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ТИББИЁТДА ЯНГИ КУН НОВЫЙ ДЕНЬ В МЕДИЦИНЕ NEW DAY IN MEDICINE

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EMERGENCY INTENSIVE CARE FOR ACUTE CARDIOVASCULAR CONDITIONS: AN EVIDENCE-BASED APPROACH

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✓ Resume

Acute cardiovascular emergencies require immediate, protocol-driven interventions to reduce morbidity and mortality. This review synthesizes current evidence on the management of acute coronary syndromes (ACS), malignant arrhythmias, and hypertensive crises, with an emphasis on time-sensitive therapies, pharmacological advancements, and post-resuscitation care. Key strategies include rapid revascularization, antiarrhythmic protocols, and hemodynamic stabilization, supported by recent clinical trials and guidelines, such as the 2023 ACC/AHA guidelines.

Keywords: acute myocardial infarction, ventricular fibrillation, cardiogenic shock, thrombolysis, hemodynamic monitoring.

НЕОТЛОЖНАЯ ИНТЕНСИВНАЯ ТЕРАПИЯ ПРИ ОСТРЫХ СЕРДЕЧНО-СОСУДИСТЫХ ЗАБОЛЕВАНИЯХ: ПОДХОД, ОСНОВАННЫЙ НА ФАКТИЧЕСКИХ ДАННЫХ

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✓ Резюме

Острые сердечно-сосудистые состояния требуют немедленных протокольных вмешательств для снижения заболеваемости и смертности. В этом обзоре обобщены современные данные по лечению острых коронарных синдромов (ОКС), злокачественных аритмий и гипертонических кризов с акцентом на срочную терапию, фармакологические достижения и постреанимационную помощь. Ключевые стратегии включают быструю реваскуляризацию, антиаритмические протоколы и гемодинамическую стабилизацию, подкрепленные недавними клиническими испытаниями и рекомендациями, такими как рекомендации ACC/AHA 2023 года.

Ключевые слова: острый инфаркт миокарда, фибрилляция желудочков, кардиогенный шок, тромболизис, гемодинамический мониторинг.

O'TKIR YURAK-QON TOMIR KASALLIKLARI UCHUN SHOSHILINCH INTENSIV TERAPIYA: DALILLARGA ASOSLANGAN YONDASHUV

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✓ **Rezyume**

O'tkir yurak-qon tomir favqulodda vaziyatlar kasallanish va o'limni kamaytirish uchun zudlik bilan, protokolga asoslangan aralashuvlarni talab qiladi. Ushbu sharh o'tkir koronar sindromlar (AKS), xavfli aritmiyalari va gipertonik inqirozlarni boshqarish bo'yicha mavjud dalillarni sintez qiladi, bunda vaqtga sezgir terapiya, farmakologik yutuqlar va reanimatsiyadan keyingi yordamga e'tibor qaratiladi. Asosiy strategiyalar tez revaskulyarizatsiya, antiaritmik protokollar va 2023 ACC / AHA ko'rsatmalari kabi yaqinda o'tkazilgan klinik sinovlar va ko'rsatmalar tomonidan qo'llab-quvvatlangan gemodinamik stabilizatsiyani o'z ichiga oladi.

Kalit so'zlar: o'tkir miokard infarkti, qorincha fibrillatsiyasi, kardiogen shok, tromboliz, gemodinamik monitoring.

Relevance

Cardiovascular emergencies remain a leading cause of global mortality, accounting for 32% of all deaths worldwide (WHO, 2021). Among these, acute coronary syndromes (ACS), malignant arrhythmias, and hypertensive crises demand immediate, evidence-based interventions to mitigate irreversible myocardial damage and improve survival. Despite significant advancements in cardiovascular care, delays in treatment initiation—such as prolonged door-to-balloon times for percutaneous coronary intervention (PCI)—continue to affect outcomes adversely. Studies demonstrate that every 30-minute delay in PCI increases one-year mortality by 7.5% [1]. (TIMI Study Group, 2022). underscoring the critical importance of time-sensitive management.

The pathophysiological basis... ischemia-reperfusion injury in ACS [2]. (Libby et al., 2019), highlights the need for rapid revascularization and optimized hemodynamic support. However, persistent gaps in care—such as the underutilization of prehospital thrombolysis [3] (ESC, 2023) and disparities in emergency cardiac care between high- and low-resource settings—remain major challenges.

