

Decision Making in Critical Care Medicine

Editors

Atul Prabhakar Kulkarni

Shilpushp Jagannath Bhosale

Contents

SECTION 1: Trauma and Prehospital Care

1. Primary and Secondary Survey in Trauma Patients.....	3
<i>Anant Vikram Pachisia, Tushar Rajendra Chopawar</i>	
2. Assessment and Management of Cervical Spine Injury.....	8
<i>Anant Vikram Pachisia, Nitika Yadav</i>	
3. Evaluation and Management of a Patient with Penetrating Thoracic Trauma.....	13
<i>Anant Vikram Pachisia, Priya Gole</i>	
4. Blunt Abdominal Trauma.....	17
<i>Sweta J Patel, Devireddy Madhava Reddy</i>	
5. Management of a Patient with Penetrating Abdominal Trauma	20
<i>Sweta J Patel, Pooja Tyagi</i>	
6. Management of Patient with Traumatic Long Bone Fractures	24
<i>Sweta J Patel, Swagat Pattajoshi</i>	
7. Massive Transfusion in Trauma Patients.....	29
<i>Anant Vikram Pachisia, Parimal B Patel</i>	
8. Damage Control Resuscitation.....	32
<i>Anant Vikram Pachisia, Ronak Zatakiya</i>	

SECTION 2: Airway

9. High-flow Nasal Oxygen Therapy in Mild-to-Moderate Hypoxemic Respiratory Failure	39
<i>Shilpushp Jagannath Bhosale, Atul Prabhakar Kulkarni</i>	
10. NIV for Mild-to-Moderate AHRF.....	42
<i>Shilpushp Jagannath Bhosale, Atul Prabhakar Kulkarni</i>	
11. Airway Management in the Critically Ill Patient	45
<i>Shilpushp Jagannath Bhosale, Atul Prabhakar Kulkarni</i>	

SECTION 3: Poisoning and Toxic Exposure

12. General Approach to Management of a Patient with Poisoning.....	51
<i>Suhail Sarwar Siddiqui, Ambuj Yadav</i>	
13. Management of Acute Alcohol Intoxication (Ethanol, Methanol, Isopropanol, Ethylene Glycol)	55
<i>Suhail Sarwar Siddiqui, Shreyas Laxman Bhor</i>	
14. Organophosphorus Poisoning.....	60
<i>Manoj Job, Binila Chacko</i>	
15. Heavy Metal Poisoning in the ICU.....	65
<i>Prithviraj Bose, Binila Chacko</i>	
16. Iron Toxicity	72
<i>Keyur Shah, Kushal Rajeev Kalvit</i>	

17. Lithium Toxicity	76
<i>Keyur Shah, Kushal Rajeev Kalvit</i>	
18. Antimony Poisoning	79
<i>Pritish John Korula</i>	
19. Thallium Toxicity	81
<i>Pritish John Korula</i>	
20. Corrosive Poisoning	83
<i>Rakesh Mohanty</i>	
21. Hydrocarbon Poisoning	88
<i>Rakesh Mohanty</i>	
22. Acetaminophen Toxicity	92
<i>Meshach M Dhas</i>	
23. Tricyclic Antidepressants Toxicity	97
<i>Meshach M Dhas</i>	
24. Cocaine Toxicity	101
<i>Meshach M Dhas</i>	
25. Paraquat Poisoning	105
<i>Kushal Rajeev Kalvit</i>	
26. Phosphorus Poisoning	107
<i>Kushal Rajeev Kalvit</i>	
27. Beta-Blocker Toxicity.....	109
<i>Kushal Rajeev Kalvit</i>	
28. Barbiturate Toxicity	111
<i>Kushal Rajeev Kalvit</i>	
29. Salicylate Toxicity	113
<i>Rakesh Mohanty</i>	
30. Phenylbutazone Poisoning	118
<i>Abhishek Singh Rajput</i>	
31. Antiarrhythmic Drug Toxicity	120
<i>Kushal Rajeev Kalvit</i>	
32. Theophylline Toxicity	123
<i>Raghavendra Kumar Giri, Anuradha Pandey, Nitin Jain</i>	
33. Valproate Overdose	126
<i>Nitin Saluja, Nitin Jain</i>	
34. Carbon Monoxide Poisoning	129
<i>Gautam Gondal</i>	
35. Cyanide Poisoning.....	132
<i>Gautam Gondal</i>	
36. Mustard Gas Inhalation	135
<i>Tarun Sahu</i>	
37. Digoxin Toxicity	138
<i>Tarun Sahu</i>	
38. Selective Serotonin Reuptake Inhibitor Overdose	141
<i>Sachin Gupta, Deeksha Singh Tomar</i>	

39. Mushroom Poisoning	144
<i>Sachin Gupta, Deeksha Singh Tomar</i>	

SECTION 4: Bites, Stings, and Envenomations

40. Management of Patients with Snake Bite	149
<i>Niteen D Karnik, Priyanshu D Shah</i>	
41. Management of Patients with Scorpion Sting	153
<i>Niteen D Karnik, Priyanshu D Shah</i>	
42. Management of Patients with Tick-borne Paralysis	157
<i>Niteen D Karnik, Priyanshu D Shah</i>	

