2024 Commentary on the Clinical Statement "Management of Cardiac Emergencies in Women" (Post-Print)

Authors: Huang Chuanying, Liao Xiaoyang, Yang Rong, Li Dongze, Zhang Peng, Jia Yu, Liu Li' s, Jia Yu, Liu Lidi

Date: 2024-09-24T00:00:00+00:00

Abstract

Cardiac emergencies develop rapidly, posing a serious threat to patients' physical health and life safety. For a long time, due to gender bias, atypical symptoms, and other reasons, female cardiac emergencies have been understudied, with problems of untimely diagnosis and treatment, and significant gender differences exist in the pathophysiological mechanisms, risk factors, management, and outcomes of female cardiac emergencies. In China, female cardiac emergencies have a high incidence rate, research started late, and currently no authoritative guidelines specifically for female cardiac emergencies have been published; therefore, strengthening the management of female cardiac emergencies is extremely urgent. This article organizes clinicians from general practice, cardiology, and emergency medicine to interpret the 2024 clinical statement "Management of Cardiac Emergencies in Women" issued by the Association for Acute Cardiovascular Care and other institutions, aiming to standardize the diagnosis and treatment of female cardiac emergencies and improve health outcomes.

Full Text

Interpretation of the 2024 Clinical Statement on Management of Female Cardiac Emergencies

HUANG Chuanying[1], LIAO Xiaoyang[2], YANG Rong[2], LI Dongze[1], ZHANG Peng[2], JIA Yu[2]*, LIU Lidi[2]*

[1]Department of Emergency, West China Hospital, Sichuan University, Chengdu 610041, China
[2]Department of General Practice, General Practice Medical Center, West China Hospital, Sichuan University, Chengdu 610041, China

*Corresponding authors: JIA Yu, Lecturer; E-mail: jiayu@wchscu.cn; LIU Lidi, Attending physician; E-mail: 1661824860@qq.com

Abstract

Cardiac emergencies develop rapidly and pose serious threats to patients' health and lives. For a long time, due to gender bias and atypical symptoms, female cardiac emergencies have been under-researched, under-diagnosed, and under-treated. Moreover, significant gender differences exist in the pathophysiological mechanisms, risk factors, management strategies, and outcomes of female cardiac emergencies. In China, female cardiac emergencies carry a high disease burden, research in this area started relatively late, and no authoritative guidelines specifically targeting female cardiac emergencies have been published. Therefore, strengthening the management of female cardiac emergencies is urgently needed. This article convenes clinicians from general practice, cardiology, and emergency medicine to interpret the 2024 Clinical Statement for Management of Female Cardiac Emergencies issued by the Association for Acute Cardiovascular Care and other organizations, aiming to standardize the diagnosis and treatment of female cardiac emergencies and improve health outcomes.

Keywords: Cardiac; Acute coronary syndrome; Acute heart failure; Cardiogenic shock; Cardiac arrest; Female; Gender differences

---

Cardiac emergencies refer to rapidly progressing, potentially life-threatening cardiac conditions such as acute coronary syndrome (ACS), acute heart failure, and cardiac arrest. Globally, over 7 million people are diagnosed with ACS annually. In the United States, ACS accounts for approximately 262,000 hospitalizations and 53,000 deaths each year. Previous research on cardiac diseases has primarily focused on men, with women representing only about 30% of participants in clinical trials. This not only hinders comprehensive understanding of cardiac diseases in women but also affects the development and optimization of clinical treatment strategies. In clinical practice, female cardiac emergencies often suffer from delayed diagnosis, pre-hospital delays, and non-adherence to clinical guidelines.

