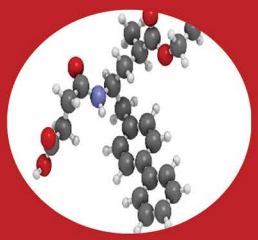
osite www.jaypeebrothers.com, for detailed information on cardiology books, visit our website www.jaypeebrothers.com, for detailed information on cardiology books, visit our website www.jaypeebrothers.c

Advances & Revolutions in Heart Failure (ARHF)

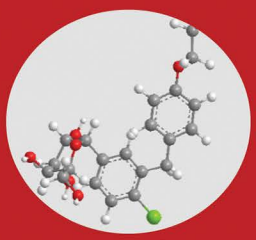
A Textbook of Cardiology

Editors-in-Chief

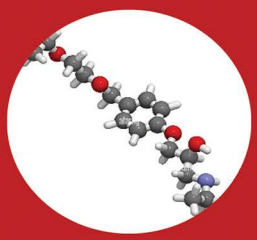
HK Chopra (India) ▪ Navin C Nanda (USA) ▪ Jagat Narula (USA)
GS Wander ▪ CN Manjunath ▪ Praveen Chandra (India)
Viveka Kumar ▪ CK Ponde ▪ AK Pancholia (India)



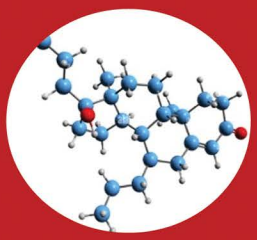
ARNI



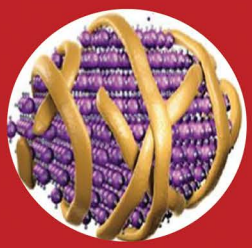
SGLT2i



βB



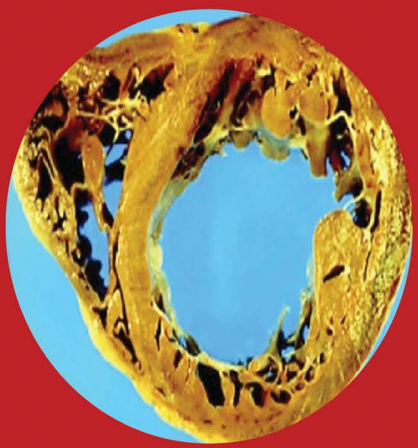
MRA



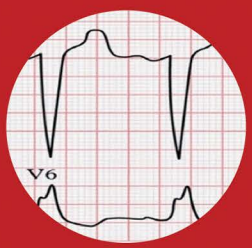
FCM



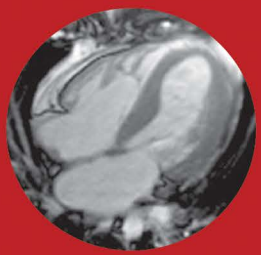
HFpEF

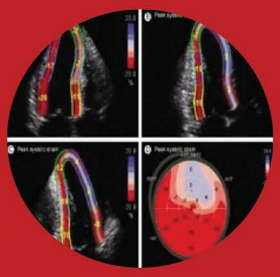


HFrEF

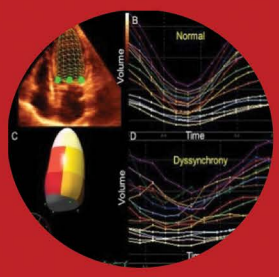














JAYPEE

Contents

SECTION 1: CLINICAL SPECTRUM

1. **Heart Failure in Women: Decoding the Missing Link** 3
   Harshit Khare, Roopali Khanna
2. **Prevention of Heart Failure: The Chopra–Levy Online Heart Protection Program** 9
   Rick Levy, Lisa Tatum
3. **Salt Intake Thresholds: Ultralow versus Low Sodium Debate** 13
   AK Pancholia
4. **Trivandrum Heart Failure Registry** 18
   Harikrishnan S, Sanjay G, Jeemon P
5. **ACC/AHA/HFSA Guidelines Update in Heart Failure Pharmacotherapy** 23
   Shraddha Ranjan, Manish Bansal, Ravi R Kasliwal, HK Chopra
6. **Clinical Guidelines for HFrEF: AHA, ACC and ESC** 30
   Tapan Sinha, Jayanta Sharma, Mrinal Kanti Das
7. **Noise Pollution, Cardiovascular Disease, and Heart Failure** 40
   Chanchal Pal, HK Chopra

SECTION 2: DRUGS IN HEART FAILURE

Angiotensin Receptor–Neprilysin Inhibitor in Heart Failure

8. **Angiotensin Receptor–Neprilysin Inhibitor and Heart Failure: An Iconic Molecule of Century** 49
   HK Chopra, Chandrashekhar K Ponde, Viveka Kumar, Anu Grover
9. **New ACC/AHA and HFSA Guidelines of Angiotensin Receptor–Neprilysin Inhibitor in Heart Failure** 66
   Abhishek, Gurpreet Singh Wander
10. **Top 10 Take-Home Messages from ACC/AHA and HFSA on Angiotensin Receptor–Neprilysin Inhibitor in Heart Failure** 72
    Satyendra Tewari, Ashish Kumar Singh, Ashvanee Kumar Sharma
11. **2023 American College of Cardiology Expert Consensus for Heart Failure with Preserved Ejection Fraction in Clinical Context** 77
    Rajeev Gupta
12. **Differentiation between Heart Failure with Preserved Ejection Fraction and Heart Failure with Reduced Ejection Fraction** 89
    Sanjay Mittal, Aparajita Kumar
13. **Mechanism of Angiotensin Receptor–Neprilysin Inhibitor in Heart Failure** 96
    Harsh Wardhan, Ramanand P Sinha, Parth Mashru, Aditya Goyal
14. **Reverse Cardiac Remodeling: Role of Angiotensin Receptor–Neprilysin Inhibitor** 100
    Chandrashekhar K Ponde, Kunal A Patankar
15. **Angiotensin Receptor–Neprilysin Inhibitor Algorithm and Guideline-directed Medical Therapy Management of Heart Failure with Preserved Ejection Fraction** 108
    Mohit D Gupta, Ghazi Muheeb, Girish MP

16. **ARNI Algorithm and GDMT Management of HFrEF** 114
Subhasish Deb, Ranjit Kr Nath

17. **Angiotensin Receptor–Neprilysin Inhibitors in Heart Failure: Outcome Data** 118
Sunil Roy Thottuvelil, Venugopal Krishnan Nair

18. **How Long to Use Angiotensin Receptor–Neprilysin Inhibitor Therapy in Heart Failure: Evidence-based Data** 123
Rupesh Agarwal, Girish MP, Mohit D Gupta

19. **Efficacy and Safety of Angiotensin Receptor–Neprilysin Inhibitor in Acute Myocardial Infarction: Current Status** 128
Saumitra Ray, Srina Ray

20. **Angiotensin Receptor–Neprilysin Inhibitor in Postmyocardial Infarction and Heart Failure** 131
Viveka Kumar

21. **Angiotensin Receptor–Neprilysin Inhibitor Postpercutaneous Coronary Intervention in ST-elevation Myocardial Infarction to Prevent Heart Failure** 134
Sameer Gupta, Purshotam Lal, Richa Aggarwal

22. **Angiotensin Receptor–Neprilysin Inhibitor and Cardiac Arrhythmia in Heart Failure** 138
Surendra Chutani, Arun Chutani, Jui Shah

23. **Angiotensin Receptor–Neprilysin Inhibitor in Ischemic Cardiomyopathy: New Dimensions** 141
HK Chopra, Shachi Kalyani, Viveka Kumar

24. **Angiotensin Receptor–Neprilysin Inhibitor from Molecular Structure to Clinical Application in Heart Failure** 146
VK Katyal, Ashima Katyal, Bijender Singh

25. **Angiotensin Receptor–Neprilysin Inhibitor for Doxorubicin-mediated Cardiotoxicity and Heart Failure** 152
Vansh Arora, Raajit Chanana

26. **Renal Safety and Efficacy of Angiotensin Receptor–Neprilysin Inhibitor in Heart Failure** 155
Dinesh Khullar, Raghav Khullar, Deepak Kumar Panigrahi

27. **Angiotensin Receptor–Neprilysin Inhibitor: "When, for Whom, and How Long in Heart Failure?"** 162
Brian Pinto, Surendra Poonia

