

围术期经食管 超声心动图学

Perioperative Transesophageal Echocardiography

A companion to Kaplan's Cardiac Anesthesia

主编 David L. Reich Gregory W. Fischer

主译 于 晖 王 晟 宋海波 彭勇刚

主审 刘 进 左明章 于 晖 彭勇刚



围术期经食管超声心动图学

Perioperative Transesophageal Echocardiography

A companion to Kaplan's Cardiac Anesthesia

主编

David L. Reich Gregory W. Fischer



主译

于晖 王晟 宋海波 彭勇刚



主审

刘进 左明章 于晖 彭勇刚



人民卫生出版社

图书在版编目(CIP)数据

围术期经食管超声心动图学/(美) 大卫·L·莱希
(David L. Reich) 主编;于晖等主译. —北京:人民卫生
出版社,2018

ISBN 978-7-117-26183-8

I. ①围… II. ①大…②于… III. ①超声心动图
IV. ①R540.4

中国版本图书馆 CIP 数据核字(2018)第 039375 号

人卫智网 www.ipmph.com 医学教育、学术、考试、健康,
购书智慧智能综合服务平台
人卫官网 www.pmph.com 人卫官方资讯发布平台

版权所有,侵权必究!

围术期经食管超声心动图学

主 译:于晖 王晟 宋海波 彭勇刚

出版发行:人民卫生出版社(中继线 010-59780011)

地 址:北京市朝阳区潘家园南里 19 号

邮 编:100021

E-mail: pmph@pmph.com

购书热线:010-59787592 010-59787584 010-65264830

印 刷:北京顶佳世纪印刷有限公司

经 销:新华书店

开 本:889×1194 1/16 印张:26

字 数:842 千字

版 次:2018 年 4 月第 1 版 2018 年 4 月第 1 版第 1 次印刷

标准书号:ISBN 978-7-117-26183-8/R·26184

定 价:286.00 元

打击盗版举报电话:010-59787491 E-mail: WQ@pmph.com

(凡属印装质量问题请与本社市场营销中心联系退换)

围术期经食管超声心动图学

Perioperative Transesophageal Echocardiography

A companion to Kaplan's Cardiac Anesthesia

主编

David L. Reich Gregory W. Fischer



主译

于晖 王晟 宋海波 彭勇刚



主审

刘进 左明章 于晖 彭勇刚



人民卫生出版社

ELSEVIER

Elsevier (Singapore) Pte Ltd.

3 Killiney Road

#08-01 Winsland House I

Singapore 239519

Tel: (65) 6349-0200

Fax: (65) 6733-1817

Perioperative Transesophageal Echocardiography: A companion to Kaplan's Cardiac Anesthesia

© 2014 by Saunders, an imprint of Elsevier Inc. All rights reserved.

ISBN-13: 978-1-4557-0761-4

This translation of Perioperative Transesophageal Echocardiography: A companion to Kaplan's Cardiac Anesthesia by David L. Reich and Gregory W. Fischer was undertaken by People's Medical Publishing House and is published by arrangement with Elsevier (Singapore) Pte Ltd.

Perioperative Transesophageal Echocardiography: A companion to Kaplan's Cardiac Anesthesia by David L. Reich and Gregory W. Fischer 由人民卫生出版社进行翻译,并根据人民卫生出版社与爱思唯尔(新加坡)私人有限公司的协议约定出版。

《围术期经食管超声心动图学》(于晖 王晟 宋海波 彭勇刚 主译)

ISBN: 978-7-117-26183-8/R · 26184

Copyright © 2018 by Elsevier (Singapore) Pte Ltd.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from Elsevier (Singapore) Pte Ltd. Details on how to seek permission, further information about Elsevier's permissions policies and arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at the website: www.elsevier.com/permissions.