Consequently, the European Society of Cardiology, Association for Acute Cardiovascular Care, European Association of Percutaneous Cardiovascular Interventions, Heart Failure Association, European Heart Rhythm Association, and ESC Working Group on Cardiovascular Pharmacotherapy jointly developed the 2024 Clinical Statement for Management of Female Cardiac Emergencies (hereinafter referred to as "the Statement"). The Statement aims to present the latest knowledge on managing female cardiac emergencies, discuss current controversies and uncertainties, and propose specific quality indicators for measuring care in this population, urging clinicians and researchers to pay greater attention to gender differences in cardiac emergencies. However, research on gender differences in cardiac emergencies in China started late and has received insufficient

attention, with no relevant authoritative guidelines currently available. For these reasons, this article organizes clinicians from general practice with cardiology subspecialties, cardiology specialists, and emergency medicine specialists to interpret all recommendations in the Statement, hoping to provide new insights and suggestions for the prevention and treatment of female cardiac emergencies in China and reduce inequalities in diagnosis, treatment, and prevention of cardiovascular diseases. The original content of the Statement can be found in the appendix. The Statement does not specify the target population or settings.

1.1 Epidemiology and Risk Factors of Female ACS

The incidence of ACS is lower in women than in men, though this difference decreases with age, and eventually women' s incidence surpasses that of men. In addition to traditional risk factors such as hypertension and diabetes, psychosocial and gender-specific risk factors should be given more consideration in female ACS. Research indicates that women appear more susceptible to smoking, obesity, and diabetes. For instance, smoking increases women' s cardiovascular disease risk sevenfold, and women with diabetes face a 2-4 times higher risk of ischemic cardiomyopathy than men. Meanwhile, women are more vulnerable to psychological and occupational stress, particularly young women. The incidence of autoimmune diseases in women is 2-10 times higher than in men, leading to more coronary atherosclerosis and worse outcomes. Additionally, women are affected by gender-specific factors: polycystic ovary syndrome increases the risk of obesity, insulin resistance, and diabetes, while breast cancer patients have higher cardiovascular mortality.

In China, traditional risk factors including smoking, diabetes, dyslipidemia, overweight/obesity, and hypertension are also common in female ACS. Due to traditional culture, economic status, and education level, Chinese women often bear greater family responsibilities and social roles, resulting in higher psychological stress and consequently more cardiovascular disease.

1.2 Pathological Basis of Female ACS

The most common pathological basis of female ACS is obstructive atherosclerotic coronary artery disease (CAD), but plaque characteristics differ by sex. Women more frequently have stable plaques rich in smooth muscle cells that are prone to erosion, whereas men tend to have unstable lipid-rich plaques more likely to hemorrhage and rupture. Additionally, women experience non-obstructive coronary atherosclerosis more often, where coronary wall dissection or hematoma causes partial or complete coronary occlusion leading to myocardial ischemia. This accounts for 23%-67% of pregnancy-related myocardial infarctions. However, most SCAD research has focused on White women. In China, one study found a higher SCAD incidence in men, but the sample size was small and not representative. Furthermore, data on SCAD incidence in Chinese women remain incomplete. Gender differences in female cardiac emergencies are summarized in Table 1 .

Table 1 Gender differences in cardiac emergencies in women

Condition	Epidemiology	Risk Factors	Pathophysiology	Clinical Presentation	Outcomes
Acute coronary syndrome	Women < Men, difference decreases with age	Traditional, emerging, and gender-specific factors	More non-CAD, microvascular dysfunction, coronary spasm, SCAD	More atypical symptoms (nausea, vomiting)	Young women worse, elderly women similar or better
Acute heart failure and cardiogenic shock	Women < Men	Hypertension, diabetes, atrial fibrillation, valvular disease	Non-cardiac causes	HFpEF more common	Similar or better
Cardiac arrest	Women < Men	-	-	-	Similar

Note: CAD = obstructive coronary atherosclerosis, non-CAD = non-obstructive coronary atherosclerosis, SCAD = spontaneous coronary artery dissection.

1.3 Management of Female ACS

Chest pain remains the most common symptom of female ACS, but non-specific symptoms are more prevalent in women, making diagnosis more challenging. Therefore, patients with suspected ACS should undergo electrocardiography within 10 minutes of presentation to identify ST-elevation myocardial infarction (STEMI) or non-ST-elevation ACS (NSTE-ACS), followed by high-sensitivity troponin testing, coronary angiography, and imaging. Notably, average high-sensitivity troponin levels are lower in women than men, suggesting that lowering the diagnostic threshold for women may be reasonable, though this has not been widely accepted.