28. **Angiotensin Receptor–Neprilysin Inhibitor and Mineralocorticoid Receptor Antagonist Combination in PARAGON-HF: Odd Couple or Dynamic Duo?** 167
Vaibhav Bandil, Suman Bhandari

29. **Role of the Angiotensin Receptor–Neprilysin Inhibitor and Sodium–Glucose Cotransporter 2 Inhibitor in Women with Heart Failure** 171
Mohan Bhargava, Ankit Kumar, Ashutosh Baheti

30. **Angiotensin Receptor–Neprilysin Inhibitor Improves Sexual Functions and Fibrosis of the Clitoral and Vaginal Tissues in Females with Heart Failure** 180
Deepak K Jumani

31. **Is It Time to Adopt Angiotensin Receptor–Neprilysin Inhibitor Therapy as Standard Care for Management of Hypertension?** 184
Neelesh Pandey, Neeraj Pandit

32. **Role of Angiotensin Receptor Blocker and Neprilysin Inhibitor in Resistant Hypertension** 191
Lokre A, Dayasagar Rao V

33. **Will ARNI Replace ARBs/ACEI in Hypertension to Heart Failure?** 197
Jabir Abdullakutty, Vijin Joseph

34. Role of Angiotensin Receptor–Neprilysin Inhibitor in Septic Cardiomyopathy **201**
SN Pathak, Deeptanshu Jain, Pradeep Jain

35. Role of Angiotensin Receptor–Neprilysin Inhibitor in Takotsubo Cardiomyopathy **205**
Rakesh Varma, Shekhar Kunal, Arvind Dambalkar

36. Role of Angiotensin Receptor–Neprilysin Inhibitor in Dilated Cardiomyopathy **211**
Manbir Singh, Vivudh Pratap Singh

37. Role of Angiotensin Receptor–Neprilysin Inhibitor in Critical Care Patients with Heart Failure **215**
Aashish Jain, Manish Bansal, Yatin Mehta

38. Role of Angiotensin Receptor–Neprilysin Inhibitor in Heart Failure Patients on Ventilator **220**
Surabhi Awasthi, Kapil Dixit, Vikas Yadav, Anshika Chaturvedi Kashyap

39. Role of Angiotensin Receptor–Neprilysin Inhibitors in Heart Failure after Heart Transplant Patients **227**
Shobhit Saurav, Ratna Malika Kumar, Rajneesh Malhotra

40. Role of Angiotensin Receptor–Neprilysin Inhibitors in Patients with Heart Failure on Pacemaker and Arrhythmias **231**
Prashant T Upasani, Sameer Gupta, Purshotam Lal

41. MitraClip in Heart Failure in Patients on Angiotensin Receptor–Neprilysin Inhibitors: When and How? **240**
Ramesh Daggubati, Abdul Subhan Talpur, Mustafa Sajjad Cheema

42. Role of Angiotensin Receptor–Neprilysin Inhibitor in Pulmonary Arterial Hypertension with Heart Failure **246**
Arun K Chopra, Neha Chopra

43. Patiromer in Hyperkalemia in Heart Failure and Chronic Kidney Disease and Angiotensin Receptor–Neprilysin Inhibitor Use **250**
Kaushik Manna, Navanil Biswas, DP Sinha

44. Angiotensin Receptor–Neprilysin Inhibitor in Heart Failure: Pharmacodynamics and Outcome **255**
Anil Pareek, Rujul Desai

Sodium–Glucose Cotransporter 2 Inhibitor in Heart Failure

45. New European Society of Cardiology Guidelines of Sodium–Glucose Cotransporter 2 Inhibitors in Heart Failure **263**
Ashish Kumar Jain, JPS Sawhney, Simran Sawhney

46. Top Ten Trials of Sodium–Glucose Cotransporter 2 Inhibitors **268**
Sanchita Sen, Olivia Mechanic, Christos Mihos, Deepika Misra

47. The Evolving Landscape: Integrating Sodium–Glucose Cotransporter 2 Inhibitors in the Contemporary Management of Heart Failure **274**
Saumitra Ray, HK Chopra, Sanjay Jain, Onkar C Swami

48. The Power and Promise of Sodium–Glucose Cotransporter 2 Inhibitor in Heart Failure with Preserved Ejection Fraction **282**
HK Chopra, Anu Grover, Viveka Kumar, Anil Pareek

49. Power and Promise of Sodium–Glucose Cotransporter 2 Inhibitors in Heart Failure with Reduced Ejection Fraction: Outcome Data **290**
Satyendra Tewari, Ashvanee Kumar Sharma, Ashish Kumar Singh

50. Clinical Outcome Data with Sodium–Glucose Cotransporter 2 Inhibitor in Heart Failure **297**
Anil Dhall, Suman Jatain, Mahendra Chouhan, Jasneet Singh

51. Sodium–Glucose Cotransporter 2 Inhibitors in Acute Heart Failure **307**
Maitreyee Bhattacharyya, Aditya Kapoor

52. Role of Sodium–Glucose Cotransporter 2 Inhibitors in Patients with Diabetes Mellitus and Heart Failure **311**
Vinod Mittal

53. Sodium–Glucose Cotransporter 2 Inhibitors in Pulmonary Hypertension in Heart Failure **317**
Bhagwan Mantri, Ritesh Sharma, Tanymol

54. Indication, Contraindication, and Uniqueness of Sodium–Glucose Cotransporter 2 Inhibitor in Heart Failure **321**
HK Chopra, Md Inamul Haque, Sunil M Raheja

55. Role of Sodium–Glucose Cotransporter 2 Inhibitor in Dilated Cardiomyopathy with Heart Failure **330**
Saubhik Kanjilal, Arup Dasbiswas

56. Role of Sodium–Glucose Cotransporter 2 Inhibitors in Hypertrophic Obstructive Cardiomyopathy with Heart Failure **337**
Sumit Rakshit, Debabrata Roy

57. Early Initiation of Sodium–Glucose Cotransporter 2 Inhibitor is Important Irrespective of Ejection Fraction **340**
Kajal Ganguly, Sandipta Roy, Mainak Mukhopadhyay

58. Role of Sodium–Glucose Transport Protein 2 Inhibitors in Septic Cardiomyopathy **343**
Gaurav Kochhar, Yatin Mehta

59. Role of Sodium–Glucose Cotransporter 2 Inhibitors in Takotsubo Syndrome-inflicted Cardiomyopathy **347**
Sarita Gulati, Chaitanya Gulati

60. Sodium–Glucose Cotransporter 2 Inhibitors in Rheumatic Heart Disease with Heart Failure **355**
Arati Dave Lalchandani

61. Sodium–Glucose Cotransporter 2 Inhibitors in Heart Failure with Preserved Ejection Fraction: Fighting the Enemy with a Newly Crafted Weapon **357**
Harshit Khare, Aditya Kapoor

62. Role of Sodium–Glucose Cotransporter 2 Inhibitors in Heart Failure with Atrial Fibrillation **360**
Shraddha Ranjan, Kartikeya Bhargava

63. Sodium–Glucose Cotransporter 2 Inhibitors in Heart Failure with Atrial Fibrillation with Stroke, Peripheral Vascular Disease **364**
NN Khanna, Sushant Mishra, Swati Singh

64. Effect of Sodium–Glucose Cotransporter 2 Inhibitors on Stroke and Atrial Fibrillation in Diabetes Mellitus **369**
Vitull K Gupta, Preeti Singh Dhoat, Meghna Gupta, Varun Gupta

65. Sodium–Glucose Cotransporter 2 Inhibitors (A Tale of Salt, Sugar, and Cancer): Mortality and Morbidity Benefits in Heart Failure with Cancer **373**
Indu Bansal Aggarwal, Hemant Madan, Harmesh Aggarwal

66. Role of Impella in Patients with Shock and Heart Failure **379**
Sarita Rao, Roshan Rao, Kamlesh Kothawade, Achukatla Kumar

67. Dapagliflozin in Heart Failure with Preserved Ejection Fraction 386
Mohit Jindal, Ankit Tandon, Rohit Tandon

68. Role of Sodium–Glucose Cotransporter 2 Inhibitor in All Spectrums of Heart Failure 389
Dev Pahlajani, Pradeep Hasija

69. Mortality and Morbidity Benefits of Sodium–Glucose Cotransporter 2 Inhibitors 397
Sunil Modi, Ranjan Modi

70. Sodium–Glucose Cotransporter 2 Inhibitors in Worsening Heart Failure 401
AK Pancholia

71. Sodium–Glucose Cotransporter 2 Inhibitor in Heart Failure with Diabetes and Chronic Kidney Disease 407
Sarita Bajaj, Yashaswi Pathak, Lekharaj Choudhary