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

注 意

本译本由 Elsevier (Singapore) Pte Ltd. 和人民卫生出版社完成。相关从业及研究人员必须凭借其自身经验和知识对文中描述的信息数据、方法策略、搭配组合、实验操作进行评估和使用。由于医学科学发展迅速,临床诊断和给药剂量尤其需要经过独立验证。在法律允许的最大范围内,爱思唯尔、译文的原文作者、原文编辑及原文内容提供者均不对译文或因产品责任、疏忽或其他操作造成的人身及/或财产伤害及/或损失承担责任,亦不对由于使用文中提到的方法、产品、说明或思想而导致的人身及/或财产伤害及/或损失承担责任。

Printed in China by People's Medical Publishing House under special arrangement with Elsevier (Singapore) Pte Ltd. This edition is authorized for sale in the People's Republic of China only, excluding Hong Kong SAR, Macau SAR and Taiwan. Unauthorized export of this edition is a violation of the contract.

译校者名单 (按姓氏汉语拼音排序)

中文姓名	英文姓名	单位
卜心怡	Bu Xinyi	南京市第一医院
邓晓倩	Deng Xiaoqian	四川大学华西医院
都义日	Du Yiri	内蒙古医科大学附属医院
葛亚力	Ge Yali	南京市第一医院
郭文娟	Guo Wenjuan	北京协和医院
郭翔	Guo Xiang	北京医院
何毅	He Yi	广东省人民医院
黄佳鹏	Huang Jiapeng	Clinical professor of Anesthesiology & Perioperative Medicine, University of Louisville, Louisville, KY, USA
黄小聪	Huang Xiaocong	广东省人民医院
姜春玲	Jiang Chunling	四川大学华西医院
梁霄	Liang Xiao	四川大学华西医院
刘进	Liu Jin	四川大学华西医院
苗永盛	Miao Yongsheng	北京医院
彭玲	Peng Ling	四川大学华西医院
彭勇刚	Peng Yonggang	Professor of Anesthesiology, Chief, Cardiothoracic Anesthesia, University of Florida, College of Medicine, Gainesville, FL, USA
尚游	Shang You	华中科技大学同济医学院附属协和医院
宋海波	Song Haibo	四川大学华西医院
汪红	Wang Hong	Professor and Vice Chair of Clinical Operations, Department of Anesthesiology, West Virginia University, Morgantown, WV, USA
王晟	Wang Sheng	广东省人民医院
王鑫	Wang Xin	北京中医药大学东方医院
魏蔚	Wei Wei	四川大学华西医院
薛瑛	Xue Ying	广东省人民医院
叶颖娴	Ye Yingxian	广东省人民医院
于春华	Yu Chunhua	北京协和医院
余海	Yu Hai	四川大学华西医院
于晖	Yu Hui	北京医院
袁婷	Yuan Ting	华中科技大学同济医学院附属协和医院
曾俊	Zeng Jun	四川大学华西医院
张莹	Zhang Ying	北京医院
赵楠楠	Zhao Nannan	北京医院
郑建桥	Zheng Jianqiao	四川大学华西医院
周雁	Zhou Yan	积水潭医院
左明章	Zuo Mingzhang	北京医院

Jafer Ali, MD

Assistant Professor
Department of Anesthesiology and Perioperative Medicine
Case Western Reserve University School of Medicine
Cleveland, Ohio

Diana Anca, MD

Assistant Professor of Clinical Anesthesiology
Columbia University College of Physicians and Surgeons;
Division of Cardiothoracic Anesthesia, Department
of Anesthesiology
St. Luke's Roosevelt Hospital Center
New York, New York

Patricia M. Applegate, MD

Director, Echocardiography
Department of Cardiology
Jerry L. Pettis Loma Linda VA Hospital;
Associate Professor of Medicine
Department of Cardiology
Loma Linda University School of Medicine
Loma Linda, California

Richard L. Applegate II, MD

Professor and Vice Chair
Department of Anesthesiology
Loma Linda University School of Medicine
Loma Linda, California

John G. Augoustides, MD, FASE, FAHA

Associate Professor
Cardiothoracic and Vascular Section
Department of Anesthesiology and Critical Care
Perelman School of Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Edwin G. Avery IV, MD

Chief, Division of Cardiac Anesthesia
Vice Chairman, Director of Research
Department of Anesthesiology and Perioperative Medicine
University Hospitals, Case Medical Center
Associate Professor of Anesthesiology
Case Western Reserve University School of Medicine
Cleveland, Ohio