Regarding treatment, female ACS patients should receive reperfusion therapy, yet women are less likely to undergo percutaneous coronary intervention (PCI) and experience approximately 12% longer average treatment delays. This may relate to disease awareness, insufficient social support, and clinicians' gender bias. Additionally, factors such as later presentation, higher rates of multi-vessel disease and severe stenosis, and higher bleeding risk pose further challenges in treatment selection for women. Encouragingly, recent studies show these issues are being gradually resolved through radial artery access and optimized

anticoagulation. In China, one study found that only 31.8% of elderly women with ACS received PCI. Women are also less likely to undergo coronary artery bypass grafting (CABG). According to the China Cardiac Surgery Registry (CCSR) data from 2013-2016, among 56,776 patients who received CABG, only 24.6% were women, and female patients had higher postoperative mortality than men.

For pharmacotherapy, the Statement recommends the same medications for women with atherosclerotic ACS as for men, such as antiplatelet agents and statins, but requires comprehensive assessment of bleeding risk, age, weight, and renal function. In addition to these medications, traditional Chinese medicine is widely used in China for female ACS. For example, Tongxinluo capsule has proven effective for ACS caused by microcirculatory ischemia.

The Statement specifically addresses SCAD and pregnancy-associated ACS management. Coronary angiography and optical coherence tomography (OCT) are recommended for SCAD diagnosis. Some studies recommend screening SCAD patients for Takayasu arteritis, which can be considered when the etiology is unclear. The optimal treatment for SCAD remains uncertain, as invasive and conservative management show similar clinical outcomes, and complications from coronary intervention and antiplatelet therapy have questioned their use. Only beta-blockers are recommended. Additionally, post-SCAD chest pain is common, indicating the need for long-term management and personalized treatment for female SCAD patients.

The incidence of pregnancy-associated ACS is approximately 4.34 per 100,000 person-years, lower than in non-pregnant women, but risk increases significantly during the peripartum and postpartum periods. Therefore, pregnancy-associated ACS should be managed with fetal monitoring and multidisciplinary collaboration, with heightened vigilance during peripartum and postpartum periods. PCI is preferred for pregnancy-associated STEMI. Regarding medications, unfractionated heparin, aspirin, clopidogrel, and beta-blockers (except atenolol and non-selective beta-blockers) are considered relatively safe, while data on bivalirudin, prasugrel, ticagrelor, and glycoprotein IIb/IIIa inhibitors are limited. Most importantly, modifiable cardiovascular risk factors should be aggressively managed in pregnant women to reduce ACS incidence.

1.4 Quality Indicators for Female ACS Management

The Statement proposes standardized management indicators for female ACS, including three domains, each with one primary and 1-3 secondary indicators related to treatment delays, ischemia-reperfusion/intervention timing, and bleeding risk (Table 3). Previously, few quality evaluation indicators specifically targeted female ACS management. These indicators aim to ensure equitable care for female ACS patients, with a gender difference exceeding 10% defined as substandard management.

Table 2 Recommendations for ACS in women from the Statement

Recommendation
Chest pain is the most common symptom of ACS in women, but dyspnea, nausea, and vomiting are also common
Obstructive atherosclerotic CAD is the most common cause of ACS in women, with recommended treatments (revascularization and medications) similar to men
Non-obstructive CAD, microvascular disease, coronary spasm, and SCAD are common causes of ACS in young women requiring special treatment
Right radial artery access during invasive angiography and careful customization of antithrombotic drugs based on age, weight, renal function, and bleeding risk are recommended to reduce bleeding risk in women
Beta-blockers are recommended for SCAD patients; antiplatelet use remains controversial

Note: ACS = acute coronary syndrome.