72. Sodium–Glucose Cotransporter 2 Inhibitors in Chronic Kidney Disease and Congestive Cardiac Failure 411
Sunil Prakash, Prabin K Majhi

73. Left Atrial Failure: The Role of SGLT2is, ARNI, Bisoprolol, and MRAs 418
Harinder K Bali, Navdeep S Sidhu

74. Effect of Sodium–Glucose Cotransporter 2 Inhibitors on Cardiovascular Outcomes and Mortality in Diabetes Mellitus 424
Namrata Gaur, Dushyant Singh Gaur

75. Cardiovascular Outcome Trials with Sodium–Glucose Cotransporter 2 Inhibitors in Diabetes 431
Rajeev Chawla, Shalini Jaggi, Siddhant Trehan

76. Development of Treatment Selection Algorithm for Sodium–Glucose Cotransporter 2 Inhibitors in Heart Failure 436
Devesh Kumar, Nirmal Ghati

77. Role of Sodium–Glucose Cotransporter 2 Inhibitors in Cardiac Remodeling: Beyond Glycemic Control 440
Chandrashekhar K Ponde, Mohit Singhal

78. Vascular Remodeling Reversal and Improvement of Endothelial Dysfunction by Sodium–Glucose Cotransporter 2 Inhibitors in Heart Failure 444
Shishu Shankar Mishra, Biswaranjan Mishra

79. Dipeptidyl Peptidase 4 Inhibitors and Cardiovascular Outcome [Heart Failure (HF)]: From Bench to Bedside 450
HK Chopra, Chandrashekhar K Ponde, AK Pancholia, Jignesh Ved

Beta-blockers in Heart Failure

80. Bisoprolol Outcome Data in Hypertension to Heart Failure 456
Deepa Malik, JPS Sawhney, Ayush Kumar

81. American College of Cardiology/American Heart Association Guidelines on Beta-blocker Use in Heart Failure 463
Vineet Bhatia, Meetu Arora, Upendra Kaul

82. Promise of Bisoprolol in Heart Failure: Present Status 467
Ajay Kumar Sinha, Shraddha Ranjan, Sushil Kumar, Pawan Kumar Singh, Shreyash Trived, Deepashree, Manish Singh

83. Bisoprolol in Resistant Hypertension with Heart Failure: A Rising Star and not an Illusion 474
HK Chopra, Anu Grover, AK Pancholia, Anil Pareek

84. Uniqueness of Bisoprolol in Heart Failure **482**
HK Chopra, Chandrashekhar K Ponde, Anu Grover, NR Shastry

85. Role of Bisoprolol in Chronic Kidney Disease with Heart Failure **491**
Himanshu Verma, Sourabh Sharma

86. Role of Bisoprolol in Heart Failure with Stroke and Hypertension **498**
Pradeep Jain, Deeptanshu Jain, SN Pathak

87. Uniqueness of Beta Blockers in Heart Failure **501**
Komal Dahiya, Rajiv Passey

88. Morbidity and Mortality Benefits of Bisoprolol in Heart Failure **506**
Dhiman Kahali, Asit Das, Sreya Mazumder

89. Role of Bisoprolol in Heart Failure with Diabetes Mellitus **514**
Vinod Mittal

90. Role of Bisoprolol in Severe Mitral Regurgitation and Heart Failure **518**
SB Gupta

91. Bisoprolol in Hypertension to Heart Failure **523**
SN Narasingan, Aravind Duruvasal

92. Role of Bisoprolol's Survival Benefits in Heart Failure **528**
Ameet G Sattur

93. Bisoprolol in Atrial Fibrillation and Heart Failure with Reduced Ejection Fraction **532**
Rohit Walia, Mohit Walia, Deepanshu Dhiman

94. Role of Bisoprolol in Tachyarrhythmia with Heart Failure **536**
Jostol Pinto, A George Koshy

95. Role of Bisoprolol in Heart Failure Postmyocardial Infarction **540**
Purneshwar Kumar Pandey, Mitendra Singh Yadav

96. Bisoprolol in Heart Failure due to COVID, Septic, and Peripartum Cardiomyopathy **545**
Meera R, Vijayaraghavan G

97. The Role of Bisoprolol in Primary, Secondary, and Tertiary Prevention of Sudden Cardiac Death in Heart Failure **550**
Kiron Varghese

98. Reverse Cardiac Remodeling: Role of Beta-blockers **554**
Chandrashekhar K Ponde, Kunal A Patankar

99. Beta Blockers in the Management of Chronic Heart Failure **558**
M Somasundaram, GV Senthilnathan, R Divya

100. Use of Beta-blockers in Patients with Heart Failure and Comorbidities **562**
I Sathyamurthy, KN Srinivasan

101. Beyond Beats: Deciphering Bisoprolol in Heart Failure Care **566**
Tiny Nair, HK Chopra, Sanjay Jain, Onkar C Swami

Ferric Carboxymaltose and Heart Failure

102. Ferric Carboxymaltose: A Fifth Pillar in Heart Failure Management **575**
Aniruddha De

103. European Society of Cardiology Recommendation for Ferric Carboxymaltose in Heart Failure **582**
Satyanarayan Routray, Nirmal Kumar Mohanty, Siddhartha Pandey

104. Ferric Carboxymaltose in Heart Failure with Kidney Disease 585
Dilip Bhalla, Ramesh Kumar Sah, Retesh Kumar Singh

105. Global Data on Ferric Carboxymaltose in Heart Failure 590
Prabhakar Dorairaj, Adhiti Krishnamoorthy

106. Iron Deficiency and Heart Failure: Current Perspective 595
Saumitra Ray, Srina Ray

107. Navigating Heart Failure: Unraveling the Role of Ferric Carboxymaltose in Comprehensive Patient Care 599
HK Chopra, Heena Bhojwani, Sanjay Jain, Onkar C Swami

Mineralocorticoid Receptor Antagonists and Heart Failure

108. Mineralocorticoid Receptor Antagonists in Heart Failure with Reduced Ejection Fraction and Heart Failure with Preserved Ejection Fraction 610
VV Muthusamy, Dhanvanth Rajesh B, Anand Priya VVM, LN Meena

109. Mineralocorticoid Receptor Antagonists in HFrEF: ACC/AHA Guidelines 615
Abhishek, Nikita Sharma, Gurpreet Singh Wander

110. Mineralocorticoid Receptor Antagonists in Heart Failure with Reduced Ejection Fraction: Outcome Data 620
Rajan Joseph Manjuran

Vericiguat and Heart Failure

111. Vericiguat in Heart Failure: What are the Guidelines? 622
SS Iyengar, Sneha Karekar

112. Vericiguat in Heart Failure 627
J Cecily Mary Majella, Geetha Subramanian, Surendran

113. Vericiguat in Heart Failure: Scientific Evidence to Clinical Practice 631
Vishal Rastogi, Pragya Kumari, Vijay Kumar

114. Worsening Heart Failure: Identifying the Patient Who will Benefit with Vericiguat 638
Vidyut Jain, Avani Jain

SECTION 3: DIAGNOSTIC BIOMARKERS

115. Role of N-terminal Fragment of pro-B-type Natriuretic Peptide: Diagnostic, Prognostic, and Therapeutic Implications 647
Srikanta Sharma, Aayushi Gupta, Lalatendu Mohanty, HK Chopra

SECTION 4: ECHO, IMAGING AND HEART FAILURE

116. Effect of Angiotensin Receptor–Neprilysin Inhibitors on Left Ventricular and Left Atrial Strain in Heart Failure 655
Donovon Allen, Srijani Thannir, Navin C Nanda, HK Chopra

117. Echocardiographic Reverse Remodeling with Angiotensin Receptor–Neprilysin Inhibitor in Heart Failure 660
Shivani Priyadarshni, Aiham Albaeni, Masood Ahmad

118. Echocardiographic-guided Therapy in Heart Failure 665
Dennis Fong, Iniya Rajendran, Rajesh Janardhanan

119. Effect of E/e' in Heart Failure Patients on Angiotensin Receptor–Neprilysin Inhibitor Therapy **674**
Naveen Garg, KK Kapur