Dalia A. Banks, MD, FASE

Associate Clinical Professor
Medical Director for Procedural Treatment Unit/Cardiovascular
Anesthesia Sulpizio Cardiovascular Center
Director of CT Anesthesia Fellowship
University of California San Diego Medical Center
San Diego, California

Manish Bansal, MD

Consultant
Department of Cardiology
Medanta-The Medicity
Gurgaon, Haryana, India

Dominique A. Bettex, MD

Associate Professor
Department of Anesthesiology
University Hospital Zurich
Zurich, Switzerland

Puneet Bhatla, MD

Noninvasive Imaging Fellow
Division of Pediatric Cardiology
Mount Sinai Medical Center
New York, New York

Marco Bosshart, MD

Institute of Anesthesiology
University Hospital Zurich
Zurich, Switzerland

Mary W. Brandon, DO

Fellow
Division of Cardiothoracic Anesthesiology and Critical Care
Medicine, Department of Anesthesiology
Duke University Health System
Durham, North Carolina

Albert T. Cheung, MD

Professor
Department of Anesthesiology and Critical Care
Perelman School of Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Joanna Chikwe, MD, FRCS

Department of Cardiothoracic Surgery
Mount Sinai Medical Center
New York, New York

Pierre Couture, MD, FRCPC

Associate Professor of Anesthesiology
Montreal Heart Institute
Montreal, Quebec, Canada

André Y. Denault, MD, FRCP(C), PhD

Clinical Associate Professor
Department of Anesthesiology
University of Montreal;
Anesthesiologist, Intensivist
Department of Anesthesiology
Montreal Heart Institute
Anesthesiologist, Intensivist
Department of Anesthesiology and Intensive Care
Centre Hospitalier de L'Université de Montreal
Montreal, Quebec, Canada

Alain Deschamps, MD, FRCPC

Associate Professor of Anesthesiology
University of Montreal
Associate Professor of Anesthesiology
Montreal Heart Institute
Montreal, Quebec, Canada

Stephen A. Esper, MD, MBA

Fellow
 Division of Cardiothoracic Anesthesiology and Critical Care
 Medicine, Department of Anesthesiology
 Duke University Health System
 Durham, North Carolina

Renata G. Ferreira, MD

Fellow
 Division of Cardiothoracic Anesthesiology and Critical Care
 Medicine, Department of Anesthesiology
 Duke University Health System
 Durham, North Carolina

Gregory W. Fischer, MD

Associate Professor of Anesthesiology and Cardiothoracic Surgery
 Director of Adult Cardiothoracic Anesthesia
 Department of Anesthesiology
 Mount Sinai School of Medicine
 New York, New York

Jonathan K. Fogel, MD

Assistant Professor
 Department of Anesthesiology and Critical Care
 Hospital of the University of Pennsylvania
 Philadelphia, Pennsylvania

Maria Galati, MBA

Vice Chair, Administration
 Department of Anesthesiology
 Mount Sinai School of Medicine
 New York, New York

Martin E. Goldman, MD

Director of the Echocardiography Laboratory
 Mount Sinai Medical Center
 Professor of Cardiology
 Mount Sinai School of Medicine
 New York, New York

Matthias Greutmann, MD

Head, Congenital Heart Disease
 Department of Cardiology
 University Hospital Zurich
 Zurich, Switzerland

Jacob T. Gutsche, MD

Assistant Professor
 Department of Anesthesiology and Critical Care
 University of Pennsylvania
 Philadelphia, Pennsylvania

Rafael Honikman, MD

Assistant Professor
 Department of Anesthesiology
 Mount Sinai School of Medicine
 New York, New York

Gregory M. Janelle, MD

Associate Professor of Anesthesiology and Surgery
 Chief, Division of Cardiovascular Anesthesiology
 Department of Anesthesiology
 University of Florida College of Medicine
 Gainesville, Florida

Ronald A. Kahn, MD

Professor of Anesthesiology and Surgery
 Mount Sinai Medical Center
 New York, New York

Marc S. Kanchuger, MD

Associate Professor and Vice Chair of Performance
 Improvement and Risk Management
 Department of Anesthesiology
 New York University School of Medicine
 Attending
 Department of Anesthesiology
 New York University Langone Medical Center
 New York, New York

