albumin not merely as a nutritional marker, but as a critical, real-time barometer of endothelial integrity and capillary leak syndrome. The universal presence of severe hypoalbuminemia (≤ 2.6 g/dL) in the non-survivor cohort fundamentally aligns with the findings of Rai et al., who concluded that a reduced mean albumin level (2.89 ± 0.77 g/dL) was significantly associated with 30-day postoperative mortality and the necessity for intensive care admission.

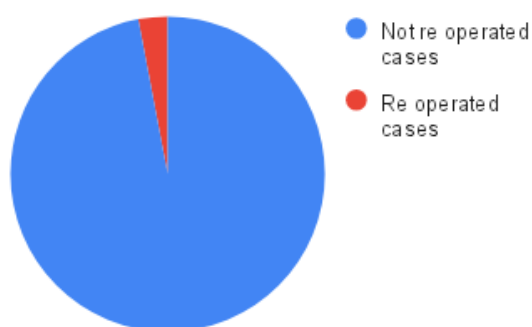


Chart 3: - 3% cases are re operated

Furthermore, the analysis forces a paradigm shift in the interpretation of Total Leukocyte Count. While general clinical intuition often correlates a higher TLC with worse outcomes, our granular analysis validates the findings of Singh et al., who explicitly included profound leukopenia ($< 4000/\text{cumm}$) as a definitive marker of severe sepsis. Our data proves that TLC follows a U-shaped prognostic curve. Both massive hyper-inflammatory leukocytosis (signifying a cytokine storm) and severe leukopenia (signifying terminal bone marrow exhaustion) are highly lethal presentations, guaranteeing rapid mortality.

Total Patients, Survivors and Non-Survivors

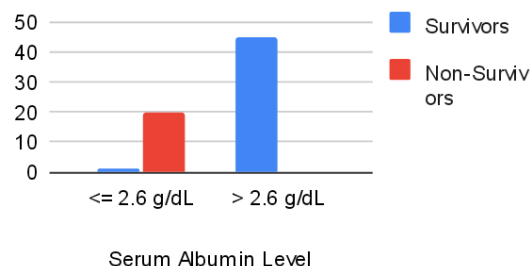


Chart 4: Serum Albumin levels and mortality

The morbidities observed perfectly reflect the temporal outcomes of the surgical delay. Non-survivors succumbed within 1 to 3 days to primary systemic collapse, notably Septic Shock and Acute Kidney Injury (AKI). This matches the conclusions of Rai et al. and Singh et al., who identified azotaemia, hypotension, and shock at presentation as powerful, independent predictors of early mortality. Prolonged hospital stays among survivors were necessitated by secondary morbidities like paralytic ileus and wound infections, which, while resource-intensive, denote successful physiological salvage.

CONCLUSION

There are various indices utilized to predict morbidity and mortality due to sepsis, but few are specifically tailored to the preoperative parameters of perforation peritonitis. This study concludes that preoperative serum albumin and total leukocyte count are powerful, independent predictors of mortality. Advanced age, combined with severe hypoalbuminemia (≤ 2.6 g/dL) and extremes of TLC (leukopenia or extreme leukocytosis), identifies patients trapped in an irreversible physiological trajectory. Recognizing these specific laboratory derangements early enables clinicians to perform accurate risk stratification and institute aggressive, early goal-directed therapy prior to surgical intervention.

REFERENCES

1. Singh R, Kumar N, Bhattacharya A, Vajifdar H. Preoperative predictors of mortality in adult patients with perforation peritonitis. *Indian J Crit Care Med.* 2011;15(3):157-163.
2. Rai A, Huda F, Kumar P, David LE, Chezian S, Basu S, Singh S. Predictors of Postoperative Outcome in Emergency Laparotomy for Perforation Peritonitis; a Retrospective Cross-sectional Study. *Arch Acad Emerg Med.* 2022;10(1):e86.
3. Gupta S, Kaushik R. Peritonitis - the Eastern experience. *World J Emerg Surg.* 2006;1:13. Ghosh PS, Mukherjee R, Sarkar S, Halder SK, Dhar D. Epidemiology of Secondary Peritonitis: Analysis of 545 Cases. *Int J Sci Study.* 2016;3(12):80-85.
4. Schein M. Surgical management of intra-abdominal infection: is there any evidence? *Langenbecks Arch Surg.* 2002;387(1):1-7.