120. Impact of Sodium–Glucose Cotransporter 2 Inhibitor on E/e' in Patients with Heart Failure **680**
Naveen Garg, KK Kapur

121. Echocardiographic Assessment of Left Ventricular Hypertrophy and Left Atrial Volume in Heart Failure **685**
Manish Bansal, Ravi R Kasliwal, HK Chopra, Karishma Walia

122. Echocardiographic Evaluation of Heart Failure in Emergency **694**
Rekha Mishra, Uday S Yadav, Amitabh Poonia

123. Echocardiography Evaluation of the Left Atrial Strain on Patients with SGLT2 Inhibitors with Heart Failure **707**
Amrish Agrawal, Thair Al Jumaily, Vishal Agrawal, Tarik Salim

124. Effect of Sodium–Glucose Cotransporter 2 Inhibitors on Increased Left Atrial Stiffness Index in Heart Failure **712**
Pritam Kitey, Mohit Bhagwati, Rahul Mehrotra, Amitabh Yaduvanshi, Vikas Kataria, Shivank Gupta

125. Heart Failure in Hypertrophic Cardiomyopathy Mechanisms and Management **718**
S Shanmugasundaram, U Ilayaraja, BG Vinodkumar

126. Echocardiographic Variables on Cardiac Remodeling Reversal by Bisoprolol in Heart Failure **734**
Ankush Sachdeva, Sanil Omar, Ashok Kumar Omar

127. Echocardiographic Evaluation of Right Ventricular Parameters in Heart Failure—On ARNI and SGLT2i **739**
Satish C Govind

128. Cardiac Magnetic Resonance Imaging Evaluation on Cardiac Remodeling Reversal after Sodium–Glucose Cotransporter 2 Inhibitors in Heart Failure **745**
Priya Jagia, Damandeep Singh

129. Cardiac Magnetic Resonance Evaluation on Cardiac Remodeling Reversal after Angiotensin Receptor–Neprilysin Inhibitor in Heart Failure **753**
Mona Bhatia, Parveen Kumar, Prasit Maity, Amit Garg, Karthika Gopal, Sachin Raiya, Akash

130. Role of Computed Tomography Evaluation for Transcatheter Aortic Valve Implantation **757**
Anshika Gulati, Parveen Gulati

131. Angiotensin Receptor–Neprilysin Inhibitor and Extracorporeal Membrane Oxygenation **763**
Poonam Malhotra Kapoor

132. Sodium–Glucose Cotransporter 2 Inhibitor and Extracorporeal Membrane Oxygenation in Heart Failure **770**
Poonam Malhotra Kapoor

SECTION 5: CARDIAC RESYNCHRONIZATION THERAPY AND DEVICE

133. Does Angiotensin Receptor–Neprilysin Inhibitor Postpone the Need of Device Therapy in Heart Failure with Reduced Ejection Fraction? **779**
Viveka Kumar

SECTION 6: CORONARY ARTERY DISEASE AND HEART FAILURE

134. Acute Coronary Syndromes and Heart Failure **783**
Brian Pinto, Bhavik Dhirawani, Neeraj A Desai

135. Role of Sodium–Glucose Cotransporter 2 Inhibitors Post-CABG with Heart Failure **789**
Anirban Kundu, OP Yadava

SECTION 7: STROKE AND HEART FAILURE

136. Sodium–Glucose Cotransporter 2 Inhibitors in Stroke Prevention **797**
Vinit Suri, Kunal Suri, Kanika Suri

137. Role of Angiotensin Receptor–Neprilysin Inhibitors in Stroke **803**
Vaibhav Deorari, Mukesh Kumar, Nilesh Jadhao, Joy Dev Mukherji

SECTION 8: ARRHYTHMIA AND HEART FAILURE

138. Newer Left Ventricular Assist Devices: Current Scenario **811**
G Justin Paul, J Cecily Mary Majella

139. Review Outcomes of Recent Device Trials in Heart Failure **820**
Aparna Jaswal, Wasim Rashid

SECTION 9: HYPERTENSION

140. Hypertension and Heart Failure as Stroke Risk Factors **827**
Pawan K Sharma, HK Chopra

141. Heart Failure and Hypertension **833**
Jostol Pinto, A George Koshy

SECTION 10: VALVULAR

142. Heart Support Devices in Heart Failure **841**
Vivudh Pratap Singh, Vishal Rastogi, Vijay Kumar, Ashok Seth

SECTION 11: CONGENITAL HEART DISEASE AND HEART FAILURE

143. Heart Failure in Pediatric Group **853**
Hala Elmarsafawy, Shimaa Khaled

144. End-stage Congestive Heart Failure between the Present and the Future: Is there a Pharmaceutical way to get around it? **865**
Sonia El Saeidi, Antoine Abdel Massih

145. Sodium–Glucose Cotransporter 2 Inhibitors in Pediatric Heart Failure: A Promising Adjuvant/Guidelines **868**
IB Vijayalakshmi, Akkatai S Teli

SECTION 12: NUTRITIONAL

146. Coenzyme Q10 Deficiency and Heart Failure **873**
Pawan K Sharma, HK Chopra

147. Evolving Scenario of Edible Oils in India: A Scientific Perspective on their Prospective Role in the Management of Noncommunicable Diseases **879**
Shashank Joshi, Shilpa Vora

SECTION 13: HEART FAILURE AND CARDIO-ONCOLOGY

148. Angiotensin Receptor–Neprilysin Inhibitor in Heart Failure with Cancer Patients **891**
Kanika Sharma Sood, Mohit Rana, Aditi Tanwar

149. Echocardiography Evaluation of Heart Failure in Oncology **894**
Madhu Mary Minz, Manish Bansal, Ravi R Kasliwal, HK Chopra

SECTION 14: REHABILITATION

150. Exercise Protocol in HFrEF on ARNI, SGLT2i, MRA, and Bisoprolol **907**
Chetan P Shah, Charan Reddy KV

151. Role of Yoga in Heart Failure **912**
SC Manchanda, Ashish Kumar Jain, Kushal Madan

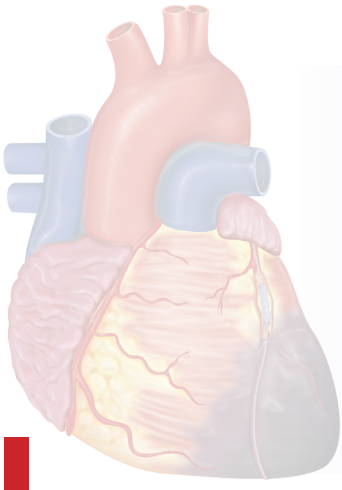
SECTION 15: ARTIFICIAL INTELLIGENCE

152. Artificial Intelligence: Its Impact in the Management of Heart Failure **919**
Vidur Mahajan, Vasanthakumar Venugopal

Index *925*

3

CHAPTER



Salt Intake Thresholds: Ultralow versus Low Sodium Debate

AK Pancholia

INTRODUCTION

There are various clinical scenarios where salt restriction has been advised, such as older persons, hypertension, heart failure, diabetes, metabolic syndrome, and chronic kidney disease.[1-4] Salt intake of <5 g/day for adults and even less for children has been recommended by the World Health Organization (WHO).[5] The European Society of Cardiology (ESC) and the European Society of Hypertension (ESH) 2018 guidelines recommended sodium intake be limited to approximately 2.0 g/day (equivalent to approximately 5.0 g salt per day) in the general population and to try to achieve this goal in all hypertensive adults.[6] The American College of Cardiology (ACC) and the American Heart Association (AHA) 2017 guidelines also endorsed low sodium intake, <1,500 mg/day[7] **(Table 1)**.

Two randomized lifestyle intervention trials, the Trials Of Hypertension Prevention Phase I (TOHP I) and Phase II (TOHP II), showed reduction in blood pressure over 18–48 months[8,9] **(Figs. 1A and B)**.

Apart from that, several other trials also showed benefit of sodium reduction.[10] The debate started regarding low sodium intake based on several prospective cohort studies which revealed a J-curve association of salt intake and cardiovascular disease (CVD) or mortality,[11-19] that is, more salt more risk and even low salt more risk[17] **(Fig. 2)**.

By using spot urinary sodium, the Prospective Urban Rural Epidemiology (PURE) study calculated the 24-hour sodium excretion and the results showed benefit in prevention of CVD with a higher intake range, sodium 3–6 g/day (salt 7.6–15.2 g/day), than currently recommended ultralow sodium intake.[20] Looking at these results, the optimal threshold for population sodium intake is not clearly established. The key issues are the challenge of sodium intake to assess measurement limitations as well as patient-related factors and also the wide variation of sodium intake to the physiological responses.