John C. Klick, MD

Assistant Professor
 Department of Anesthesiology and Perioperative Medicine
 Case Western Reserve University School of Medicine
 Cleveland, Ohio

Sandeep Krishnan, MD

Assistant Professor of Anesthesiology
 New York University Langone Medical Center
 New York, New York

Michelle M. Liao, MD

Chief Resident
 Department of Anesthesiology
 Columbia University College of Physicians and Surgeons
 New York, New York

Sanford M. Littwin, MD

Assistant Professor of Clinical Anesthesiology
 Columbia University College of Physicians and Surgeons
 Director, Clinical Anesthesia (CA I) Education
 Division of Cardiothoracic and Pediatric Anesthesia,
 Department of Anesthesiology
 St. Luke's Roosevelt Hospital Center
 New York, New York

Sansan S. Lo, MD

Assistant Professor
 Division of Cardiothoracic Anesthesiology
 Department of Anesthesiology
 Columbia University
 New York Presbyterian Hospital
 New York, New York

William J. Mauermann, MD

Assistant Professor of Anesthesiology
 Department of Anesthesiology
 Mayo Clinic College of Medicine
 Rochester, Minnesota

Timothy Maus, MD, FASE

Assistant Clinical Professor
 Department of Anesthesiology
 University of California San Diego Medical Center
 San Diego, California

Teresa A. Mulaikal, MD

Cardiothoracic and Critical Care Fellow
Department of Anesthesiology
Columbia University
New York Presbyterian Hospital
New York, New York

Jagat Narula, MD, PhD

Zena and Michael A. Wiener Cardiovascular Institute
Mount Sinai School of Medicine
New York, New York

Jennie Y. Ngai, MD

Assistant Professor
Department of Anesthesiology
New York University Langone Medical Center
New York, New York

Gregory A. Nuttall, MD

Professor of Anesthesiology
Department of Anesthesiology
Mayo Clinic College of Medicine
Rochester, Minnesota

William C. Oliver, Jr., MD

Professor of Anesthesiology
Department of Anesthesiology
Mayo Clinic College of Medicine
Rochester, Minnesota

Jeremy S. Poppers, MD, PhD

Assistant Professor of Anesthesiology
Division of Cardiothoracic Anesthesiology
Columbia University College of Physicians and Surgeons
New York, New York

Kent H. Rehfeldt, MD

Assistant Professor of Anesthesiology
Department of Anesthesiology
Mayo Clinic College of Medicine
Rochester, Minnesota

David L. Reich, MD

Horace W. Goldsmith Professor and Chair of Anesthesiology
Mount Sinai School of Medicine
New York, New York

Amanda J. Rhee, MD

Assistant Professor
Department of Anesthesiology
Mount Sinai Medical Center
New York, New York

Antoine G. Rochon, MD, FRCPC

Assistant Professor of Anesthesiology
Montreal Heart Institute
Montreal, Quebec, Canada

Cesar Rodriguez-Diaz, MD

Assistant Professor
Department of Anesthesiology
Mount Sinai School of Medicine
New York, New York

Ivan S. Salgo, MD, MS

Senior Director, Global Cardiology
Philips Ultrasound
Andover, Massachusetts

Joseph S. Savino, MD

Professor and Vice Chairman
Department of Anesthesiology and Critical Care
University of Pennsylvania Perelman School of Medicine
Hospital of the University of Pennsylvania
Philadelphia, Pennsylvania

Barry J. Segal, MD

Associate Professor
Department of Anesthesiology
Mount Sinai School of Medicine
New York, New York

Partho P. Sengupta, MD, DM, FASE

Zena and Michael A. Wiener Cardiovascular Institute
Mount Sinai School of Medicine
New York, New York

Jack S. Shanewise, MD

Professor of Clinical Anesthesiology
Columbia University College of Physicians and Surgeons;
Director, Division of Cardiothoracic Anesthesiology
Columbia University Medical Center
New York, New York

W. Brit Smith, MD

Fellow, Adult Cardiothoracic Anesthesiology
Department of Anesthesiology
University of Florida College of Medicine
Gainesville, Florida