Table 3 Quality evaluation indicators for female ACS management

Domain	Primary Indicator	Secondary Indicators
Delay in treatment	The time ratio from first medical contact to ECG + troponin completion should not exceed 110% between men and women	The median time ratio from symptom onset to emergency call should not exceed 110% between men and women
Ischemia-reperfusion/intervention	The gender ratio for reperfusion in eligible STEMI patients should not be below 90%	1. The gender ratio for timely reperfusion in STEMI patients should not be below 90%2. The proportion of NSTEMI patients receiving coronary angiography within 24h of diagnosis should not be below 90%3. The median time ratio from STEMI diagnosis to coronary angiography should not exceed 110% between men and women
Bleeding risk	The gender ratio for P2Y12 inhibitor use (patients receiving P2Y12 inhibitors / eligible patients) should not be below 90%	Use validated tools for ischemia and bleeding risk assessment

Note: PCI = percutaneous coronary intervention, STEMI = ST-elevation myocardial infarction, P2Y12 = purinergic receptor.

2.1 Epidemiology and Risk Factors

The onset of acute heart failure occurs later in women than in men, with heart failure with preserved ejection fraction (HFpEF) being the most common type. Hypertension, diabetes, atrial fibrillation, and valvular heart disease are common risk factors. The incidence of cardiogenic shock in women is rising rapidly, often associated with higher overall risk including older age, more comorbidities, hemodynamic instability, and vasopressor requirements, though mortality rates are comparable between sexes. Studies show that the incidence of heart failure is slightly lower in women than men, but prevalence increases with age, with approximately 60.3% of patients having HFpEF and average hospitalization costs of $4,406.8 per person. Hypertension and coronary heart disease are the main causes of heart failure, and poor economic status, unemployment, low education level, and lack of social support increase mortality in heart failure patients. Specific incidence data for cardiogenic shock in Chinese women remain inconclusive, but given the heavy burden of cardiovascular disease in China, the incidence is likely relatively high.

2.2 Management of Female Acute Heart Failure

The diagnosis and treatment recommendations for female acute heart failure primarily reference the 2021 and 2023 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. These guidelines state that treatment protocols are the same for men and women but should account for physiological differences such as hepatic and renal function, gastrointestinal motility, and body weight that may affect drug metabolism. Diuretic therapy remains the cornerstone of acute heart failure management, with guideline-directed medical therapy recommended to be initiated promptly upon admission. However, clinical trial data for these medications in female patients are insufficient. Additionally, women have a narrower therapeutic window for heart failure medications and are more prone to side effects at the same doses. Therefore, further research is needed to determine optimal dosing for women. Notably, the Statement only mentions treatment principles without providing specific drug recommendations or dosages, nor does it address fluid management or device therapy.

The Statement mentions two special conditions: Takotsubo cardiomyopathy and peripartum cardiomyopathy. Takotsubo cardiomyopathy, also known as broken heart syndrome or stress-induced cardiomyopathy, is a reversible ventricular dysfunction often triggered by severe psychological or physical stress, commonly seen in postmenopausal women. Due to its ACS-like presentation, it is easily misdiagnosed. The Statement proposes a diagnostic algorithm based on the InterTAK diagnostic score, which includes seven items: female sex (25 points), emotional stress (24 points), physical stress (13 points), absence of ST-segment depression (12 points), psychiatric disorders (11 points), neurological disease (9 points), and QTc prolongation (6 points). The diagnostic algorithm is shown in Figure 1 [Figure 1: see original paper]. Studies show that an InterTAK score >70 has 21% sensitivity and 98% specificity for distinguish-

ing Takotsubo cardiomyopathy from NSTEMI, but may delay revascularization and miss some SCAD cases. For management, given the generally favorable prognosis, the Statement recommends supportive therapy to prevent complications, avoiding beta-agonists, and suggests levosimendan if hemodynamically unstable. In China, Takotsubo cardiomyopathy is more often triggered by psychological factors, presenting with chest tightness, dizziness, sweating, palpitations, and abdominal pain/diarrhea. Electrocardiograms more frequently show ST-segment elevation, T-wave inversion, and atrioventricular block. Commonly used treatments include beta-blockers, antiplatelet agents, ACE inhibitors or ARBs, anticoagulants, and diuretics. Levosimendan has also proven effective and safe in China.

