Risk-Score–Based Diagnosis of SBP in Cirrhosis: Mansoura Scoring System Versus Absolute Neutrophil Count

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Received: 28 October 2024, **Accepted:** 17 November 2024, **Published:** 20 November 2024

Abstract

Background: Spontaneous bacterial peritonitis (SBP) remains a frequent and life-threatening complication of liver cirrhosis, contributing substantially to morbidity, mortality, and health care utilization. Early diagnosis is critical, as prompt initiation of empirical antibiotics significantly improves outcomes. For decades, the diagnosis of SBP has relied primarily on an ascitic fluid polymorphonuclear neutrophil (PMN) count ≥250 cells/mm³, often referred to clinically as the absolute neutrophil count (ANC). While this threshold is simple and widely accepted, it has important limitations, including reduced sensitivity in early infection, variability due to sampling and laboratory factors, and inability to account for systemic clinical context. In response to these shortcomings, composite diagnostic tools such as the Mansoura Scoring System have been developed, integrating clinical, laboratory, and inflammatory parameters to enhance diagnostic accuracy.

Aim: This review aims to critically evaluate risk-score–based diagnosis of SBP in patients with liver cirrhosis, with a specific focus on comparing the Mansoura Scoring System to the conventional ANC-based diagnostic approach. From an internal medicine perspective, the review explores the pathophysiological rationale, diagnostic performance, and clinical applicability of both strategies, highlighting their strengths and limitations in real-world practice.

Conclusion: The traditional ANC threshold remains a cornerstone in SBP diagnosis due to its simplicity and strong guideline endorsement; however, it does not fully capture the complexity of SBP presentation in cirrhotic patients. Risk-score–based approaches, exemplified by the Mansoura Scoring System, offer a more holistic diagnostic framework by incorporating systemic inflammatory markers and clinical variables alongside ascitic fluid analysis. Emerging evidence suggests that such composite scores may improve early detection, particularly in patients with atypical presentations, culture-negative SBP, or advanced liver dysfunction. While further external validation and standardization are required before widespread adoption, risk-score–based diagnostic models represent a promising step toward more individualized and timely diagnosis of SBP in cirrhosis. Integrating these tools into clinical practice may ultimately enhance decision-making, facilitate earlier treatment, and improve patient outcomes.

Keywords: *SBP, Cirrhosis, Mansoura Scoring System , Absolute Neutrophil Count*

Introduction

Spontaneous bacterial peritonitis (SBP) is one of the most serious infectious complications encountered in patients with liver cirrhosis and ascites. It represents a manifestation of immune dysfunction, bacterial translocation, and impaired host defenses that accompany advanced chronic liver disease. Despite advances in cirrhosis management, SBP continues to be associated with high short-term mortality, prolonged hospitalization, and increased risk of hepatorenal syndrome and acute-on-chronic liver failure. Early recognition and prompt initiation of empirical antibiotic therapy are critical determinants of survival, making accurate and timely diagnosis a central concern in internal medicine and hepatology practice [1].

Traditionally, the diagnosis of SBP has been based on the ascitic fluid polymorphonuclear neutrophil (PMN) count, with a threshold of ≥250 cells/mm³ considered diagnostic, irrespective of ascitic fluid culture results. This criterion, endorsed by major international guidelines, was designed to prioritize sensitivity and facilitate rapid bedside decision-making. However, reliance on the absolute neutrophil count (ANC) alone has notable limitations, particularly in patients with early infection, prior antibiotic exposure, hemorrhagic ascites, or severe immune dysfunction. Moreover, ascitic fluid analysis provides limited insight into the systemic inflammatory response and clinical context that often accompany SBP in cirrhotic patients [2].

In recent years, increasing attention has been directed toward composite diagnostic models and risk-based scoring systems that integrate laboratory markers, clinical features, and inflammatory parameters. Such approaches reflect a broader shift in internal medicine toward multidimensional risk stratification rather than dependence on a single laboratory cutoff. In the setting of SBP, these models aim to improve diagnostic accuracy, reduce delays in treatment, and identify high-risk patients who may benefit from early intervention even when classical diagnostic thresholds are not met [3].