Shubhika Srivastava, MBBS

Associate Professor of Pediatrics
Director, Pediatric and Fetal Echocardiography
Division of Pediatric Cardiology
Mount Sinai Medical Center
New York, New York

Marc E. Stone, MD

Associate Professor
Program Director, Fellowship in Cardiothoracic Anesthesiology
Department of Anesthesiology
Mount Sinai School of Medicine
New York, New York

Madhav Swaminathan, MD, FASE, FAHA, MBBS

Associate Professor
Division of Cardiothoracic Anesthesiology and Critical Care
Medicine, Department of Anesthesiology
Duke University Health System
Durham, North Carolina

James E. Szalados, MD, MBA, MHA, JD, FCCP, FCLM, FCCM, Esq.

Professor of Anesthesiology and Medicine
University of Rochester;
Director, Surgical Critical Care, SICU, and Critical
Care Telemedicine
Rochester General Hospital;
Critical Care, Medicine, and Anesthesiology
Unity Health System
Rochester, New York;
Vice President for Medical Affairs
Chief Medical Officer
Lakeside Health System
Brockport, New York;
Principal, Counselor, and Attorney at Law
The Szalados Law Firm
Hilton, New York

Daniel M. Thys, MD

Professor Emeritus of Anesthesiology
Columbia University College of Physicians and Surgeons;
Chairman Emeritus
Department of Anesthesiology
St. Luke's Roosevelt Hospital Center
New York, New York

Paula Trigo, MD

Former Cardiothoracic Anesthesiology Fellow
Icahn School of Medicine
Mount Sinai Medical Center
New York, New York

William J. Vernick, MD

Assistant Professor
Department of Anesthesiology and Critical Care
Hospital of the University of Pennsylvania
University of Pennsylvania;
Director of Cardiac Anesthesia
Department of Anesthesia and Critical Care
Penn-Presbyterian Medical Center
Philadelphia, Pennsylvania

David J. West, MD

Attending Anesthesiologist
TeamHealth Anesthesia at Palm Beach Gardens
Medical Center
Palm Beach Gardens, Florida

Robert Williams, MBA, RRT

Director, Clinical Operations
Department of Anesthesiology
Mount Sinai Medical Center
New York, New York

经食管超声心动图监测作为第一个引入临床麻醉主要监测项目的影像学技术,其意义是重大的。该应用不仅局限于心脏手术,也覆盖了非心脏手术和危急重症的诊断和治疗,使众多病患在围术期受益。多年来作为麻醉学科的临床医师,我们一直在各个层面不遗余力地推广此技术的应用,当看到此技术已被越来越多的临床麻醉医师所掌握时,内心是十分欣慰的。

《围术期经食管超声心动图学》(*Perioperative Transesophageal Echocardiography*)是一本主要针对临床麻醉医生的围术期经食管超声心动图学专著,也是第6版《卡普兰心脏麻醉学:超声时代》的系列图书。这本书自出版以来受到世界同仁的广泛认可,是欧美等国家围术期经食管超声心动图教学用书,被誉为“最有价值的学习工具”。本书涵盖了经食管超声心动图原理、对心脏生理病理状态的解读以及围术期的质控、监督与管理等内容,同时对临床医学、法律、医保等环节亦有涉猎,故而对在我国现阶段下应用推广此技术具有广泛并重要的指导意义。

受人民卫生出版社委托,在以于晖、王晟、宋海波和彭勇刚为主的海内外翻译团队的精心工作下,《围

术期经食管超声心动图学》(*Perioperative Transesophageal Echocardiography*)一书终于成功出版。感谢纽约大学医学院邹圣平教授推荐此书,邹教授是于晖医生在美学习时的指导老师。感谢纵横律师事务所合伙人王慧律师从法律角度给予的指导。由于水平有限、中英两种语言差异以及时间紧迫,译文难免有不妥之处,欢迎批评指正!

在围术期医学快速发展的今天,相信本书的出版会有助于规范麻醉医师的培训,提高他们的诊治水平,更好地保证围术期麻醉的质量和安、改善患者的预后和转归,促进围术期的管理水平。

感谢所有人为此付出的努力!