Peripartum cardiomyopathy is defined as heart failure occurring during the peripartum period or within 6 months postpartum, excluding other causes. Clinical presentation varies widely, and management should consider both fetal and maternal aspects. Severe cases should be referred to centers capable of providing mechanical circulatory support and cardiac transplantation. Cesarean delivery is recommended if cardiogenic shock is present, and breastfeeding is discouraged. Many commonly used heart failure medications are teratogenic and must be avoided in pregnant women, including ACE inhibitors/ARBs and aldosterone antagonists. Diuretics, nitrates, nitroprusside, beta-blockers, and hydralazine are relatively safe.

Female cardiogenic shock (CS) follows the same treatment protocol as male CS. For CS caused by acute myocardial infarction, revascularization of the culprit vessel only is recommended, with enhanced mechanical support as a bridge to further therapy. This aligns with the 2018 expert consensus on cardiogenic shock, which recommends PCI or CABG based on angiographic findings and discourages concurrent complete revascularization. Specific recommendations are detailed in Table 4 .

Table 4 Consensus statement and recommendations on acute heart failure in women and CS

Recommendation
HFpEF is the most common phenotype of heart failure in women
Outcomes of acute heart failure in women are similar to or better than in men
Takotsubo and peripartum cardiomyopathy are rare causes of heart failure that predominantly or exclusively affect women, requiring urgent and specific evaluation and management
ESC heart failure guidelines recommend early initiation of key disease-modifying medications at target doses, similar for men and women
Drug dosing should be adjusted based on age, weight, and renal function
Optimal drug dosing for women with heart failure remains undetermined and should be re-evaluated in randomized controlled trials with equal representation of women and men

Recommendation
Many commonly used heart failure medications are teratogenic and must be avoided in pregnant women with heart failure
Female CS management should follow the same guidelines as for men

Note: ESC = European Society of Cardiology; CS = cardiogenic shock.

3 Consensus and Recommendations for Female Cardiac Arrest

The incidence of cardiac arrest is lower in women than men, but overall prognosis is similar. The Statement notes that younger age, bystander-initiated resuscitation, and initial shockable rhythm are associated with better outcomes. However, female cardiac arrest patients tend to be older, have lower bystander intervention rates, more often experience non-cardiac cause arrest, and less frequently present with shockable rhythms—these factors may contribute to worse outcomes in women. These conclusions remain controversial across studies and require further validation. For pregnant women with cardiac arrest, basic resuscitation principles apply, but manual uterine displacement to the left is recommended for those beyond 20 weeks gestation to relieve aortocaval compression. Cesarean delivery within 4 minutes is recommended if resuscitation fails in late pregnancy.

In China, approximately 1.05 million out-of-hospital cardiac arrests (OHCA) occur annually, with only 1% survival to hospital discharge. This is closely related to bystander CPR rates, which are only 4.5% in China compared to 40-60% in Europe and North America. Due to traditional culture and other factors, women are relatively less likely to receive timely CPR. Many Chinese scholars have begun exploring the establishment of resuscitation centers and cardiac arrest centers, which hold great potential for optimizing pre-hospital and in-hospital emergency care and improving outcomes. Specific recommendations from the Statement are shown in Table 5 .

Table 5 Consensus statement recommendations for cardiac arrest in women

Recommendation
Female OHCA has low bystander witness rates; successfully resuscitated women are older, less likely to have STEMI, and more often experience non-cardiac cause arrest
No significant gender difference in cardiac arrest outcomes
Female cardiac arrest management should follow general guideline recommendations
Increased awareness of OHCA and importance of bystander resuscitation is needed
Increasing representation of women in OHCA randomized controlled trials is urgently needed

Note: OHCA = out-of-hospital cardiac arrest.

4 Strengths and Limitations of the Statement

The Statement is one of the few guideline-type articles focusing exclusively on female cardiac arrest, highlighting the need to emphasize standardized management of female cardiac emergencies and improve female representation in clinical trials. However, it has clear limitations. In terms of disease scope, it only covers ACS, acute heart failure, cardiogenic shock, and cardiac arrest, while many other types of female cardiac emergencies exist. Regarding content, the Statement only presents management principles without specifying detailed treatment protocols, which may limit its clinical utility. It identifies current problems and research gaps but does not propose concrete solutions to narrow these gaps.