TABLE 1: 2017 American College of Cardiology/American Heart Association (ACC/AHA) recommendation for sodium intake in hypertension.

Nutrition recommendations to reduce blood pressure		
COR	*LOR*	*Recommendation*
I	A	Sodium reduction is recommended for adults with elevated BP or hypertension
Dose		Optimal goal is <1,500 mg/day, but aim for at least a 1,000 mg/day reduction in most adults

(BP: blood pressure; COR: class of recommendation; LOR: level of evidence)

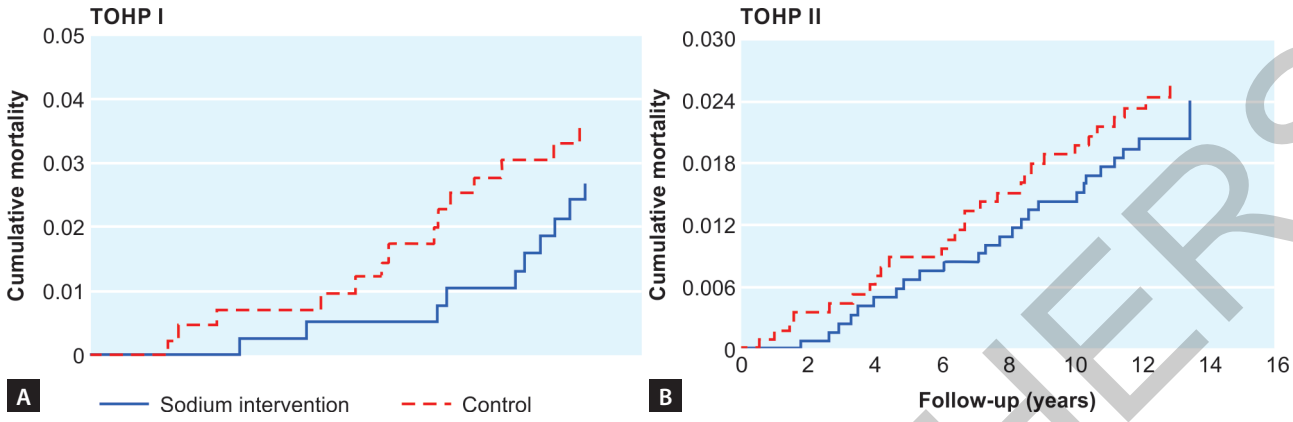
Source: Whelton PK, Carey RM, Aronow WS, Casey Jr DE, Collins KJ, Himmelfarb CD, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Hypertension. 2018;71(6).

DOES A REDUCTION IN SODIUM INTAKE REDUCE CARDIOVASCULAR RISK?

Debate

Despite the fact that low sodium intake reduces blood pressure and thus cardiovascular (CV) events, Mente et al.[21] argue that there is no "definitive evidence" or any

JAYPEE BROTHERS



Figs. 1A and B: Cumulative incidence of cardiovascular disease (CVD) by sodium intervention group in the Trials Of Hypertension Prevention (TOHP) (A) I and (B) II, adjusted for age, sex, and clinic.
Source: Cook NR, Cutler JA, Obarzanek E, Buring JE, Rexrode KM, Kumanyika SK, et al. Long term effects of dietary sodium reduction on cardiovascular disease outcomes: observational follow-up of the Trials Of Hypertension Prevention (TOHP). BMJ. 2007;334(7599): 885-8.

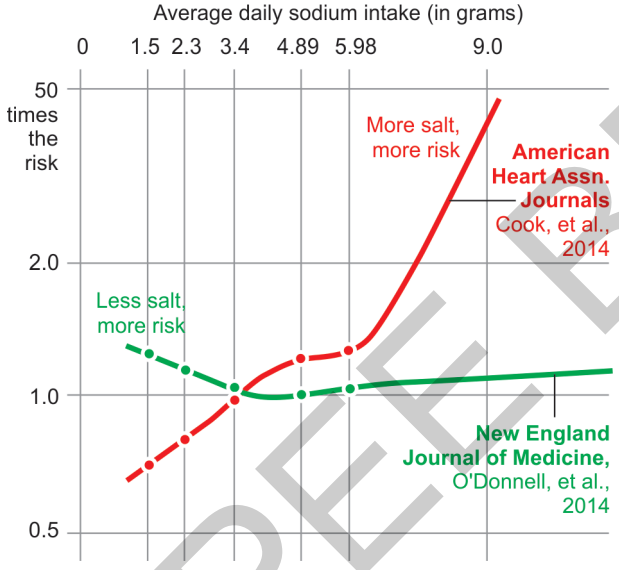


Fig. 2
Source: O'Donnell et al.[17]

study showing a "clear reduction" in clinical outcomes from reducing sodium intake. The statement is incorrect and initiated a debate on this important public health issue. In fact, randomized clinical trials, including TONE[22] and TOHP,[8,9] and meta-analyses of these studies, showed that moderately reducing sodium intake from 4,100 to 2,300 mg reduces CV events by 20–30%.[23] Apart from that, a recent large trial from China[24] showed that a reduction in sodium consumption to even 350 mg/day with an increase in potassium consumption of 803 mg showed a statistically significant 14% reduction in fatal and nonfatal strokes over 4.7 years of follow-up, with reductions of nonfatal acute coronary syndrome events (–30%) and of deaths from any cause (–12%).

Sodium-reduction recommendations have been questioned recently by eight articles published on sodium and CVD in the European Heart Journal toward the end of 2020 and the beginning of 2021. These articles conclude that there is insufficient evidence to date to recommend a low sodium intake (<2,300 mg) at the population level.[25]

Observational Studies which showed J-effect

Graudal et al.[11] found a J-effect with high CV events and mortality with consumption of sodium both above 5 g/day and below 2.7 g/day, compared with moderate levels of intake (2.7–5 g/day).

PURE international study (n = 101,945 participants, follow-up of 7.2 years)[20] also found a J-shaped association between sodium excretion and increased CV events with the lowest risk of events between 3 and 5 g/day. PURE also showed mitigation of high CV events with excess sodium by consuming high potassium.[26]

UK-Biobank (n = 322,624 participants, follow-up of 7.0 years)[27] found that increased risk with high sodium intake (above 5 g/day) was largely confined to those with hypertension, a finding consistent with the PREVEND study.[28]

Other landmark studies, which showed higher risk for CV events or death with low sodium intake, compared to average intake, are ONTARGET/TRANSCEND,[14] EPIDREAM,[29] EPIC-Norfolk,[12] PREVEND,[28] NHANES-I, II, and III,[30-32] FLEMENGHO/EPOGH,[13] SURDIAGENE,[33] and CRIC studies.[34]

JAYPEE BROTHERS

Explanation for the J-effect

There are many inherent limitations of the analyses by Messerli et al.[35] Correlation of sodium intake and outcomes is to be taken by an individual, not by a country. Many countries do not have data on sodium intake and, whatever available, it is often of poor quality. To estimate 24-hour urinary sodium excretion, calculating spot urine samples with discredited conversion formulas is not correct. Using Kawasaki or other formulas for estimating salt intake from 24-hour urinary sodium excretion is also incorrect.[36-38] These cohort studies have several methodological problems, including reverse causality and inaccurate and biased estimation of salt intake, e.g., from a single spot urine sample with formulas. Recent studies have shown that the formulas used to estimate salt intake from spot urine cause a spurious J-curve. Thus, a more accurate method is needed from spot sample to estimate 24-hour urine sodium.[39] Several 24-hour urine collections are needed to detect an individual's usual sodium intake with a high degree of confidence (i.e., within 10%) with no bias.[40-43] Moreover, these formulas are important contributors to the J-shaped association between sodium intake and CVD or mortality because the formulas make use of age, sex, urinary creatinine concentration, height, and weight, most of which are independent predictors of CVD and mortality[44-46] **(Fig. 3)**.

In 2019, the report by the National Academies of Sciences, Engineering, and Medicine (NASEM)[45] did not consider the evidence and conclusions from these cohort studies and meta-analyses. Instead, the report focused mainly on the data from the TOHP trial.[8,9] Their report concludes the linear association between sodium intake and CV events. World Heart Federation, ESH, and European Public Health considered the same information in their technical report in 2017.