SECTION 5: Immune System

43. Anaphylactic and Anaphylactoid Reactions	163
<i>Malini Joshi, Atul Prabhakar Kulkarni</i>	

SECTION 6: Burns, Electrical Injuries and Heat Related Injuries

44. Management of a Patient with Extensive Burns.....	169
<i>Amarja Ashok Havaladar</i>	
45. Management of a Patient with Massive Electrical Injury.....	173
<i>Amarja Ashok Havaladar</i>	
46. Management of a Patient with Severe Hypothermia	176
<i>Sangeeta Chakraborty, Saurabh Taneja</i>	
47. Management of Heatstroke	181
<i>Pranshuta Sabharwal, Saurabh Taneja</i>	

SECTION 7: Near Drowning and Hanging

48. Management of a Drowning Victim	187
<i>Mohd Saif Khan, Gagan Gunjan</i>	
49. Management of a Patient with Strangulation or Near-Hanging	190
<i>Mohd Saif Khan, Neeraj Kumar</i>	

SECTION 8: Respiratory System

50. Bronchial Asthma	195
<i>Manu Varma MK, Karun Mahesh KP, Natesh Prabu R</i>	
51. Chronic Obstructive Pulmonary Disease.....	198
<i>Manu Varma MK, Natesh Prabu R</i>	
52. Restrictive Lung Diseases	202
<i>Natesh Prabu R, Muralidharan R</i>	
53. Ventilatory Management of a Patient with Acute Respiratory Distress Syndrome.....	207
<i>Divya Pal, Keerti Brar</i>	
54. Ventilatory Management of Patient with Bronchopleural Fistula	212
<i>Keerti Brar, Divya Pal</i>	
55. Severe Community-acquired Pneumonia	215
<i>Deeksha Singh Tomar, Sachin Gupta</i>	

56. Management of a Patient with Ventilator-associated Pneumonia	218
<i>Deeksha Singh Tomar, Sachin Gupta</i>	
57. Diffuse Alveolar Hemorrhage	221
<i>Bhushan H Katira</i>	
58. Pulmonary Alveolar Proteinosis	224
<i>Parag Dekate</i>	
59. Extracorporeal Membrane Oxygenation	227
<i>Avinash Reddy, Parag Dekate</i>	
60. High-frequency Oscillatory Ventilation.....	232
<i>VC Lokesh Kumar, Parag Dekate</i>	
61. Prone Ventilation.....	235
<i>Bhushan H Katira</i>	
62. Management of a Patient with Massive Hemoptysis	238
<i>Ankit Sushil Ganju, Jaya Sharma, Vikas Bhagat</i>	
63. Superior Vena Cava Syndrome.....	242
<i>Partha Pratim Das, Jaya Sharma, Vikas Bhagat</i>	
64. Acute Pulmonary Embolism	248
<i>Mozammil Shafi, Mohammad Ameen Al-Marhoon</i>	
65. Fat Embolism Syndrome	253
<i>Mozammil Shafi, Hossam Ahmed Alhanafi</i>	
66. Blood Transfusion Reaction.....	256
<i>Mozammil Shafi, Hichem Ksibi</i>	

SECTION 9: Cardiovascular System

67. Hypertensive Urgencies and Emergencies	265
<i>Mohd Mustahsin Malik, Bashir Ahmad Mir</i>	
68. ST-Elevation Myocardial Infarction	270
<i>Mohd Mustahsin Malik, Bashir Ahmad Mir</i>	
69. Non-ST Elevation Myocardial Infarction	277
<i>Mohd Mustahsin Malik, Bashir Ahmad Mir</i>	
70. Aortic Dissection	284
<i>Srinivas Samavedam, Narmada Aluru</i>	
71. Supraventricular Tachycardia.....	288
<i>Srinivas Samavedam, Ramakrishna Reddy Paidi</i>	
72. Ventricular Arrhythmias	293
<i>Srinivas Samavedam, Ramakrishna Reddy Paidi</i>	
73. Heart Blocks.....	299
<i>Srinivas Samavedam, Narmada Aluru</i>	
74. Acute Myocarditis.....	304
<i>Harish Mallapura Maheshwarappa, Monisha S, Nithish Mukunthan M</i>	
75. Infective Endocarditis	307
<i>Harish Mallapura Maheshwarappa, Thilakchand KR, Radhika KT</i>	
76. Management of Valvular Heart Disease	311
<i>Harish Mallapura Maheshwarappa, Akshatha V Rai, G Gokulakrishnan</i>	