5. Chatterjee AS. POSSUM: A Scoring System for Perforative Peritonitis. *J Clin Diagn Res.* 2015;9(4):PC05-PC09.
6. Ramakrishnan K, Salinas RC. Peptic Ulcer disease. *Am Fam Physician* 2007;1:1005-12.
7. Jhobta RS, Attri AK, Kaushik R, Sharma R, Jhobta A. Spectrum of perforation peritonitis in India-review of 504 consecutive cases. *World J Emerg Surg* 2006;1:26.
8. Ersumo T, W/Meskel Y, Kotisso B. Perforated peptic ulcer in Tikur Anbessa Hospital; a review of 74 cases. *Ethiop Med J* 2005;43:9-13.
9. Külah B, Gülgez B, Ozmen MM, Ozer MV, Coşkun F. Emergency bowel surgery in the elderly. *Turk J Gastroenterol* 2003;14:189-93.
10. Seo HJ, Park HK, Park YH, Lee HK, Lee WG, Cho SY, et al. Prognostic factors in duodenal ulcer perforation. *J Korean Surg Soc* 2001;60:425-31.
11. Kocer B, Sürmeli S, Solak C, Unal B, Bozkurt B, Yildirim O, et al. Mortality and Morbidity - Patients With Peptic Ulcer Perforation. *J Gastroenterol Hepatol* 2007;22:565-70.
12. Vorwerk C, Loryman B, Coats TJ, Stephenson JA, Gray LD, Reddy G, et al. Prediction of mortality in adult emergency department patients with sepsis. *Emerg Med J* 2009;26:254-8.
13. Mikkelsen ME, Miliades AN, Gaieski DF, Goyal M, Fuchs BD, Shah CV, et al. Serum lactate is associated with mortality in severe sepsis independent of organ failure and shock. *Crit Care Med* 2009;37:1670-7.
14. Joynt GM, Lipman J, Gomersall CD, Tan I, Scribante J. Gastric intramucosal pH and blood lactate in severe sepsis. *Anesthesia* 1997;52:726-32.
15. Notash AY, Salimi J, Rahimian H, Fesharaki MS, Abbasi A. Evaluation of Mannheim peritonitis index and multiple organ failure score in patients with peritonitis. *Indian J Gastroenterol* 2005;24:197-200.
16. Bosscha K, Reijnders K, Hulstaert PF, Algra A, van der Werken C. Prognostic scoring systems to predict outcome in peritonitis and intra abdominal sepsis. *Br J Surg* 1987;4:1532-4.
17. Rogy M, Függer R, Schemper M, Koss G, Schulz F. The value of two distinct prognosis score in patients with peritonitis. The Mannheim Peritonitis Index versus the APACHE Score. *Chirurg* 1990;61:297-300.
18. Lee FY, Leung KL, Lai BS, Ng SS, Dexter S, Lau WY. Predicting Mortality and morbidity of patients operated on for perforated peptic ulcers. *Arch Surg* 2001;136:90-4.
19. Boey J, Choi SK, Poon A, Alagaratnam TT. Risk stratification in perforated duodenal ulcer: A prospective validation of predictive factors. *Ann Surg* 1987;205:22-6.
20. Mäkelä JT, Kiviniemi H, Ohtonen P, Laitinen SO. Factors that predict morbidity and mortality in patients with perforated peptic ulcers. *Eur J Surg* 2002;168:446-51.
21. Riché F, Panis Y, Laisné MJ, Briard C, Cholley B, Bernard-Poenaru O, et al. High tumor necrosis factor serum level is associated with increased survival in patients with abdominal septic shock: A prospective study in 59 patients. *Surgery* 1996;120:801-7.
22. McIntyre R, Reinbach D, Cushieri RJ. Emergency abdominal surgery in the elderly. *J R Coll Surg Edinb* 1997;42:173-8.
23. Afridi SP, Malik F, Rahman S, Shamim S, Samo KA. Spectrum of perforation peritonitis in Pakistan: 300 cases Eastern experience. *World J Emerg Surg* 2008;3:31.
24. Meregalli A, Oliveira RP, Friedman G. Occult hypoperfusion is associated with increased mortality in hemodynamically stable, highrisk, surgical patients. *Crit Care* 2004;8:R60-5.
25. Pacelli F, Doglietto GB, Alfieri S, Piccioni E, Sgadari A, Gui D, et al. Prognosis in intra abdominal infections. Multivariate analysis on 604 patients. *Arch Surg* 1996;131:641-5.
26. Irvin TT. Mortality and perforated peptic ulcer: a case for risk stratification in elderly patients. *Br J Surg.* 1989;76:215-18. doi: 10.1002/bjs.1800760304.
27. Moller MH, Engebjerg MC, Adamsen S, Bendix J, Thomsen RW. The Peptic Ulcer Perforation (PULP) score: a predictor of mortality following peptic ulcer perforation. A cohort study. *Acta anaesthesiologica Scandinavica.* 2012;56(5):655-62. doi: 10.1111/j.1399-6576.2011.02609.x.
28. Moller MH, Adamsen S, Thomsen RW, Moller AM. Preoperative prognostic factors for mortality in peptic ulcer perforation – a systematic review. *Scand J Gastroenterol.* 2010;45:785-805. doi: 10.3109/00365521003783320.
29. Moller MH, Shah K, Bendix J, Jensen AG, Zimmermann-Nielsen E, Adamsen S, Moller AM. Risk factors in patients surgically treated for peptic ulcer perforation. *Scand J Gastroenterol.* 2009;44:145-52. doi: 10.1080/00365520802401261.
30. Demmel N, Maag K, Osterholzer G. The value of clinical parameters for determining the prognosis of peritonitis-validation of the Mannheim Peritonitis Index. *Langenbecks Arch Chir.* 1994;379(3):152-58. doi: 10.1007/BF00680111.
31. Notash AY, Salimi J, Rahimian H, Fesharaki MS, Abbasi A. Evaluation of Mannheim peritonitis index and multiple organ failure score in patients with peritonitis. *Indian Journal of Gastroenterology.* 2005;24(5):197.