RECOMMENDATION BASED ON CURRENT EVIDENCE[25]

At Individual Level

Avoid recommending a specific g/day sodium intake target, as there are no large clinical outcome trials, and proper methods to measure sodium intake accurately in individuals. It is reasonable to provide practical advice on avoidance of key sources of high sodium intake (especially those food items independently associated with CV risk, such as processed foods with high sodium content). This guidance should be embedded within recommendations on overall dietary quality and best targeted at specific groups of individuals, particularly those with hypertension.

At Population Level

Existing evidence has been put to the question as there are differences of opinion in interpretation of it. Based upon observational studies, it is reasonable to suggest a population-level mean target of 5 g/day and await the results of large randomized controlled trials of sodium reduction on the incidence of CV events and mortality.

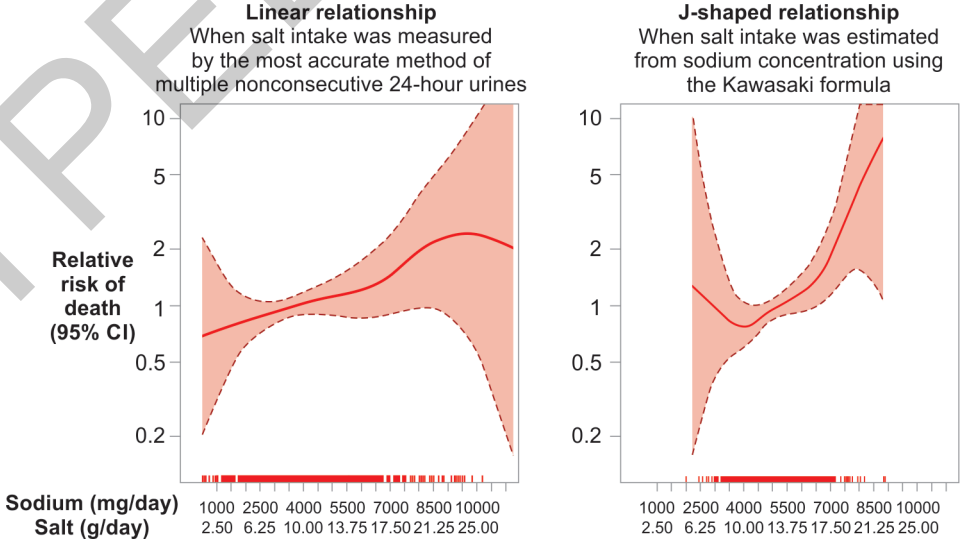


Fig. 3: Salt intake and mortality in cohort studies. (CI: confidence interval)
Source: He et al.[45]

JAYPEE BROTHERS

CONCLUSION

There is little evidence that ultralow sodium intake will further reduce CV events or death. Therefore, it cannot be justified to reduce sodium intake in entire populations. It is better to target individuals consuming high amounts of sodium (>5 g/day). At present, it is premature to reduce sodium intake in whole populations. Two recent reviews by a group of experts (with diverse opinions and background) have also concluded the same. There is a need for large clinical trials to answer this controversy; till then, the optimal sodium intake should be in the range between 3 and 5 g/day.

REFERENCES

1. Mozaffarian D, Fahimi S, Singh GM, Micha R, Khatibzadeh S, Engell RE, et al. Global sodium consumption and death from cardiovascular causes. N Engl J Med. 2014;371:624-34.
2. He FJ, Li J, MacGregor GA. Effect of longer term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomised trials. BMJ. 2013; 346:f1325.
3. Graudal NA, Hubeck-Graudal T, Jürgens G. Effects of low-sodium diet vs. high-sodium diet on blood pressure, renin, aldosterone, catecholamines, cholesterol, and triglyceride (Cochrane Review). Am J Hypertens. 2012;25(1):1-15.
4. Suckling RJ, He FJ, Markandu ND, MacGregor GA. Modest salt reduction lowers blood pressure and albumin excretion in impaired glucose tolerance and type 2 diabetes mellitus: a randomized double-blind trial. Hypertension. 2016;67(6):1189-95.
5. World Health Organization. Guideline: Sodium Intake for Adults and Children. Geneva: World Health Organization; 2012.
6. Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M, et al. 2018 ESC/ESH Guidelines for the management of arterial hypertension. Eur Heart J. 2018;39(33):3021-104.
7. Whelton PK, Carey RM, Aronow WS, Casey Jr DE, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation. 2018;138:e484-594.
8. Whelton PK, Appel L, Charleston J, Dalcin AT, Ewart C, Fried L, et al. The effects of nonpharmacologic interventions on blood pressure of persons with high normal levels. Results of the Trials of Hypertension Prevention, Phase I. JAMA. 1992;267(9):1213-20.
9. Trials of Hypertension Prevention Collaborative Research Group (TOHP II). Effects of weight loss and sodium reduction intervention on blood pressure and hypertension incidence in overweight people with high-normal blood pressure: the Trials of Hypertension Prevention, Phase II. Arch Intern Med. 1997;157(6):657-67.
10. Aburto NJ, Ziolkovska A, Hooper L, Elliott P, Cappuccio FP, Meerpohl JJ. Effect of lower sodium intake on health: systematic review and meta-analyses. BMJ. 2013;346: f1326.
11. Graudal N, Jürgens G, Baslund B, Alderman MH. Compared with usual sodium intake, low- and excessive-sodium diets are associated with increased mortality: a meta-analysis. Am J Hypertens. 2014;27(9):1129-37.
12. Pfister R, Michels G, Sharp SJ, Luben R, Wareham NJ, Khaw KT. Estimated urinary sodium excretion and risk of heart failure in men and women in the EPIC-Norfolk study. Eur J Heart Fail. 2014;16(4):394-402.
13. Stolarz-Skrzypek K, Kuznetsova T, Thijs L, Tikhonoff V, Seidlerová J, Richart T, et al. Fatal and nonfatal outcomes, incidence of hypertension, and blood pressure changes in relation to urinary sodium excretion. JAMA. 2011; 305(17):1777-85.
14. O'Donnell MJ, Yusuf S, Mente A, Gao P, Mann JF, Teo K, et al. Urinary sodium and potassium excretion and risk of cardiovascular events. JAMA. 2011;306(20):2229-38.
15. Thomas MC, Moran J, Forsblom C, Harjutsalo V, Thorn L, Ahola A, et al. The association between dietary sodium intake, ESRD, and all-cause mortality in patients with type 1 diabetes. Diabetes Care. 2011;34(4):861-6.
16. Ekinci EI, Clarke S, Thomas MC, Moran JL, Cheong K, MacIsaac RJ, et al. Dietary salt intake and mortality in patients with type 2 diabetes. Diabetes Care. 2011;34(3): 703-9.
17. O'Donnell M, Mente A, Rangarajan S, McQueen MJ, Wang X, Liu L, et al. Urinary sodium and potassium excretion, mortality, and cardiovascular events. N Engl J Med. 2014;371:612-23.
18. Yusuf S, Rangarajan S, Teo K, Islam S, Li W, Liu L, et al. Cardiovascular risk and events in 17 low-, middle-, and high-income countries. NEJM. 2014;371(9):818-27.
19. Cook NR, Appel LJ, Whelton PK. Lower levels of sodium intake and reduced cardiovascular risk. Circulation. 2014;129(9):981-9.
20. Mente A, O'Donnell M, Rangarajan S, McQueen M, Dagenais G, Wielgosz A, et al. Urinary sodium excretion, blood pressure, cardiovascular disease, and mortality: a community-level prospective epidemiological cohort study. Lancet. 2018;392(10146):496-506.
21. Mente A, O'Donnell M, Yusuf S. Sodium and health: another challenge to the current dogma. EHJ. 2021;42(21): 2116-8.
22. Whelton PK, Appel LJ, Espeland MA, Applegate WB, Ettinger Jr WH, Kostis JB, et al. Sodium reduction and weight loss in the treatment of hypertension in older persons: a randomized controlled trial of nonpharmacologic interventions in the elderly (TONE). TONE Collaborative Research Group. JAMA. 1998;279(11):839-46.
23. He FJ, MacGregor GA. Salt reduction lowers cardiovascular risk: meta-analysis of outcome trials. Lancet. 2011;378(9789):380-2.