SECTION 10: Gastrointestinal and Hepatobiliary Disorders

77. Upper Gastrointestinal Bleeding	321
<i>Ujwal Prakash Dhundi</i>	
78. Lower Gastrointestinal Bleeding	326
<i>Ujwal Prakash Dhundi</i>	
79. Hepatic Encephalopathy.....	330
<i>Ujwal Prakash Dhundi</i>	
80. Severe Acute Pancreatitis	334
<i>Khalid Ismail Khatib</i>	
81. Calculous and Acalculous Cholecystitis.....	338
<i>Kushal Rajeev Kalvit</i>	
82. Spontaneous Bacterial Peritonitis	341
<i>Kushal Rajeev Kalvit</i>	
83. Fulminant Hepatic Failure	344
<i>Khalid Ismail Khatib</i>	
84. Acute Intestinal Obstruction/Perforation	347
<i>Santi Swaroop Pattanaik, Rohit Kumar Patnaik</i>	
85. Toxic Megacolon	351
<i>Samir Samal, Rohit Kumar Patnaik</i>	
86. Paralytic Ileus	356
<i>Rohit Kumar Patnaik, Satyajit Choudhury</i>	
87. Hepatopulmonary Syndrome	359
<i>Keyur Shah, Kushal Rajeev Kalvit</i>	
88. Abdominal Compartment Syndrome	362
<i>Keyur Shah, Kushal Rajeev Kalvit, Atul Prabhakar Kulkarni</i>	
89. Acute Mesenteric Ischemia	366
<i>Ankit Sharma, Atul Prabhakar Kulkarni</i>	
90. Nonocclusive Mesenteric Ischemia	369
<i>Ankit Sharma, Atul Prabhakar Kulkarni</i>	

SECTION 11: Renal Disorders and Electrolyte Derangements

91. Acute Kidney Injury.....	373
<i>Ranajit Chatterjee, Preeti Goyal Varshney</i>	
92. Hypokalemia	379
<i>Ranajit Chatterjee, Preeti Goyal Varshney</i>	
93. Hyperkalemia	382
<i>Malini Joshi, Atul Prabhakar Kulkarni</i>	
94. Hyponatremia.....	386
<i>Malini Joshi, Atul Prabhakar Kulkarni</i>	
95. Hyponatremia	391
<i>Abhishek Jain, Jeetendra Sharma</i>	
96. Hypercalcemia	393
<i>Abhishek Jain, Jeetendra Sharma</i>	

97. Hyperphosphatemia	397
<i>Shruti Gupta, Namrata S Rao, Sai Saran</i>	
98. Metabolic Alkalosis	400
<i>Haider Husain, Sai Saran</i>	

SECTION 12: Endocrine Disorders

99. Diabetic Ketoacidosis.....	405
<i>VS Pavan Kumar, Pankaj Kumta</i>	
100. Hyperglycemic Hyperosmolar State	408
<i>VS Pavan Kumar, Pankaj Kumta</i>	
101. Adrenal Insufficiency	411
<i>VS Pavan Kumar, Pankaj Kumta</i>	
102. Thyroid Storm.....	414
<i>Abhilash Dash, Shakti Bedanta Mishra</i>	
103. Myxedema Coma	419
<i>Abhilash Dash, Shakti Bedanta Mishra</i>	
104. Diabetes Insipidus.....	423
<i>Abhilash Dash, Shakti Bedanta Mishra</i>	

SECTION 13: Central Nervous System Disorders

105. Acute Ischemic Stroke	429
<i>Lakshmi Narsinganallore Venkatesh</i>	
106. Acute Hemorrhagic Stroke	435
<i>Lakshmi Narsinganallore Venkatesh</i>	
107. Subarachnoid Hemorrhage	441
<i>Lakshmi Narsinganallore Venkatesh</i>	
108. Management of Patient with Traumatic Brain Injury with Raised ICP	446
<i>Shweta Ram Chandankhede</i>	
109. Status Epilepticus.....	450
<i>Shweta Ram Chandankhede</i>	
110. Spinal Cord Compression	453
<i>Nirmalyo Lodh, Shoily Nath</i>	
111. Posterior Reversible Encephalopathy Syndrome (PRES) in Children.....	455
<i>Alekhyia Reddy, Parag Dekate</i>	
112. Guillain–Barré Syndrome	460
<i>Nirmalyo Lodh</i>	
113. Myasthenia Gravis.....	462
<i>Nirmalyo Lodh</i>	

SECTION 14: Rheumatology and Autoimmune Disorders

114. Nonbacterial Thrombotic Endocarditis	467
<i>Abhishek Singh Rajput, Kushal Rajeev Kalvit</i>	
115. Catastrophic Antiphospholipid Syndrome	469
<i>Abhishek Singh Rajput, Kushal Rajeev Kalvit</i>	

116. Acute Interstitial Pneumonia	472
<i>Abhishek Singh Rajput, Kushal Rajeev Kalvit</i>	

SECTION 15: Obstetric Emergencies

117. Eclampsia	477
<i>Nupur Karan, Dona Saha</i>	
118. HELLP Syndrome	482
<i>Nupur Karan, Dona Saha</i>	
119. Antepartum Hemorrhage	486
<i>Armin Ahmed</i>	
120. Postpartum Hemorrhage.....	490
<i>Armin Ahmed</i>	
121. Amniotic Fluid Embolism.....	494
<i>Armin Ahmed</i>	