5 Summary and Outlook

The Statement presents the latest knowledge and research gaps in female cardiac emergencies, emphasizing that clinicians and researchers should pay attention to gender differences in pathophysiology, risk factors, management, and outcomes. China faces a heavy cardiovascular disease burden, with insufficient research on female cardiac emergencies and inadequate recognition of gender differences. Further efforts are needed to narrow these gaps.

At the patient level, education should be strengthened, including sex education, symptom recognition, first aid measures, and emergency training to improve bystander resuscitation rates and success. Additionally, social support networks including family, friends, and community groups should be established to help women enhance self-management capabilities and compliance while reducing anxiety and depression. Since many elderly women live alone, mobile health technologies such as myocardial infarction warning systems and wearable devices can aid early recognition of cardiac emergencies.

At the healthcare level, clinicians'awareness of gender differences in cardiac emergencies should be improved to avoid fixed thinking patterns, follow guideline-recommended treatments, and actively promote female participation in cardiac rehabilitation. Mobile health technologies can help elderly women living alone with early recognition. Policy-level interventions could include legislation to protect bystanders from liability, encouraging resuscitation efforts, and incorporating reduction of gender disparities in cardiac emergencies as a performance metric to incentivize greater clinical attention to female patients. Additionally, female participation in cardiac rehabilitation is low in China due to insufficient facilities and public awareness, requiring improved medical resource allocation and public education to increase participation.

Future efforts should focus on patient education, social support enhancement, mobile health technology utilization, clinician training, policy improvements, and increased female representation in clinical trials. Developing more sensitive

and specific diagnostic tools for women and establishing cardiovascular disease prediction models that incorporate gender-specific risk factors are also needed. The Statement will provide valuable guidance for standardizing female cardiac emergency management, enhancing female representation in research, and reducing cardiovascular gender inequalities.

Author Contributions: HUANG Chuanying conceived and designed the article and drafted the manuscript; LIAO Xiaoyang, YANG Rong, LI Dongze, and ZHANG Peng contributed to conception, design, and literature review; JIA Yu and LIU Lidi were responsible for quality control and revision.

Conflict of Interest: None declared.

References

[1] BHATT D L, LOPES R D, HARRINGTON R A. Diagnosis and treatment of acute coronary syndromes: a review[J]. JAMA, 2022, 327(7): 662-675. DOI: 10.1001/jama.2022.0358.

[2] MEHTA L S, BECKIE T M, DEVON H A, et al. Acute myocardial infarction in women: a scientific statement from the American heart association[J]. Circulation, 2016, 133(9): 916-947. DOI: 10.1161/CIR.0000000000000351.

[3] TAHHAN A S, VADUGANATHAN M, GREENE S J, et al. Enrollment of older patients, women, and racial/ethnic minority groups in contemporary acute coronary syndrome clinical trials: a systematic review[J]. JAMA Cardiol, 2020, 5(6): 714-722. DOI: 10.1001/jamacardio.2020.0359.

[4] MATEO-RODRÍGUEZ I, DANET A, BOLÍVAR-MUÑOZ J, et al. Gender differences, inequalities and biases in the management of Acute Coronary Syndrome[J]. J Healthc Qual Res, 2022, 37(3): 169-181. DOI: 10.1016/j.jhqr.2021.10.010.

[5] REUE K, WIESE C B. Illuminating the mechanisms underlying sex differences in cardiovascular disease[J]. Circ Res, 2022, 130(12): 1747-1762. DOI: 10.1161/CIRCRESAHA.122.320259.

[6] KAUTZKY-WILLER A, LEUTNER M, HARREITER J. Sex differences in type 2 diabetes[J]. Diabetologia, 2023, 66(6): 986-1002. DOI: 10.1007/s00125-023-05891-x.

[7] VOGEL B, ACEVEDO M, APPELMAN Y, et al. The Lancet women and cardiovascular disease Commission: reducing the global burden by 2030[J]. Lancet, 2021, 397(10292): 2385-2438. DOI: 10.1016/S0140-6736(21)00684-X.