The Mansoura Scoring System represents one such risk-score–based approach, developed to enhance SBP diagnosis by combining ascitic fluid findings with systemic inflammatory and biochemical markers. While preliminary studies suggest that this scoring system may outperform ANC alone in certain clinical scenarios, its role relative to established diagnostic standards remains incompletely defined. The primary aim of this review is to critically examine the rationale, performance, and clinical implications of the Mansoura Scoring System compared with the conventional ANC-based approach, highlighting the existing evidence, unresolved controversies, and research gaps relevant to internists managing cirrhotic patients with suspected SBP [4].

Pathophysiology of Spontaneous Bacterial Peritonitis in Liver Cirrhosis

Spontaneous bacterial peritonitis develops as a consequence of profound pathophysiological alterations associated with advanced liver cirrhosis, particularly portal hypertension and cirrhosis-associated immune dysfunction. Increased portal pressure leads to intestinal congestion, mucosal edema, and disruption of the gut barrier, facilitating bacterial translocation from the intestinal lumen to mesenteric lymph nodes and systemic circulation. This process is further amplified by qualitative and quantitative changes in gut microbiota, favoring pathogenic organisms. Once bacteria or bacterial products reach the ascitic fluid, the impaired local immune defense in cirrhotic patients predisposes to uncontrolled infection and inflammation within the peritoneal cavity [5].

Cirrhosis is characterized by a state of immune paresis despite chronic systemic inflammation, commonly referred to as cirrhosis-associated immune dysfunction syndrome. This paradoxical condition involves defective neutrophil chemotaxis, phagocytosis, and oxidative burst, as well as impaired complement activity in ascitic fluid. Consequently, even low bacterial inocula may trigger SBP, while the inflammatory cellular response may be blunted or delayed. This altered immune response partially explains why some patients with clinically significant SBP present with ascitic neutrophil counts below the conventional diagnostic threshold, challenging reliance on ANC alone [6].

Systemic inflammation plays a pivotal role in the progression and clinical severity of SBP. Bacterial translocation and peritoneal infection lead to the release of pathogen-associated molecular patterns, triggering cytokine cascades involving tumor necrosis factor-α, interleukin-6, and other pro-inflammatory mediators. These inflammatory signals contribute not only to local peritoneal inflammation but also to systemic circulatory dysfunction, vasodilation, and activation of neurohormonal pathways. The resulting hemodynamic instability increases the risk of renal impairment, acute-on-chronic liver failure, and mortality, underscoring the importance of early identification of infection beyond ascitic fluid cell counts [7].

Given the multifactorial nature of SBP pathogenesis, it is increasingly evident that a single laboratory parameter cannot fully reflect disease presence or severity. Ascitic fluid neutrophil count captures only one aspect of the host response, while neglecting systemic inflammation, organ dysfunction, and biochemical derangements that often precede overt peritonitis. This pathophysiological complexity provides a strong rationale for composite diagnostic tools such as the Mansoura Scoring System, which aim to integrate multiple dimensions of SBP biology into a clinically actionable framework [8].

Diagnostic Standards for Spontaneous Bacterial Peritonitis and Limitations of Absolute Neutrophil Count

The diagnosis of spontaneous bacterial peritonitis has historically been standardized around ascitic fluid analysis, with particular emphasis on the polymorphonuclear neutrophil count. An ascitic PMN count of ≥250 cells/mm³ is widely accepted as the diagnostic cutoff for SBP, regardless of culture results, and remains strongly endorsed by international hepatology guidelines. This approach was designed to maximize diagnostic sensitivity and allow rapid initiation of empirical antibiotics, recognizing the time-sensitive nature of SBP management in cirrhotic patients. From an internal medicine perspective, this criterion has provided a practical and reproducible bedside tool across diverse clinical settings [9].

Despite its widespread adoption, reliance on absolute neutrophil count as a solitary diagnostic parameter has several inherent limitations. The PMN response in cirrhosis is often impaired due to dysfunctional neutrophil activity and reduced chemotaxis, which may result in falsely low ascitic neutrophil counts during early or evolving infection. Additionally, prior or ongoing antibiotic exposure can suppress neutrophil recruitment without eradicating infection, leading to underdiagnosis. Technical factors, including delayed sample processing, dilution in large-volume ascites, and blood contamination, may further compromise the accuracy and reliability of ANC measurement [10].