SECTION 16: Infectious Diseases

122. Approach to Fever in ICU	501
<i>Rakesh Mohanty</i>	
123. Infections in the Immunocompromised Host	508
<i>Karthikkeyan Rajachandran, Santhosh Raja, Natesh Prabu R</i>	
124. Meningitis	514
<i>Rajshree Trivedi</i>	
125. Encephalitis	518
<i>Rajshree Trivedi</i>	
126. Catheter-related Bloodstream Infections	523
<i>Nishanth Baliga</i>	
127. Methicillin-resistant <i>Staphylococcus aureus</i> and Vancomycin-resistant <i>Enterococcus</i> Infections	526
<i>Nishanth Baliga</i>	
128. <i>Clostridioides Difficile</i> Diarrhea	529
<i>Atul Prabhakar Kulkarni</i>	
129. Infections in Solid Organ Transplant Recipients.....	534
<i>Atul Prabhakar Kulkarni</i>	
130. Intra-abdominal Sepsis.....	538
<i>Satish Vishnu Sarode, Subhash Rajkumar Bajaj</i>	
131. Sepsis in Asplenic Patients	542
<i>Satish Vishnu Sarode, Sachin Ravan Katkade</i>	

SECTION 17: Tropical Illness

132. Dengue Shock Syndrome	549
<i>Anand Mohanlal Tiwari, Kapil Gangadhar Zirpe</i>	
133. Severe Malaria	554
<i>Kapil Gangadhar Zirpe, Shrirang Nagorao Bamne</i>	
134. Leptospirosis	558
<i>Gunjan Prakash Chanchalan, Sunil Sanjaybhai Amin</i>	

135. **Scrub Typhus** 562
Gunjan Prakash Chanchalan, Ajinkya Krishnarao Bhosle

SECTION 18: Miscellaneous

136. **Management of Brain-dead Organ Donor** 567
Prajakta Pote, Kapil Gangadhar Zirpe

137. **Macrophage Activation Syndrome** 572
Abhijeet M Deshmukh

138. **Thrombotic Microangiopathy** 576
Shilpushp Jagannath Bhosale, Atul Prabhakar Kulkarni

139. **Tumor Lysis Syndrome** 579
Srilekha Ammapalli

Index 585

Lower Gastrointestinal Bleeding

Ujwal Prakash Dhundi

■ INTRODUCTION

The term acute lower gastrointestinal (LGI) bleeding denotes bleeding which occurs from a source distal to the ligament of Treitz. The causes of acute LGI bleeding are given in **Table 1**. We must keep in mind that nearly 10% patients are later found to have upper GI (UGI) tract bleeding who were initially thought to be having LGI bleeding. Therefore, in all patients suspected to have LGI bleed, we must keep in mind the possibility of UGI hemorrhage.

■ CLINICAL FEATURES

A patient with LGI bleeding typically complains of hematochezia, i.e., the passage of bright red or maroon-colored blood or blood clots per rectum. Generally, the color of blood from the left colon is bright red, and that from the right colon is maroon colored and it is mixed with stools. Infrequently bleeding from the right side of the colon may present with melena.

Laboratory features in a patient with LGI bleeding usually have normocytic red cells if the bleeding is acute; microcytic red cells or iron deficiency anemia suggest chronic bleeding.

Patients with acute LGI bleeding and normal renal function have normal blood urea nitrogen (BUN) to creatinine or urea to creatinine ratio (<20:1 or <100:1, respectively).

■ INITIAL EVALUATION AND MANAGEMENT

The evaluation and management of a patient with acute LGI bleeding should occur simultaneously. The goals of management are to establish that the source of bleeding

is from LGI bleeding, identify the severity of bleeding and triage the patient to the appropriate management setting, and simultaneously initiate and continue resuscitation as required.

Initial evaluation: The goals of the evaluation are to identify the severity of bleeding, if bleeding is from an UGI source, and to identify the factors which might interfere with the subsequent management.

History: This includes prior history of bleeding, reviewing medical records to identify the potential source of bleeding, and comorbidities which might affect the patients' subsequent management.

Medication history should probe for the use of medications that might be associated with the risk of bleeding and impaired coagulation, such as antiplatelets, anticoagulants, and nonsteroidal anti-inflammatory medication. The presence of specific symptoms may indicate the possible source of LGI bleeding, e.g., painless hematochezia in diverticular bleeding, change in bowel habits in malignancy, and abdominal pain in colitis.

Physical examination: It should aim at the assessment of hemodynamic stability and examination of stools to ascertain if it is melena or hematochezia. Signs of hypovolemia include resting tachycardia, orthostatic hypotension, and supine hypotension. Abdominal pain on examination suggests the possibility of inflammatory source of bleeding such as ischemic or infectious or perforation.