[8] RIDKER P M. Autoimmune diseases and atherothrombotic risk[J]. Lancet, 2022, 400(10354): 708-710. DOI: 10.1016/S0140-6736(22)01602-6.

[9] MEHILLI J, PRESBITERO P. Coronary artery disease and acute coronary syndrome in women[J]. Heart, 2020, 106(7): 487-492. DOI: 10.1136/heartjnl-2019-315555.

[10] GREENLEE H, IRIBARREN C, RANA J S, et al. Risk of cardiovascular disease in women with and without breast cancer: the pathways heart study[J]. J Clin Oncol, 2022, 40(15): 1647-1658. DOI: 10.1200/JCO.21.01736.

[11] YANG Hongxia, ZUO Xiaojuan, JIA Shujie, et al. Gender differences in risk factors and disease characteristics in patients hospitalized with first-onset acute coronary syndrome[J]. National Medical Journal of China, 2021, 101(9): 1403-1409. DOI: 10.3760/cma.j.cn112137-20201203-03331.

[12] SATO Y, KAWAKAMI R, SAKAMOTO A, et al. Sex differences in coronary atherosclerosis[J]. Curr Atheroscler Rep, 2022, 24(1): 23-32. DOI: 10.1007/s11883-022-00980-5.

[13] TWEET M S, LEWEY J, SMILOWITZ N R, et al. Pregnancy-associated myocardial infarction: prevalence, causes, and interventional management[J]. Circ Cardiovasc Interv, 2020: CIRCINTERVENTIONS120008687. DOI: 10.1161/CIRCINTERVENTIONS.120.008687.

[14] HAYES S N, TWEET M S, ADLAM D, et al. Spontaneous coronary artery dissection: JACC state-of-the-art review[J]. J Am Coll Cardiol, 2020, 76(8): 961-984. DOI: 10.1016/j.jacc.2020.05.084.

[15] LIU X T, XU C Y, LIU C W, et al. Clinical characteristics and long-term prognosis of spontaneous coronary artery dissection: a single-center Chinese experience[J]. Pak J Med Sci, 2019, 35(1): 106-112. DOI: 10.12669/pjms.35.1.321.

[16] HAMID A A, BECKETT R, WILSON M, et al. Gender bias in diagnosis, prevention, and treatment of cardiovascular diseases: a systematic review[J]. Cureus, 2024, 16(2): e54264. DOI: 10.7759/cureus.54264.

[17] KANIC V, NAJI F H, KOMPARA G. Long-term mortality in women with myocardial infarction who underwent PCI using radial versus femoral access[J]. Eur Heart J, 2021, 42(Supplement 1): ehab724.2775. DOI: 10.1093/eurheartj/ehab724.2775.

[18] WANG J L, GUO C Y, CHEN H, et al. Improvement of long-term clinical outcomes by successful PCI in the very elderly women with ACS[J]. BMC Cardiovasc Disord, 2021, 21(1): 122. DOI: 10.1186/s12872-021-01933-7.

[19] Writing Group of the China Cardiovascular Health and Disease Report. Overview of the China Cardiovascular Health and Disease Report 2022[J]. Chinese Journal of Cardiovascular Research, 2023, 21(7): 577-600. DOI: 10.3969/j.issn.1672-5301.2023.07.001.

[20] GUO Liuli, YANG Haolin, YANG Zhihua, et al. Clinical efficacy and mechanism of Tongxinluo capsule in coronary microvascular disease[J]. Modern Medicine & Clinical, 2024, 39(2): 530-535. DOI: 10.7501/j.issn.1674-5515.2024.02.044.

[21] WANG X, GE J. Spontaneous coronary-artery dissection[J]. N Engl J Med, 2021, 384(11): 1077-1078. DOI: 10.1056/nejmc2100339.

[22] BOCCHINO P P, ANGELINI F, FRANCHIN L, et al. Invasive versus conservative management in spontaneous coronary artery dissection: a meta-analysis and meta-regression study[J]. Hellenic J Cardiol, 2021, 62(4): 297-303. DOI: 10.1016/j.hjc.2021.02.013.