刘进

麻醉科主任

四川大学华西医院

左明章

手术麻醉科主任

北京医院 国家老年医学中心

献给我们敬爱的人，尤其是我们的导师：

你们是我们汲取力量和灵感的源泉。

原著前言

过去的三十年间,围术期超声心动图已经成为心脏手术患者围术期治疗不可缺少的工具。除了已发表的证据和专业操作参数,最能够证明围术期超声心动图价值的或许就是外科医生在做复杂手术时坚持要有称职的超声检查者合作。因此,心脏麻醉的亚专业已经将围术期超声心动图列为现代实践的基础之一,同时在麻醉专业领域心脏麻醉医生也已享有得天独厚的地位。由麻醉医生主导的围术期解剖和功能评估不仅优化了麻醉和外科治疗,并已将心脏麻醉医生完全整合为外科团队的一员。

围术期超声心动图虽然很重要,但也只是心脏麻醉技能与科学的一部分。围术期超声心动图促进了围术期治疗,但必须在透彻理解患者病史和计划手术目标的前提下使用。本书的主要目的是将超声心动图的洞察作为心脏病患者整体管理方法的一部分。因此,有几章介绍了心脏病专家和心脏外科医生的专业知识。

虽然多位作者对本书的出版作出了贡献,但我们尽力使书中的内容和编辑的反馈保持一致。这本书分为四个主要部分:

1. 基本原理及正常心脏解剖和生理。
2. 理解超声心动图如何表现心血管病理状态。
3. 保持围术期超声心动图的质量。
4. 监督和管理。

市面上有许多关于围术期超声心动图的优秀图书。本书继承了这些书的传统,同时对诸如三维 TEE、斑点跟踪和血流可视化等更新的超声心动图模式提出了独到的见解。除了关于物理、瓣膜病理生理学等经典章节,还纳入了非临床的补充章节,如“设备、感染控制和安全”和“经食管超声心动图相关的监管、法律和责任问题”。

我们向各个章节的作者表示真诚的感谢。没有他们的努力工作和奉献,本书不可能完成。我们也要感谢 Elsevier 出版社 Andrea Vosburgh 的专业精神和才华。

David L. Reich, MD
Gregory W. Fischer, MD
(于晖 译)

第一部分 原理和正常心脏

- 1 开始学习超声心动图:二十个标准切面 2
- 2 超声的基本原理和物理现象 15
- 3 原理与物理:超声多普勒的原理 19
- 4 原理与物理:需要记忆的方程(伯努利方程、速度-时间积分及连续方程) 23
- 5 原理与物理:探头传感器特性 29
- 6 原理与物理:成像伪影和缺陷 32
- 7 全面检查中正常的解剖与血流:全面检查的组成部分 36
- 8 全面检查中的正常解剖和血流:经主动脉成像 52
- 9 全面检查中的正常解剖和血流:三维超声视野:复制外科医生视野 60
- 10 全面检查中的正常解剖和血流:心脏外解剖 66
- 11 超声的定量和半定量评估:大小和血流 80
- 12 超声心动图的定量与半定量评估:心室与瓣膜生理学 100

第二部分 理解经食管超声心动图是如何显示心血管病理

- 13 心肌缺血与主动脉粥样硬化 122
- 14 主动脉瓣解剖学与胚胎学 141
- 15 二尖瓣病变 162
- 16 三尖瓣疾病 176

- 17 肺动脉瓣疾病 184
- 18 心肌病 189
- 19 主动脉瘤与夹层 217
- 20 心内膜炎 248
- 21 心脏肿物、固体、气体物质的影像 255
- 22 心内装置、导管及管道 274
- 23 心包疾病的超声心动图评估 288
- 24 成人先天性心脏病 300
- 25 肺动脉高压 327
- 26 研究进展 337

第三部分 围术期经食管超声心动图的质量控制

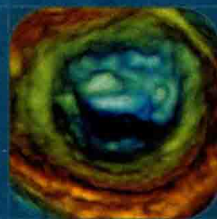
- 27 经食管超声心动图监测指征 342
- 28 经食管超声心动图的并发症 348
- 29 设备、感染控制和安全 357