Laboratory tests: Complete blood count, liver function test, coagulation test, and serum chemistries should be sent, and hemoglobin concentration should be monitored based on the clinical condition of the patient every 2–8 hours.

Differential diagnosis: The primary differential diagnosis for LGI bleeding should be UGI bleeding as approximately 10–15% of the patient with severe hematochezia will actually have UGI bleeding. Finding that corroborate likely UGI bleeding is hemodynamic instability, orthostatic

TABLE 1: Causes of lower gastrointestinal bleeding.

Anatomic	Diverticulosis, hemorrhoids, fistula, rectal ulcers
Vascular	Angiodysplasia, ischemia, radiation colitis
Inflammatory	Inflammatory bowel disease, infection
Neoplastic	Polyps and cancers
Miscellaneous	Post polypectomy

hypotension, and elevated BUN to creatinine ratio or urea to creatinine ratio $>20\text{--}30:1$ or $>100:1$, respectively. However, the possibility of UGI bleeding source is reduced if there are blood clots in the stool. Consideration to UGI endoscopy should be given if there is a high suspicion of UGI bleeding.

Initial management: This involves triaging the patient to the appropriate level of the hospital setting for better management. The management of bleeding involves general supportive measures, appropriate fluid and blood resuscitation, and the management of coagulopathy, reversal (if possible) of effects of anticoagulant, and antiplatelet agents.

Triage and consultation: The timing and setting of evaluation depend on the severity of the bleeding and the patient's comorbidities. Urgent gastroenterologist consult should be sought right at the beginning for endoscopic evaluation. Surgical or interventional radiology should also be involved in cases with massive hematochezia and in those with high-risk of complications.

Intensive care unit (ICU) admission: Patients with hemodynamic instability, persistent bleeding, and significant comorbid illnesses should be shifted to the ICU for resuscitation and therapeutic intervention. Several features can predict the risk of complications in patients with LGI bleeding (**Table 2**). The number of high-risk features present increase the risk of poor outcomes in these patients.

General supportive measures in the ICU: Patients should be monitored using an electrocardiogram, pulse oximeter, and frequent measurement of blood pressure. Invasive arterial pressure monitoring is desirable for unstable patients. Oxygen supplementation should be started, and the patient should be kept fasting. Adequate venous access with two large bore cannulas (16 or 18 G) for resuscitation with fluid and blood should be done as needed. Central venous catheter may be inserted later, if vasopressors are required.

Fluid resuscitation: Optimum resuscitation and stabilization of the patient are the most vital components of management. Patients should receive crystalloids while awaiting grouping

and cross-matching. If blood pressure fails to respond to initial fluid resuscitation, then the rate of administration should be increased, and urgent interventional angiography should be considered.

Blood transfusion: This should be individualized. A young patient without any comorbid illness may not require blood transfusion until hemoglobin falls below 7 g/L while a patient who is older and has significant comorbidities and coronary artery diseases may be transfused to achieve a higher level of hemoglobin (9–10 g/L). The patient who is actively bleeding and hemodynamically unstable will need a blood transfusion, even if the hemoglobin level is normal.

Management of Coagulopathy, Anticoagulants, and Antiplatelet Agents

The decision regarding continued use of anticoagulant and antiplatelet agents should be individualized in all cases. The risk of holding or reversing anticoagulation should be weighed with the risk of continued bleeding without reversal. In complicated cases, consultation with a prescribing specialist should be obtained to make the final decision. In case of life-threatening bleeding, anticoagulant medications such as warfarin and direct-acting oral anticoagulant (DOAC) should be withheld. Warfarin should be withheld, and prothrombin complex concentrate (PCC) and vitamin K should be administered; in the absence of PCC fresh frozen plasma should be given in bleeding patients with international normalized ratio (INR) more than 2.5.

Platelet transfusion: It is indicated if the platelet count drops below 50,000/ μL . Routine platelet transfusion is not indicated in a patient on antiplatelet medication. Endoscopy can be performed on a patient with INR between 1.5 and 2.5. If the INR >2.5 , it needs correction before endoscopy.

Antiplatelet medications: Aspirin should be continued if it is being used for secondary prophylaxis. Dual antiplatelet should not be discontinued without cardiologist consultation in a patient with acute coronary syndrome within 90 days or with a bare metallic stent placed within the past 6 weeks or a drug-eluting stent placed within the past 6 months. Studies have shown increased all-cause mortality in patients with cardiovascular disease and peptic ulcer bleeding on discontinuation of aspirin. The decision to reintroduce this medication will also depend on the risk of thrombosis and bleeding and should be individualized. Low-dose aspirin or antiplatelet agent should be reintroduced within 5 days or earlier if hemostasis is achieved and there is no further bleeding.

TABLE 2: Features predicting the risk of complications in patients with lower gastrointestinal (GI) bleeding.