Another important limitation of the ANC-based approach is its inability to account for systemic inflammatory and clinical features that frequently accompany SBP. Patients may present with fever, encephalopathy, renal dysfunction, or hemodynamic instability before ascitic fluid neutrophil counts reach diagnostic thresholds. In such cases, exclusive dependence on ANC may delay treatment initiation, potentially worsening outcomes. This limitation is particularly relevant in hospitalized patients with advanced cirrhosis, where nonspecific clinical deterioration may be the earliest manifestation of infection [11].

Furthermore, the traditional diagnostic framework does not adequately address the heterogeneity of SBP presentations, including culture-negative neutrocytic ascites and bacterascites. While these entities are recognized within current definitions, their management remains challenging, and clinical judgment often supersedes rigid cutoff values. The growing recognition of these diagnostic gray zones has prompted interest in more nuanced, risk-based diagnostic strategies that incorporate biochemical markers, inflammatory indices, and clinical variables. These considerations have laid the groundwork for the development and evaluation of composite tools such as the Mansoura Scoring System, which seek to overcome the shortcomings of ANC-centered diagnosis [12].

Conceptual Basis of Risk-Score–Based Diagnosis in Spontaneous Bacterial Peritonitis

Risk-score–based diagnostic models have emerged in internal medicine as tools to address the complexity and heterogeneity of disease presentation, particularly in conditions where reliance on a single laboratory parameter is insufficient. In SBP, this approach is conceptually grounded in the understanding that infection in cirrhotic patients is a systemic process involving immune dysregulation,

inflammatory activation, and multiorgan interaction rather than an isolated peritoneal event. Risk scores aim to integrate these dimensions into a unified framework, allowing clinicians to estimate disease probability more accurately and initiate timely management even in diagnostically ambiguous scenarios [13].

The theoretical advantage of composite scoring systems lies in their ability to combine ascitic fluid findings with systemic inflammatory markers and routine biochemical parameters. Variables such as serum inflammatory indices, renal function markers, and liver synthetic capacity reflect host response and disease severity, offering additional diagnostic signals beyond neutrophil count alone. In cirrhosis, where immune dysfunction may blunt local inflammatory responses, these systemic markers can provide early clues to infection, particularly when ascitic fluid analysis yields borderline or nondiagnostic results [14].

Risk-score–based approaches also align with contemporary internal medicine principles of stratified and individualized care. Rather than dichotomizing patients into "SBP" or "no SBP" based solely on an arbitrary cutoff, scoring systems generate a gradient of risk that may guide clinical decision-making. This is especially relevant in patients with advanced cirrhosis, acute decompensation, or multiple comorbidities, where the consequences of delayed antibiotic therapy are substantial. By contextualizing ascitic neutrophil counts within a broader clinical picture, risk scores may reduce diagnostic uncertainty and support earlier intervention [15].

Importantly, the adoption of diagnostic risk scores requires careful validation to ensure reproducibility, simplicity, and clinical relevance. An effective scoring system must rely on readily available parameters, demonstrate superiority or complementary value to existing standards, and maintain high sensitivity to avoid missed diagnoses. These principles underpin the development of the Mansoura Scoring System, which was designed to enhance SBP detection by incorporating objective laboratory and inflammatory markers alongside ascitic fluid analysis. Understanding this conceptual foundation is essential before evaluating its components and performance relative to the traditional ANC-based approach [16].

Mansoura Scoring System: Components, Development, and Rationale

The Mansoura Scoring System was developed as a pragmatic diagnostic tool aimed at improving early detection of spontaneous bacterial peritonitis in patients with liver cirrhosis by integrating multiple objective parameters into a single score. The system was conceived in response to the recognized limitations of ascitic fluid neutrophil count alone, particularly in patients with atypical or early presentations of SBP. Its development reflects an internal medicine–oriented approach that emphasizes the interaction between local infection, systemic inflammation, and organ dysfunction in cirrhotic patients [17].

The components of the Mansoura Scoring System typically include a combination of ascitic fluid indices and serum laboratory markers that are routinely available in clinical practice. These variables were selected based on their pathophysiological relevance to infection and cirrhosis severity, as well as their statistical association with SBP in derivation cohorts. By incorporating both local and systemic markers, the score aims to capture the broader biological footprint of SBP rather than relying solely on peritoneal neutrophil recruitment, which may be impaired in cirrhosis [18].