JAYPEE BROTHERS

24. Neal B, Wu Y, Feng X, Zhang R, Zhang Y, Shi J, et al. Effect of salt substitution on cardiovascular events and death. N Engl J Med. 2021;385:1067-77.
25. O'Donnell M, Mente A, Alderman MH, Brady AJB, Diaz R, Gupta R, et al. Salt and cardiovascular disease: insufficient evidence to recommend low sodium intake. Eur Heart J. 2020;41(35):3363-73.
26. O'Donnell M, Mente A, Rangarajan S, McQueen MJ, O'Leary N, Yin L, et al. Joint association of urinary sodium and potassium excretion with cardiovascular events and mortality: prospective cohort study. BMJ. 2019;364: 1772.
27. Welsh C, Welsh P, Jhund P, Delles C, Celis-Morales C, Lewsey JD, et al. Urinary sodium excretion, blood pressure, and risk of future cardiovascular disease and mortality in subjects without prior cardiovascular disease. Hypertension. 2019;73:1202-9.
28. Joosten MM, Gansevoort RT, Mukamal KJ, Lambers Heerspink HJ, Geleijnse JM, Feskens EJ, et al. Sodium excretion and risk of developing coronary heart disease. Circulation. 2014;129:1121-8.
29. Mente A, O'Donnell M, Rangarajan S, Dagenais G, Lear S, McQueen M, et al. Associations of urinary sodium excretion with cardiovascular events in individuals with and without hypertension: a pooled analysis of data from four studies. Lancet. 2016;388:465-75.
30. Alderman MH, Cohen H, Madhavan S. Dietary sodium intake and mortality: the National Health and Nutrition Examination Survey (NHANES I). Lancet. 1998;351:781-5.
31. Cohen HW, Hailpern SM, Fang J, Alderman MH. Sodium intake and mortality in the NHANES II follow-up study. Am J Med. 2006;119:275.e7-14.
32. Cohen HW, Hailpern SM, Alderman MH. Sodium intake and mortality follow-up in the Third National Health and Nutrition Examination Survey (NHANES III). J Gen Intern Med. 2008;23:1297-302.
33. Saulnier PJ, Gand E, Hadjadj S. Sodium and cardiovascular disease. N Engl J Med. 2014;371:2135-6.
34. Mills KT, Chen J, Yang W, Appel LJ, Kusek JW, Alper A, et al. Sodium excretion and the risk of cardiovascular disease in patients with chronic kidney disease. JAMA. 2016;315:2200-10.
35. Messerli FH, Hofstetter L, Syrogiannouli L, Rexhaj E, Siontis GCM, Seiler C, et al. Sodium intake, life expectancy, and all-cause mortality. EHJ. 2021;42(21): 2103-12.
36. Cogswell ME, Wang CY, Chen TC, Pfeiffer CM, Elliott P, Gillespie CD, et al. Validity of predictive equations for 24-h urinary sodium excretion in adults aged 18–39 y. Am J Clin Nutr. 2013;98(6):1502-13.
37. Ji C, Miller MA, Venezia A, Strazzullo P, Cappuccio FP. Comparisons of spot vs 24-h urine samples for estimating population salt intake: validation study in two independent samples of adults in Britain and Italy. Nutr Metab Cardiovasc Dis. 2014;24(2):140-7.
38. Wang CY, Cogswell ME, Loria CM, Chen TC, Pfeiffer CM, Swanson CA, et al. Urinary excretion of sodium, potassium, and chloride, but not iodine, varies by timing of collection in a 24-hour calibration study. J Nutr. 2013;143(8):1276-82.
39. Peng Y, Li W, Wang Y, Chen H, Bo J, Wang X, et al. Validation and assessment of three methods to estimate 24-h urinary sodium excretion from spot urine samples in Chinese adults. PLoS One. 2016;11(2):e0149655.
40. Lerchl K, Rakova N, Dahlmann A, Rauh M, Goller U, Basner M, et al. Agreement between 24-hour salt ingestion and sodium excretion in a controlled environment. Hypertension. 2015;66(4):850-7.
41. Liu K, Cooper R, Soltero I, Stamler J. Variability in 24-hour urine sodium excretion in children. Hypertension. 1979; 1(6):631-6.
42. Liu K, Dyer AR, Cooper RS, Stamler R, Stamler J. Can overnight urine replace 24-hour urine collection to asses salt intake? Hypertension. 1979;1(5):529-36.
43. Siani A, Iacoviello L, Giorgione N, Iacone R, Strazzullo P. Comparison of variability of urinary sodium, potassium, and calcium in free-living men. Hypertension. 1989;13(1): 38-42.
44. He FJ, Ma Y, Campbell NRC, MacGregor GA, Cogswell ME, Cook NR. Formulas to estimate dietary sodium intake from spot urine alter sodium-mortality relationship. Hypertension. 2019;74(3):572-80.
45. He FJ, Campbell NRC, Woodward M, MacGregor GA. Salt reduction to prevent hypertension: the reasons of the controversy. EHJ. 2021;42(25):2501-5.
46. National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Food and Nutrition Board; Committee to Review the Dietary Reference Intakes for Sodium and Potassium. Oria M, Harrison M, Stallings VA (Eds). Health and Medicine Division Dietary Reference Intakes for Sodium and Potassium. Washington, DC, USA: National Academies Press; 2019.

JAYPEE BROTHERS

detailed information on cardiology books, visit our website www.jaypeebrothers.com, for detailed information on cardiology books, visit our website www.jaypeebrothers.com, for detailed information on cardi

Advances & Revolutions in Heart Failure (ARHF)

A Textbook of Cardiology

It is the first publication of its kind in the form of a textbook of cardiology from India to the world. Over 300 contributors from India and abroad have contributed their prestigious chapters in this book. This book focuses on every aspect of heart failure management with enormous information about advances in clinical approach, imaging including echocardiography and multimodality imaging, drug, mechanical and surgical interventions for better patient care. It has tremendous innovative and research potential of understanding advances and revolutions in heart failure for the undergraduates, postgraduates, practicing cardiologists, endocrinologists, nephrologists, neurologists, critical care specialists, pulmonologists, pediatricians, pediatric surgeons, physicians, cardiovascular surgeons, imaging experts, nutritionists, etc. The book includes 15 sections and 152 chapters.



HK Chopra is the Senior Consultant Cardiologist, working in Moolchand Medcity, New Delhi, India, for the last 43 years, and now at Medanta–Moolchand Heart Institute, New Delhi. He is the Chairman of CME, Moolchand Medcity. He is the Chairman of World Wellness Foundation and was the President of the Cardiological Society of India (2015) and Indian Academy of Echocardiography (2017). He has pioneering contribution in thrombolysis in STEMI since 1983 in India and at Cedar Sinai Hospital, University of California, Los Angeles, USA, with Dr William Ganz (1985–86) and University of Alabama, USA, with Dr Navin C Nanda (1986–87). He has organized more than 25 World Congresses in Cardiology and is the country head, American Heart Association (AHA). He is the Editor-in-Chief of *Advances in Clot Treatment, Advances in Statin Therapy and Beyond in CVD, Hypertension: New Frontiers, Advances and Innovation in Heart Failure, Advances in Clinical Cardiovascular Imaging, Echocardiography and Interventions Cardiodiabetes Update, Atrial Fibrillation Update, STEMI Update, Heart Protection Book,* and *CSI Cardiology Update 2014* by M/s Jaypee Brothers Medical Publishers (P) Ltd, New Delhi. He has authored the book *"Lifestyle and Health: A Mind Body Capsule"*. He is the former Editor-in-Chief of Indian Heart Journal and Journal of Indian Academy of Echocardiography. He is the Chief Advisor of the Health Committee of SCOPE. He has contributed more than 840 articles in various national and international journals. His clinical research work is recognized all over the world. He is a recipient of various national and international awards. Recently, he was conferred National Award by Science and Technological Communications, Ministry of Science and Technology, Government of India, for most popular 12 focused textbooks of Cardiology. He was conferred a special award "World Icon in Cardiology" by American Association of Cardiologists of Indian Origin (AACIO), USA, for the first time in the world as a Chief Editor of top 12 textbooks of cardiology on 12 topics in 12 years, thus making India proud. He was conferred recognition of Icon of the Century in Clinical Preventive Cardiology by Bharat Ratna Dr APJ Abdul Kalam, Former President of India, and Ministry of Health, Government of India. He has organized more than 2,200 workshops on public health education and heart checkup camps. He is FRCP. He is a fellow of ACC, ESC, ISCU, CSI, IMSA, ASE, IAE, and GSI.