第四部分 监督与管理

- 30 经食管超声心动图的培训和认证 366
- 31 麻醉相关医疗保险申报,依从和赔付政策 371
- 32 经食管超声心动图相关的监管、法律和责任问题 375

索引 389

第一部分
原理和正常心脏



开始学习超声心动图：二十个标准切面

SANSAN S. LO | JEREMY S. POPPERS | TERESA A. MULAİKAL | DAVID J. WEST MICHELLE M. LIAO | JACK S. SHANEWISE

翻译：邓晓倩 校对：于晖 审阅：彭勇刚

TEE：适应证、禁忌证、探头的置入和操作

自从20世纪80年代经食管超声心动图(transesophageal echocardiography, TEE)开始用于围术期,它的临床应用已经得到扩展。TEE是可以评价心功能和诊断意外情况的多功能工具。1996年美国麻醉医师协会(American Society of Anesthesiologists, ASA)和美国心血管麻醉医师协会(Society of Cardiovascular Anesthesiologists, SCA)发布了术中TEE应用指南,将术中TEE使用指征归入以下三类情况^[1]。A类指征包括支持性文献表明临床情况能够强烈受益于应用TEE临床评估。实例包括瓣膜修补术、先天性心脏缺损、肥厚性梗阻型心肌病、主动脉夹层、感染性心内膜炎,以及不稳定的血流动力学状态。B类指征是指有证据提示患者能获益于TEE的情况,包括心肌缺血、瓣膜置换、心脏动脉瘤和心内肿瘤。C类指征是指文献模棱两可的情况,包括心肌灌注、骨科手术中监测血栓以及放置动脉内球囊反搏和肺动脉导管。2010年又修订了这个指南,现在主张在没有TEE禁忌证的成年患者中,所有开胸心脏手术(例如瓣膜手术)和胸主动脉手术都应使用TEE,冠脉搭桥的手术可考虑使用TEE以便:①明确和完善术前诊断;②发现新的或者可疑的病理改变;③根据TEE所见调整麻醉和手术计划;④评估手术治疗效果^[2]。

虽然TEE被认为是相对安全和非侵入性的检查,但是TEE的探头可能引起口咽、食管或者胃的创伤。TEE其他并发症还包括牙齿损伤、喉部功能障碍、术后误吸、气管导管移位以及上消化道出血。婴儿还可能出现支气管和主动脉受压。因此在置入TEE探头之前,了解病史应针对询问是否有食管疾病、吞咽困难和

呕血。同时需要回顾患者既往病史。TEE的相对禁忌证包括吞咽困难、吞咽疼痛、纵隔放疗史、近期上消化道手术、近期上消化道出血、胸主动脉瘤、食管狭窄/肿瘤/憩室/静脉曲张、食管炎和最近胸部创伤的病史。对于食管远端或者胃有病变的患者,努力得到必要的信息而不要将探头伸至食管远端。当TEE的风险不明确时,应考虑术前行食管镜检查。

在置入TEE探头前,经胃管吸净食管及胃的空气很有帮助。然后左手提起下颌,使下颚向前,右手置入涂有润滑剂的探头,探头朝着咽后壁的方向,沿正中轴送至食管。探头经过食管括约肌时会有轻微的阻力,但在置入及操作探头时应该注意动作要轻柔,绝不能用力过猛。如果需要,甚至可以在喉镜帮助下抬下颚暴露食管开口。向前屈曲颈部有助于置入探头,而颈部后伸则使探头的置入更加困难。一旦探头到达食管胸段(略距离门齿30cm),心脏会显影在超声屏幕上。极少数情况下,有经验的操作者多次尝试仍不能成功将TEE探头置入食管时,则应放弃置入以避免损伤患者。

当使用TEE成像心脏时,显示的结构取决于探头在食管上段和胃之间的位置以及超声束的方向。比如,探头在食管上段、食管中段和胃内时,紧挨TEE探头的结构分别是大血管、左心房和左心室。这些结构会展示在成像部分的顶端或上方。