From a mechanistic standpoint, the rationale behind the Mansoura score lies in recognizing SBP as a manifestation of systemic immune dysregulation rather than a purely localized infection. Parameters reflecting inflammation, hepatic synthetic dysfunction, and renal impairment serve as indirect indicators of infection-related stress on the cirrhotic host. This multidimensional approach aligns with current understanding of SBP as a trigger for acute decompensation and acute-on-chronic liver failure, conditions in which systemic responses may precede or outweigh local ascitic findings [19].

An additional strength of the Mansoura Scoring System is its emphasis on clinical feasibility. The score was designed to be easily calculated at the bedside without reliance on specialized assays or advanced imaging. This practicality is particularly relevant in resource-limited settings and busy internal medicine wards, where rapid decision-making is essential. By providing a quantitative risk estimate, the score supports clinicians in identifying patients who may benefit from early empirical therapy or closer

monitoring, even when conventional ANC thresholds are not met [20].

Comparative Diagnostic Performance of Mansoura Scoring System Versus Absolute Neutrophil Count

Absolute neutrophil count in ascitic fluid (PMN ≥250 cells/mm³) remains the guideline-endorsed diagnostic standard for SBP because it is simple, rapid, and generally sensitive for clinically meaningful infection. Its practical strength is that it directly reflects peritoneal neutrophilic inflammation and provides an immediate trigger for empirical antibiotics without waiting for culture results. However, in real-world internal medicine practice, diagnostic uncertainty arises when patients are clinically deteriorating yet have borderline ascitic PMN counts, when sampling occurs early in the infectious course, or when confounders (e.g., hemorrhagic ascites or pre-treatment with antibiotics) affect test interpretation and downstream decisions. [21]

The Mansoura simple scoring system was proposed to improve diagnostic discrimination by combining readily available systemic inflammatory and hematologic indices with age, thereby translating "probability of SBP" into a bedside score rather than a single cutoff. In its derivation work, the score (built from age, mean platelet volume, neutrophil-to-lymphocyte ratio, and C-reactive protein with weighted points) demonstrated high diagnostic performance and clinically appealing thresholds for ruling in and ruling out SBP, suggesting it may reduce missed cases when ascitic PMN results are equivocal or delayed. This framework is particularly relevant to cirrhosis, where immune dysfunction may blunt local neutrophil recruitment, while systemic inflammation and acute decompensation features may be prominent. [22]

External validation is essential before any scoring system can be trusted across populations with different etiologies of cirrhosis, comorbidity profiles, microbiologic patterns, and health-system practices. A subsequent validation study supported good overall discrimination of the Mansoura score and reinforced the clinical usefulness of higher cutoffs for "rule-in" decisions and lower cutoffs for "rule-out" decisions, indicating that the tool may have value as an adjunct to standard ascitic fluid testing. From an internal medicine standpoint, this suggests potential utility in triage settings (emergency/ward) where rapid risk stratification can influence early antibiotic initiation, monitoring intensity, and timely escalation of care. [23]

Comparatively, the key conceptual difference is that ANC is a "local inflammation threshold," whereas the Mansoura score is a "multisystem risk signal" that may capture infection biology even when peritoneal neutrophilia is less pronounced. The most clinically defensible role for a composite score, based on current evidence, is not to replace diagnostic paracentesis but to complement it—supporting decisions when ANC is borderline, when systemic inflammatory response is disproportionate to ascitic findings, or when delays in lab turnaround could postpone treatment. This complementary strategy aligns with how contemporary practice guidance frames SBP diagnosis and emphasizes early paracentesis plus prompt treatment in suspected infection. [24]

Clinical Applicability and Decision-Making Pathways: Using Mansoura Score Alongside ANC at the Bedside

In day-to-day internal medicine practice, the safest diagnostic pathway for suspected SBP continues to start with **early diagnostic paracentesis** in any hospitalized cirrhotic patient with ascites and clinical deterioration (e.g., fever, abdominal pain/tenderness, encephalopathy, renal dysfunction, hypotension, leukocytosis, or otherwise unexplained decompensation). Ascitic fluid testing should include at minimum PMN count and culture, and management should prioritize **rapid antibiotic initiation when SBP is suspected**, rather than waiting for culture confirmation. This "paracentesis-first" principle remains essential because SBP can present with nonspecific systemic findings, and delays are clinically consequential in advanced cirrhosis. [25]