Navin C Nanda is the Distinguished Professor of Medicine and Cardiovascular Disease, University of Alabama at Birmingham, Birmingham, Alabama, USA, and President, International Society of Cardiovascular Ultrasound (ISCU). He is the Editor-in-Chief, Echocardiography: A Journal of Cardiovascular Ultrasound and Allied Techniques. He is the Hon. President, Dr Navin C Nanda Echocardiograph, Emergency Medicine and Paramedics Training Institute (EEPI), Jaipur, Rajasthan, India. He is the Patron, Navin C Nanda Institute of Excellence in Cardiovascular Ultrasound, Nashik, Maharashtra, India. He is also International President, JROP Institute of Echocardiography, New Delhi, India. He is a nationally and internationally renowned cardiologist and echocardiographer "whose pioneering work has significantly altered the way cardiology is practiced in the world today". Dr Nanda was awarded the prestigious Ellis Island Medal of Honor (USA) in 2006 and also the 2010 International Service Award from the American College of Cardiology for "significantly enhancing cardiovascular care throughout the world". Dr Nanda was declared the "Echocardiographer of the Millennium" by the Argentinean and Columbian Societies of Cardiology and the "Prince of Echocardiography" by the Italian Society of Echocardiography. He was also named the "Father of Echocardiography" by the Emirates Cardiology Society and the Indian Academy of Echocardiography and "Father of Modern Echocardiography" by the Chinese Medical Association, the largest medical association in that country.



Jagat Narula is the Executive Vice President and Chief Academic Officer, University of Texas Health Sciences Center, Houston, Texas, USA. He was the Professor of Medicine and holds the Philip J and Harriet L Chair in Cardiovascular Medicine at the Mount Sinai Hospital in New York. He is also the Director of the Cardiovascular Imaging Program at the Zena and Michael A Wiener Cardiovascular Institute and of the Marie-Josée and Henry R Kravis Center for Cardiovascular Health, as well as Associate Dean for Global Health at the Mount Sinai School of Medicine. He is the President-Elect, World Heart Federation. He is the Executive Editor of Journal of American College of Cardiology and Editor-in-Chief of the Journal of WHF. Dr Narula after completing his cardiology fellowship training and PhD (Cardiovascular Immunology) from AIIMS, New Delhi, relocated to Massachusetts General Hospital (MGH) and Harvard Medical School in 1989. At MGH, after Cardiology, Heart Failure and Transplantation, and Nuclear Cardiology Fellowships, he joined the cardiology faculty. In 1997, he moved to Hahnemann University School of Medicine, Philadelphia, where he was Thomas J Vischer Professor of Medicine, Chief of the Division of Cardiology, Vice Chairman of the Department of Internal Medicine, and the Director of Heart Failure and Transplantation Center. He subsequently joined University of California, Irvine School of Medicine (2003), as Chief of the Division of Cardiology, Associate Dean for Research, and Director of the Cardiovascular Center of the UC Irvine's Douglas Hospital. He was also the Director of MemorialCare Heart and Vascular Institute, Long Beach Memorial Hospital, California, and Medical Director of the Edwards Lifesciences Center for Advanced Cardiovascular Technology in UC Irvine's Henry Samueli School of Engineering, California. He moved to Mount Sinai as the Philip J and Harriet L Goodhart Chair in Cardiology, and the Director of Cardiovascular Imaging Program in the Mount Sinai's Zena and Michael A Wiener Cardiovascular Institute in 2011. Dr Narula has more than 1,000 original research publications or presentations to his credit and more than 35 books or journal supplements edited and has been awarded as "Best Young Investigator" on several occasions for his research contributions. He was awarded as the Best Educator as well as the Innovator in Cardiovascular Medicine by the American College of Cardiology in the year 2012 and was honored as the Master of the American College of Cardiology in 2013. He has received the Distinguished Scientist Award 2015 from the American College of Cardiology.



GS Wander is the Professor and Head, Department of Cardiology, Dayanand Medical College and Hospital, Unit of Hero DMC Heart Institute, Ludhiana, Punjab, India and Coordinator of Hero DMC Heart Institute. He has been instrumental in the planning, conception, construction, and running of this institute. He was the President of the Association of Physicians of India (2016–17) and Hypertension Society of India (2012–13). He was the Member of Core Committee which has formulated Indian Guidelines for Management of Hypertension in 2001, 2005, and 2013. He has published 170 papers, 45 of them in the Lancet, Nature Genetics, JACC, BHJ, and JHJ. He has organized various conferences like ISH, HSI, IMSACON, CSI, ACADIMA, etc. He has been Guest Faculty and delivered lectures in various national and international conferences. He was awarded the Dr BC Roy Award in 2006 from Smt Pratibha Patil, Ex-President of India, Dr K Sharan Cardiology Excellence Award by India Medical Association (IMA).



CN Manjunath is the Professor of Cardiology and the Director, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bengaluru, Karnataka, India and practicing the "Treatment First Payment Next" concept. He was the President of the Indian College of Cardiology. He has been awarded for success and achievement in the field of medicine with "Padma Shri" in 2007 by the President of India. He was honored "Man of the Year" by Bangalore Press Club in 2016 and "Doctorate of Science" from Rajiv Gandhi University of Health Sciences, Bengaluru, in 2012. He was awarded Millennium Plaque of Honour by Hon'ble Prime Minister of India. He has performed more than 26,000 cardiac interventions including coronary and noncoronary cases. He has done the highest number of balloon mitral valvuloplasties with Accura balloon in India and had done original research on Accura balloon resulting in balloon valvuloplasty operations. He has more than 250 publications in international and national journals and has conducted live workshops for more than 10–15 national and international conferences. He has authored chapters in many textbooks. He is the author and architect of "Hrudaya Sanjeevini Scheme for the Poor".



Praveen Chandra is the Chairman of Interventional Cardiology at Medanta—The Medicity, Gurugram, Haryana, India and Medanta–Moolchand Heart Institute, New Delhi. He is recognized as one of the leaders in angioplasty in the country and is proficient in a lot of new devices and technologies. He has been awarded for success and achievement in the field of medicine with "Padma Shri" in 2016 by the President of India. He served as Director of Cardiac Cath Lab and Acute MI Services at Max Healthcare and Consultant Cardiologist at Escorts Heart Institute and Research Center, New Delhi. He is a Fellow of the Endovascular Intervention Society of India and the Asia-Pacific Society of Interventional Cardiology. Dr Chandra has been a distinguished faculty member in various international meetings. He has published approximately 100 articles, reviews, and abstracts in various national and international journals. He has been awarded the prestigious Recognition Award for Success and Achievement in the field of angioplasty in India in 1998. He did percutaneous aortic valve implantation without surgery for the first time in India. He also did the first-ever percutaneous mitral valve repair. Both have important implications in our country with the highest number of valvular cases in the world.



Viveka Kumar is the Principal Director and Chief of Cath Labs (Pan Max)—Cardiac Sciences and Max Heart and Vascular Institute, Saket, New Delhi, India. He has extensive experience in the field of cardiac interventions and electrophysiology. He specializes in complex angioplasties including multivessel, bifurcation and left main angioplasties with rotablation, FFR, IVUS, IABP, IMPELLA devices. He has done more than 7,500 angioplasties and 2,500 balloon valvotomies with good outcome. He is in Editorial Board of Indian Heart Journal. He is Principal Investigator and Subinvestigator of more than 14 international trials. He is recipient of Chikitsa Ratna Award, DMA and Vidya Ratna Award, Kanpur University, Uttar Pradesh. He is Fellow of SCAI, MHRS and ACC.



CK Ponde is the Head, Department of Cardiology, PD Hinduja Hospital and Medical Research Centre, Mumbai, Maharashtra, India. He was National President, IAE and is recipient of Rashtriya Jan Seva Puraskar 2006. He has up to 150 publications in national and international journals to his credit.



AK Pancholia is the Head, Department of Clinical and Preventive Cardiology, Arihant Hospital, Indore, Madhya Pradesh, India. He is Convener of CSI-RHD Council, he was the Associate Editor of Indian Heart Journal, and was the Organizing Secretary, 1st National CSI-Heart Failure Conference, Indore, 2015. He is the recipient of Excellence in Cardiology Award by American Association of Cardiologists of Indian Origin (AACIO).

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

Shelving Recommendation
CARDIOLOGY

ISBN 978-93-5696-536-2