Hemodynamic instability	Bleeding inpatient admitted for another reason
Persistent bleeding	Current use of aspirin
Significant comorbidities	Prolonged prothrombin time
Advanced age	A nontender abdomen
Hypoalbuminemia	Anemia
Abnormal white cell count	Prior history of bleeding due to diverticular disease or angiodysplasia
Elevated blood urea nitrogen	

■ DIAGNOSTIC STUDIES

After the UGI source of bleeding is excluded, diagnostic colonoscopy is the initial choice for diagnostic evaluation

and treatment of acute LGI bleeding. Other diagnostic studies that can be performed are radionuclide imaging, computed tomography (CT) angiography and mesenteric angiography. The radiological imaging needs ongoing active bleeding to detect the source and therefore it should be reserved for patients with severe ongoing bleeding or in whom we are unable to find the source.

Colonoscopy: It has the advantage of precisely locating the site of bleeding irrespective of the cause or rate of bleeding, the ability to take biopsy and microbiology samples, and the ability to provide therapeutic interventions. Disadvantages include bowel preparation, poor visualization in inadequately prepared bowel, and the need for sedation and the risk associated with it.

Timing of colonoscopy: The colonoscopy should be performed in the next available setting after bowel preparation. Studies have shown no significant differences in the outcomes in patients with LGI bleeding undergoing colonoscopy in less than 24 hours versus 24–96 hours.

Bowel preparation: Some gastroenterologists prefer unprepared bowel since blood itself is cathartic, but as the cecal intubation rate is lower in unprepared colon and stool may obscure the bleeding source cleaning the colon with 4–6 L of polyethylene glycol is preferred. Bowel preparation should be done cautiously as there is a risk of aspiration and fluid overload. If perforation or obstruction is suspected radiographic studies should be obtained before bowel preparation.

Radiographic imaging: The advantage of radiographic studies is that they can identify the location of bleeding throughout the GI tract including the small bowel, and treatment can be attempted by using angioembolization of the lesion. However, the studies need active bleeding at the time they are being performed to detect the bleeding. In a patient with severe bleeding who is unstable for colonoscopy or with active bleeding despite colonoscopy, CT angiography can be used to identify the patient for angiographic embolization and to determine the site of bleeding before surgery. It is important to note that angiography should immediately follow a positive CT angiography.

Radionuclide imaging: Radionuclide scanning is the most sensitive radiographic test which detects the bleeding occurring at the rate of 0.1–0.5 mL/min. It is important to mention that angiography should be promptly done after a positive radionuclide scan. The disadvantage of a radionuclide scan is that it is positive only if there is active bleeding at the time of the scan, and it can only localize bleeding to the general area of the abdomen and has a variable accuracy rate.

Computed tomography angiography: Advantages of CT angiography include its wide availability, minimal invasiveness, rapidity, and precision of the anatomical location for the source of bleeding. It detects the bleeding occurring at the rate of 0.3–0.5 mL/min. Disadvantages include lack of therapeutic ability, exposure to radiation, and risk associated with contrast media.