[23] BLACHER J, LAILLER G, GABET A, et al. Acute coronary syndrome during pregnancy and postpartum in France: the nationwide CONCEPTION study[J]. Am J Obstet Gynecol MFM, 2023, 5(1): 100781. DOI: 10.1016/j.ajogmf.2022.100781.

[24] YU Y, GUPTA A, WU C Q, et al. Characteristics, management, and outcomes of patients hospitalized for heart failure in China: the China PEACE retrospective heart failure study[J]. J Am Heart Assoc, 2019, 8(17): e012884. DOI: 10.1161/JAHA.119.012884.

[25] WANG H, CHAI K, DU M H, et al. Prevalence and incidence of heart failure among urban patients in China: a national population-based analysis[J]. Circ Heart Fail, 2021, 14(10): e008406. DOI: 10.1161/CIRCHEARTFAILURE.121.008406.

[26] GE Y L, ZHANG L H, GAO Y, et al. Socio-economic status and 1-year mortality among patients hospitalized for heart failure in China[J]. ESC Heart Fail, 2022, 9(2): 1027-1037. DOI: 10.1002/ehf2.13762.

[27] MCDONAGH T A, METRA M, ADAMO M, et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure[J]. Eur Heart J, 2021, 42(36): 3599-3726. DOI: 10.1093/eurheartj/ehab368.

[28] MCDONAGH T A, METRA M, ADAMO M, et al. 2023 Focused Update of the 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure[J]. Eur Heart J, 2023, 44(37): 3627-3639. DOI: 10.1093/eurheartj/ehad195.

[29] SAMBOLA A, HALVORSEN S, ADLAM D, et al. Management of cardiac emergencies in women: a clinical consensus statement of the Association for Acute CardioVascular Care (ACVC), the European Association of Percutaneous Cardiovascular Interventions (EAPCI), the Heart Failure Association (HFA), and the European Heart Rhythm Association (EHRA) of the ESC, and the ESC Working Group on Cardiovascular Pharmacotherapy[J]. Eur Heart J Open, 2024, 4(2): oeae011. DOI: 10.1093/ehjopen/oeae011.

[30] ALI T, HAUSVATER A, SMILOWITZ N R, et al. Predictive performance of the international takotsubo registry score in the diagnosis of takotsubo syndrome among women with non-ST segment elevation myocardial infarction[J]. J Womens Health, 2022, 31(2): 279-284. DOI: 10.1089/jwh.2021.0054.

[31] RAN Qian, ZHOU Xia, SUN Yazhou, et al. Comparison of clinical characteristics of Takotsubo syndrome between Chinese and European/American patients[J]. Chinese Journal of Cardiology, 2022, 50(4): 9. DOI: 10.3760/cma.j.cn112148-20220304-00152.

[32] GUO Y, ZHOU C F, YANG X. Efficacy and safety of levosimendan in Chinese elderly patients with Takotsubo syndrome[J]. Ann Transl Med, 2018, 6(22): 438. DOI: 10.21037/atm.2018.10.15.

[33] KOTINI-SHAH P, DEL RIOS M, KHOSLA S, et al. Sex differences in outcomes for out-of-hospital cardiac arrest in the United States[J]. Resuscitation, 2021, 163: 6-13. DOI: 10.1016/j.resuscitation.2021.03.020.

[34] Chinese Society of Emergency Medicine, Emergency Medicine Professional Committee of China Medical Education Association. Expert consensus on the construction of cardiac arrest centers in China[J]. Chinese Journal of Emergency Medicine, 2023, 32(10): 1296-1303. DOI: 10.3760/cma.j.issn.1671-0282.2023.10.003.

[35] GRÄSNER J T, WNENT J, HERLITZ J, et al. Survival after out-of-hospital cardiac arrest in Europe - Results of the EuReCa TWO study[J]. Resuscitation, 2020, 148: 218-226. DOI: 10.1016/j.resuscitation.2019.12.042.

(Received: July 31, 2024; Revised: September 2, 2024)
(Editor: LI Weixia)

Note: Figure translations are in progress. See original paper for figures.