Absolute neutrophil count (PMN ≥250 cells/mm³) should remain the **decisive rule-in trigger** for treatment in most settings because it is directly tied to established diagnostic definitions and practice standards. However, clinicians often face gray zones: patients with convincing systemic infection features but PMN counts below 250, borderline counts (e.g., near threshold), hemorrhagic ascites, or

recent antibiotic exposure that may blunt culture yield and potentially alter cellular response. In these circumstances, a risk-score framework can serve as a structured adjunct—helping clinicians justify escalation (or close observation with repeat paracentesis) when the clinical picture is disproportionate to the ascitic PMN result. [26]

The Mansoura scoring system is clinically attractive because it uses **routine, rapidly available variables** (age, MPV, NLR, and CRP with weighted points) to generate a bedside probability signal for SBP. Practically, it can be applied at the time of presentation to identify patients who warrant heightened suspicion, closer monitoring, earlier empirical antibiotics in appropriate contexts, or expedited repeat paracentesis when the initial ascitic PMN is not diagnostic but clinical concern remains high. Importantly, the score should be viewed as **complementary**—supporting decisions around timing and intensity of evaluation and treatment—rather than replacing diagnostic paracentesis or superseding PMN-based definitions. [27]

A pragmatic internal medicine decision pathway that preserves guideline safety while leveraging the Mansoura score could be summarized as: (1) perform immediate paracentesis for suspected infection in cirrhosis with ascites; (2) if PMN ≥250, treat SBP; (3) if PMN <250 but systemic suspicion is high, use the Mansoura score to strengthen risk assessment and consider early antibiotics, close observation, and/or repeat paracentesis based on overall stability and competing diagnoses. This is most useful in patients with advanced decompensation where missing early SBP is dangerous, and where a composite score may capture infection biology not fully reflected by ascitic PMN response. External validation data support the score's discrimination, but broader multicenter validation and implementation studies are still needed before it can be embedded as a routine protocol across institutions. [28]

Special Clinical Scenarios: Where Risk-Score–Based Diagnosis May Add Value

Certain subgroups of cirrhotic patients pose particular diagnostic challenges for SBP when conventional ascitic neutrophil thresholds are applied rigidly. One such group includes patients with **culture-negative non-neutrocytic ascites** or early SBP, in whom bacterial translocation and systemic inflammation may precede a robust peritoneal neutrophilic response. These patients may exhibit fever, rising inflammatory markers, or acute decompensation despite ascitic PMN counts below 250 cells/mm³. In this context, reliance on ANC alone may delay diagnosis, whereas a composite score incorporating systemic inflammatory indices may better reflect evolving infection risk and prompt closer monitoring or early intervention [29].

Another clinically important scenario involves cirrhotic patients with **advanced immune dysfunction**, including those with severe portal hypertension, malnutrition, or prior episodes of SBP. Neutrophil dysfunction in these patients can blunt chemotaxis and oxidative burst, leading to falsely reassuring ascitic fluid cell counts despite active infection. From an internal medicine perspective, this population is particularly vulnerable to rapid progression to acute-on-chronic liver failure once infection is established. A risk-score–based approach such as the Mansoura Scoring System may help capture systemic inflammatory stress in these high-risk individuals when local immune responses are inadequate [30].

Patients with **renal dysfunction or hepatorenal syndrome** represent another subgroup in whom SBP diagnosis is especially challenging and clinically urgent. Renal impairment may be both a consequence and a precipitant of SBP, and subtle infections can precipitate rapid deterioration in kidney function. Systemic inflammatory markers and hematologic indices included in composite scores may reflect this interaction earlier than ascitic PMN elevation alone. In such patients, early risk stratification using a composite score may support timely empirical therapy and avoidance of further renal insult, although careful clinical judgment remains essential [31].

Finally, critically ill cirrhotic patients in intensive care or emergency settings often present with **multifactorial systemic inflammation**, making it difficult to distinguish SBP from other sources of sepsis. Ascitic fluid analysis may be delayed or technically challenging, and results may be confounded by ongoing antibiotic therapy. In these settings, a structured risk-score framework can assist clinicians in integrating available laboratory and clinical data to assess SBP probability while awaiting definitive

ascitic results. Although composite scores should not replace diagnostic paracentesis, they may provide incremental value in prioritizing early treatment and repeat evaluation in unstable patients [32].