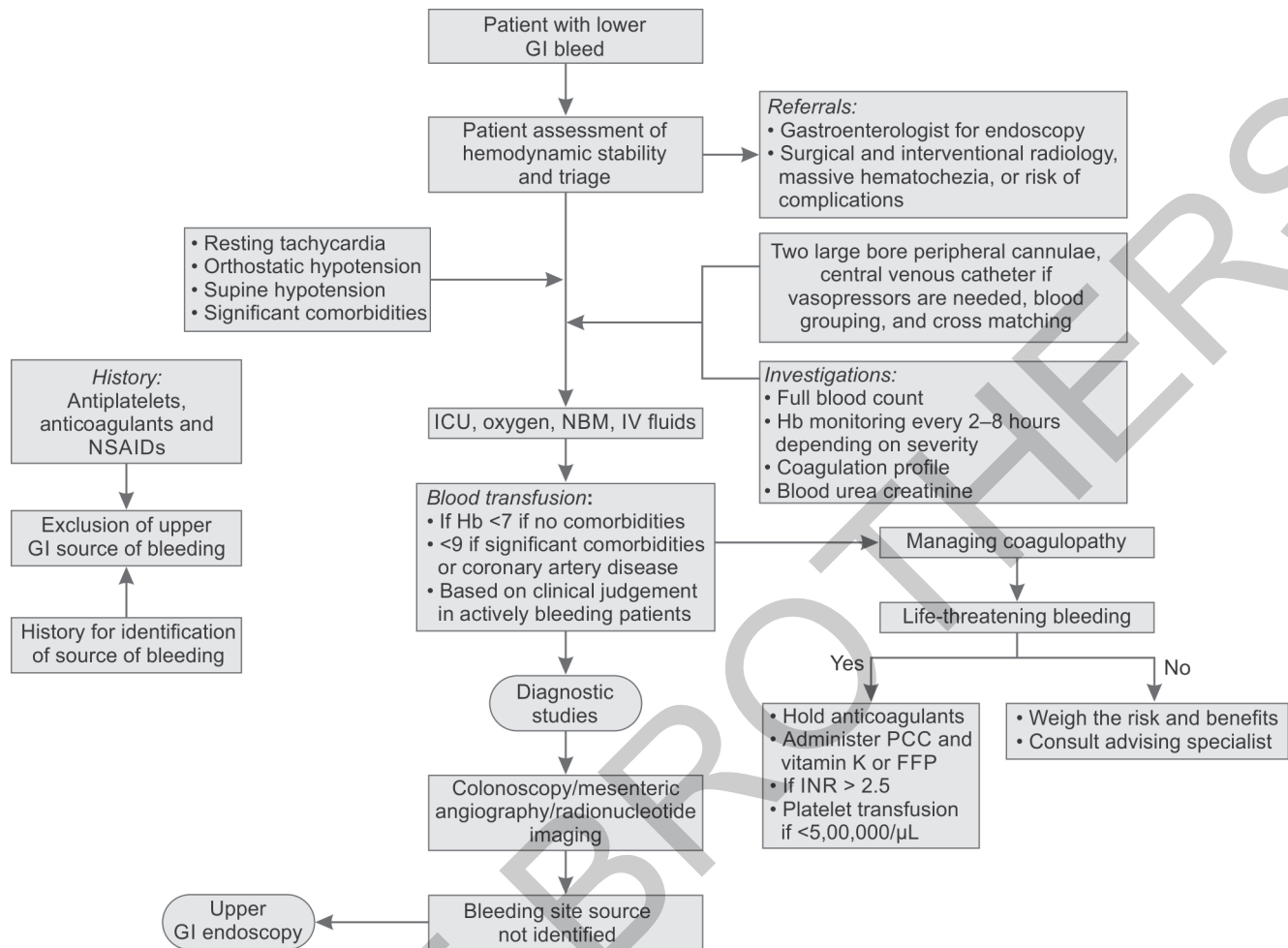
Digital subtraction angiography (DSA): DSA requires a 0.5–1 mL/min rate of bleeding to detect the source of bleeding, and it should be reserved for severely bleeding unstable patients who are not candidates for endoscopy. Its advantages include lack of need for bowel preparation and accurate anatomical localization along with the ability to provide therapeutic interventions. Angiography and intra-arterial vasopressin injection are used to stop or reduce the bleeding, but vasopressin has significant side effects such as cardiac arrhythmia and bowel ischemia. Transcatheter angioembolization is a definitive method for stopping the bleeding. Super selective embolization has reduced the risk of bowel infarction significantly. The disadvantages of embolization include bowel infarction, arterial injury, thrombus formation, and contrast-induced nephropathy and subsequent renal failure.

ADDITIONAL TESTING IF THE SOURCE OF BLEEDING IS NOT IDENTIFIED

If the bleeding site is not evident despite thorough LGI evaluation, push enteroscopy (where a small diameter flexible scope is pushed beyond the ligament of Treitz) should be considered in those with severe ongoing bleeding. Push enteroscopy can detect bleeding in up to 60 cm of the proximal jejunum. Capsule endoscopy and deep small bowel enteroscopy (called Sonde enteroscopy) can be done to evaluate the small bowel for bleeding source. In patients in whom the bleeding has stopped, the identification might be very difficult. Those cases should be observed for 24–48 hours. An urgent CT angiography or radionuclide scan can be obtained to localize the site of bleeding if bleeding recurs. Provocative challenges with thrombolytics, anticoagulants, and vasodilators have been used to help in the diagnosis of elusive bleeding. However, these methods carry a significant risk of bleeding refractory to the treatment and death. Hence, these are used rarely.

TREATMENT OF BLEEDING

The treatment of bleeding depends upon the cause of the bleeding. In most cases, bleeding is controlled by therapeutic measures [e.g., four-quadrant submucosal injection of epinephrine (1–2 mL aliquots, dilution 1:20,000), endoscopic tamponade, bipolar coagulation, application of endoscopic clips, bipolar electrocautery, hemostatic powder, argon plasma coagulation] taken at the time of colonoscopy or angiography. In the event the patient is exsanguinating due

Flowchart 1: Management of the patient with lower gastrointestinal bleeding.

(FFP: fresh frozen plasma; GI: gastrointestinal; Hb: hemoglobin; ICU: intensive care unit; INR: international normalized ratio; IV: intravenous; NBM: nil by mouth; NSAIDs: nonsteroidal anti-inflammatory drugs; PCC: prothrombin complex concentrate)

to LGI bleeding, surgery is needed on an emergent basis. The risk of mortality and morbidity in the patient without prior localization of the bleeding site before surgery is higher than in those with a preidentified location of bleeding before surgery.