可以对TEE探头进行一些操作和调整以优化心脏的解剖成像(图1-1)。移动探头之前,探头手柄上的大转盘应在解锁状态并处于正中位以避免损伤。探头可以在食管中前进或者后撤,也可通过手动旋转探头手柄来控制超声束的方向,旋转探头朝向患者的左侧(逆时针转动)或患者的右侧(顺时针转动)。顺时针旋转手柄处的大转盘可使探头前屈(使探头尖端向前屈曲),而逆时针旋转大转盘可使探头后屈(探头

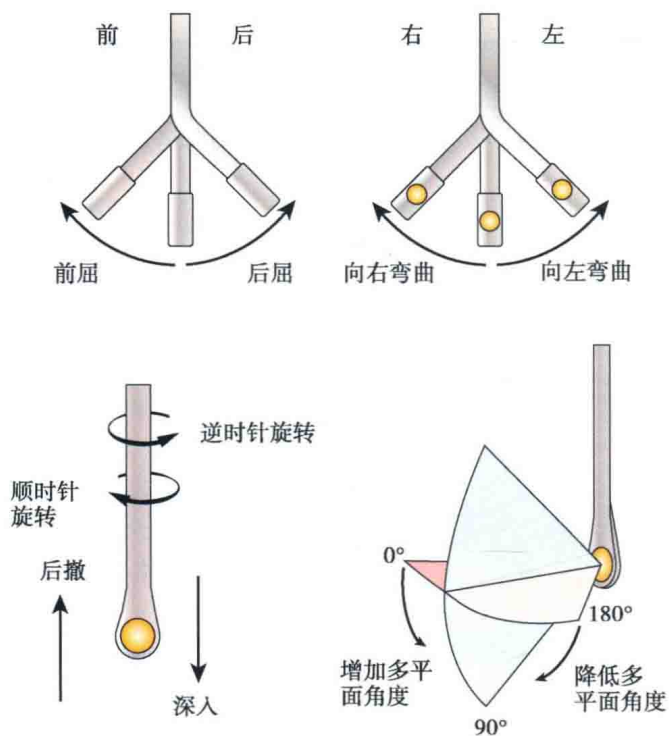


图 1-1 描述操作探头及晶片的术语

尖端向后伸展)。手柄上的小转盘可使探头向右或是向左屈曲。若使用多平面探头,探头晶片旋转的角度

可以从 0° (水平)到 90° (垂直)再到 180° (0° 水平切面的镜面成像),而探头尖端却保持在固定的位置。根据超声束和屏幕成像来判断方位可能会困惑。有一个帮助超声操作者进行定向判断简便的方法是使用右手,将右手的大拇指指向左侧而手掌朝向地面。当患者仰卧位时,操作者站在患者头侧,面朝患者的足侧。在这个位置,手指代表了超声束的方向,超声束从探头头部垂直发出。在 0° 时,大拇指指向心脏左侧的结构会显示在屏幕的右方。当平面角度逐渐增加到 90° 时,右手顺时针旋转直到大拇指指向天花板,心脏前面部分的结构将显示在屏幕的右侧,下方的心脏结构将显示在屏幕的左侧。

二十个标准切面

美国心脏超声协会(American society of echocardiography, ASE)及美国心血管麻醉医师协会(SCA)在1999年公布了术中TEE全面检查的指南,并对20个TEE标准切面进行了描述和命名。这20个标准切面构成了完整的术中TEE常规检查^[3]。表1-1对这20个标准切面进行了总结和描述。

表 1-1 TEE 标准切面

标准切面	角度($^{\circ}$)	探头深度	可以观察的结构
食管中段四腔心切面	0~20	距门齿 30~40cm	左心房 右心房 左心室 右心室 三尖瓣 二尖瓣 左、右肺静脉
食管中段二尖瓣交界区切面	50~80	距门齿 30~40cm	左心房 左心室 前外侧乳头肌 后内侧乳头肌 二尖瓣 P1-A2-P3
食管中段两腔心切面	90	距门齿 30~40cm	左心房 左心耳 二尖瓣 左心室前壁 左心室下壁 回旋支短轴 冠状静脉窦短轴左肺静脉
食管中段长轴切面	110~160	距门齿 30~40cm	左心房 二尖瓣 A2-P2 左心室前间隔壁 左心室下侧壁 主动脉瓣长轴 右冠状动脉