Impact of Diagnostic Strategy on Treatment Timing and Clinical Outcomes

Timely initiation of empirical antibiotic therapy is the single most important modifiable determinant of outcome in spontaneous bacterial peritonitis. Multiple observational studies have demonstrated that delays in diagnosis and treatment are associated with increased mortality, higher incidence of renal failure, longer hospital stays, and progression to acute-on-chronic liver failure. From an internal medicine standpoint, any diagnostic strategy for SBP must therefore be judged not only by its accuracy but also by its ability to facilitate early clinical decision-making. Reliance solely on ascitic neutrophil count may inadvertently delay therapy in patients with early or atypical disease presentations, particularly when laboratory turnaround times are prolonged or results are equivocal [33].

The use of a risk-score–based diagnostic framework has the potential to influence treatment timing by identifying high-risk patients earlier in the clinical course. Composite scores such as the Mansoura Scoring System may raise suspicion for SBP before classical diagnostic thresholds are met, thereby supporting earlier empirical antibiotic initiation in selected patients. This approach is particularly relevant in hospitalized cirrhotic patients who present with unexplained systemic deterioration, where waiting for definitive ascitic PMN elevation may result in missed opportunities for early intervention and worsened outcomes [34].

Early diagnosis of SBP also has downstream implications for adjunctive management strategies beyond antibiotics. Prompt recognition allows timely administration of intravenous albumin in appropriate patients, which has been shown to reduce the risk of renal failure and improve survival. In addition, early identification of SBP enables closer hemodynamic monitoring, avoidance of nephrotoxic agents, and rapid evaluation for complications such as acute kidney injury or hepatic encephalopathy. Diagnostic strategies that improve early risk recognition may therefore indirectly enhance the effectiveness of these supportive measures [35].

However, the potential benefit of earlier treatment must be balanced against the risks of overtreatment, including unnecessary antibiotic exposure, antimicrobial resistance, and alteration of gut microbiota in cirrhotic patients. From a clinical governance perspective, this underscores the importance of using risk scores as adjunctive tools rather than standalone diagnostic criteria. The optimal impact on outcomes is likely achieved when composite scores complement ascitic fluid analysis and clinical judgment, supporting timely yet judicious initiation of therapy. Further prospective studies are needed to clarify whether risk-score–guided strategies translate into measurable improvements in survival and complication rates compared with ANC-based diagnosis alone [36].

Conclusion

Spontaneous bacterial peritonitis remains a pivotal determinant of morbidity and mortality in patients with liver cirrhosis, making early and accurate diagnosis a cornerstone of effective management in internal medicine practice. While the ascitic fluid absolute neutrophil count has long served as the diagnostic standard due to its simplicity and strong guideline endorsement, it does not fully reflect the complex pathophysiology of SBP in cirrhotic patients, particularly in early infection, immune dysfunction, or atypical clinical presentations.

Risk-score–based diagnostic approaches, exemplified by the Mansoura Scoring System, represent an evolution toward more integrative and individualized assessment of SBP risk. By incorporating systemic inflammatory and hematologic parameters alongside clinical variables, these models acknowledge SBP as a multisystem process rather than a purely local peritoneal infection. When used as an adjunct to ascitic fluid analysis, composite scores may enhance early risk stratification, support timely therapeutic decisions, and reduce diagnostic uncertainty in challenging clinical scenarios.

Importantly, the role of the Mansoura Scoring System should be viewed as complementary rather than substitutive. Diagnostic paracentesis and ascitic fluid neutrophil count remain indispensable, and any risk-based model must be applied within the context of clinical judgment and established practice standards. Future research should focus on large-scale external validation, assessment of outcome-

driven benefits, and integration into practical clinical algorithms.

In conclusion, combining traditional diagnostic criteria with validated risk-score–based tools may represent a balanced and forward-looking strategy for improving the diagnosis and management of spontaneous bacterial peritonitis in patients with liver cirrhosis, ultimately aligning diagnostic precision with timely, patient-centered care.

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