CONCLUSION

Lower GI bleed usually denotes the bleeding below the level of ligament of Treitz. Typically, lower GI bleed presents with passage of maroon colored stool or blood clots per rectum. The management of lower GI bleed involves evaluation risk factor and potential causes for lower GI bleeds such as antiplatelet and anticoagulants. If the patient is on anticoagulants and antiplatelets medication and coagulopathy should be corrected. Clinical evaluation focuses of hemodynamic assessment and triaging to intensive care based on clinical status. Two large bore cannulas should be ensured always for rapid resuscitation. Diagnostic modalities involve colonoscopy, radiographic imaging and radionucleotide imaging. Radiographic and radionucleotide

imaging needs active bleeding to diagnose the source of bleeding but have potential to treat the cause of bleeding when identified. Other modalities when the source of bleeding is not identified are push enteroscopy and capsule endoscopy. However, if the patient is exsanguinating urgent surgery is might be needed as a life saving measure.

SUGGESTED READING

1. Oakland K, Chadwick G, East JE, Guy R, Humphries A, Jairath V, et al. Diagnosis and management of acute lower gastrointestinal bleeding: guidelines from the British Society of Gastroenterology. *Gut*. 2019;68(5):776-89.
2. Strate LL, Gralnek IM. ACG clinical guideline: management of patients with acute lower gastrointestinal bleeding. *Am J Gastroenterol*. 2016;111(4):459-74.
3. Strate LL, Orav EJ, Syngal S. Early predictors of severity in acute lower intestinal tract bleeding. *Arch Intern Med*. 2003; 163(7):838-43.
4. Triantafyllou K, Gkolfakis P, Gralnek IM, Oakland K, Manes G, Radaelli F, et al. Diagnosis and management of acute lower gastrointestinal bleeding: European Society of Gastrointestinal Endoscopy (ESGE) guideline. *Endoscopy*. 2021;53(8):850-68.

Decision Making in Critical Care Medicine

Salient Features

- A quick bedside guide for how to diagnose, assess and manage common and uncommon critically ill patients
- An algorithmic and stepwise approach
- Practical answers to emergencies with quick look at the pathophysiology, etiology, and differential diagnoses
- What to do and what not to do? When to do and when not to?
- Useful for the postgraduate trainees of critical care medicine and also the practicing intensivists.

Atul Prabhakar Kulkarni MD (Anesthesiology) FISCCM PGDHHM FICCM is currently Professor and Head, Division of Critical Care, Department of Anesthesiology, Critical Care and Pain, Tata Memorial Hospital, Homi Bhabha National Institute, Mumbai, Maharashtra, India. A recognized Postgraduate Teacher for MD (Anesthesiology), he is now a Teacher for DM (Critical Care Medicine). A postgraduate diploma holder in Health and Healthcare Management, he has received training in intensive care at St George Hospital, Sydney, Australia in 2002–2003. He has participated in many conferences on critical care and anesthesiology at international, national, and state levels. He was the Organizing Secretary for the Anesthesia Review Course since 2004 to 2018. He successively held the posts of the Treasurer (2004–2010), General Secretary (2010–2014) of Indian Society of Critical Care Medicine (ISCCM) before he took over as the President of ISCCM (2015–2017) and the Chancellor of Indian College of Critical Care Medicine. He was a Member of the Editorial Board of Indian Journal of Critical Care Medicine (IJCCM) and Reviewer for IJCCM and Indian Journal of Anaesthesia (IJA). He is also the Past President of Association of South Asian Association for Regional Cooperation (SAARC) Critical Care Societies and Secretary General. After serving as the Honorary Secretary General of the Asia Pacific Association of Critical Care Medicine, he took over as the President of the prestigious organization and is currently holds this post. Currently, he is the Editor-in-Chief of the IJCCM.

Shilpushp Jagannath Bhosale DM (Critical Care Medicine) Fellowship Pediatric Critical Care Medicine (University of Toronto) is currently Professor, Division of Critical Care, Department of Anesthesiology, Critical Care and Pain, Tata Memorial Hospital, Homi Bhabha National Institute, Mumbai, Maharashtra, India. He completed his Fellowship in Pediatric Critical Care Medicine at the Sick Kids Hospital, University of Toronto, Canada in 2015. He is recognized Postgraduate Teacher and Examiner for DNB and DM (Critical Care Medicine) examinations. He has been the Treasurer of Indian Society of Critical Care Medicine in 2019–20 and Joint Secretary in 2016. He has also been the Member of the Indian Society of Critical Care Medicine, Mumbai Branch in 2018. He has participated in many conferences on critical care medicine and anesthesiology at international, national, and state levels. He is also the Organizing Secretary for Case Based Review In Critical Care Medicine for The Examinee (BRITE) course that is conducted in Tata Memorial Hospital yearly.

Printed in India

Available at all medical bookstores
or buy online at www.jaypeebrothers.com



JAYPEE BROTHERS
Medical Publishers (P) Ltd.
EMCA House, 23/23-B, Ansari Road,
Daryaganj, New Delhi - 110 002, INDIA
www.jaypeebrothers.com

Join us on [facebook.com/JaypeeMedicalPublishers](https://www.facebook.com/JaypeeMedicalPublishers)

Shelving Recommendation
CRITICAL CARE

ISBN 978-93-5696-132-6