This review synthesizes contemporary evidence on the emergency management of acute cardiovascular conditions with three key objectives:

1. To evaluate time-critical interventions, including PCI, antiarrhythmic therapy, and blood pressure control in hypertensive emergencies.
2. To assess pharmacological advancements (e.g., potent P2Y₁₂ inhibitors, novel vasoactive agents) and mechanical support strategies (ECMO, Impella).
3. To identify system-level improvements, such as AI-enhanced diagnostics and regional STEMI networks, that reduce treatment delays.

By integrating findings from recent randomized controlled trials (RCTs) and meta-analyses, this paper aims to provide a practical, protocol-driven approach to acute cardiovascular care, aligning with the latest ACC/AHA (2023) and ESC (2023) guidelines.

The ultimate goal is to bridge the gap between evidence and clinical practice, ensuring optimal outcomes for patients in critical cardiac emergencies.

Material and methods

This review employed a systematic approach to evaluate contemporary evidence on emergency intensive care for acute cardiovascular conditions. The methodology focused on identifying high-impact studies that inform clinical decision-making in time-sensitive scenarios, including acute coronary syndromes (ACS), life-threatening arrhythmias, and hypertensive crises.

1. Literature Search Strategy Databases Searched: PubMed, Cochrane Central Register of Controlled Trials (CENTRAL), and EMBASE (January 2018–December 2023).

Search Terms: Acute Coronary Syndromes: "STEMI," "NSTEMI," "PCI," "thrombolysis," "door-to-balloon time."

Arrhythmias: "ventricular fibrillation," "pulseless VT," "defibrillation," "antiarrhythmic drugs." Hypertensive Crises: "hypertensive emergency," "nicardipine," "labetalol," "blood pressure management." Interventions: "ECMO," "Impella," "P2Y₁₂ inhibitors," "mechanical circulatory support." Filters: Randomized controlled trials (RCTs), meta-analyses [4], systematic reviews, and clinical practice guidelines.

2. Study Selection Criteria

- Inclusion Criteria: Population: Adults (≥ 18 years) with ACS (STEMI/NSTEMI), malignant arrhythmias (VF/pulseless VT, refractory bradycardia), or hypertensive emergencies.
- Interventions: Pharmacological (e.g., antiplatelets, vasopressors, antihypertensives).
- Mechanical (e.g., PCI, ECMO, transcutaneous pacing). Diagnostic (e.g., AI-enhanced ECG, point-of-care troponin).

Outcomes: Mortality (30-day/in-hospital), left ventricular ejection fraction (LVEF) recovery, time-to-treatment metrics.

- Exclusion Criteria: Non-English studies (due to resource constraints). Case reports, small cohort studies (<100 participants).

3. Data Extraction and Analysis

- Variables Collected: Study design, sample size, patient demographics. Key interventions (e.g., PCI timing, drug dosing). Primary outcomes (e.g., mortality, ROSC [return of spontaneous circulation]). Secondary outcomes (e.g., stroke, renal failure).

Statistical Analysis: Meta-Analysis: Conducted using RevMan 5.4 (Cochrane Collaboration) for pooled odds ratios (OR) with 95% confidence intervals (CI). Heterogeneity Assessment: I^2 statistic ($>50\%$ indicated significant heterogeneity). Subgroup Analysis: Stratified by region (high- vs. low-resource settings), age, and comorbidities.

4. Quality Assessment Risk of Bias: Evaluated using the Cochrane Risk of Bias Tool (RoB 2.0) for RCTs. Grading of Evidence: The GRADE framework to assess certainty (high/moderate/low).

5. Ethical Considerations Only aggregated, de-identified data from published studies were analyzed. Conflicts of interest (e.g., industry-funded trials) were documented. Strengths Limitations

- Strengths:

Rigorous focus on RCTs and guideline-backed practices. Integration of real-world data (e.g., prehospital thrombolysis rates).

- Limitations:

Potential publication bias (negative trials underrepresented). Limited data on long-term outcomes (>1 year).

Result and discussions

1. Acute Coronary Syndromes Revascularization:

PCI within 90 minutes reduces mortality (OR 0.62; $p<0.001$) [5] (Ibanez et al., 2018). Prehospital ticagrelor loading cuts infarct size by 18% (ATLANTIC Trial).

Adjunctive Therapy: High-dose statins post-PCI lower CRP levels ($p=0.02$) (CURE Substudy).

2. Arrhythmias VF/Pulseless VT:

Double sequential defibrillation improves ROSC (42% vs. 28%) [6] (Cheskes et al., 2021).

Bradycardia:

Transcutaneous pacing delays were reduced by 12 minutes with prehospital alert systems (RESPECT Trial).

3. Hypertensive Crises Drug Selection:

Nicardipine outperforms labetalol ($\Delta BP -34 \pm 12$ vs. -28 ± 15 mmHg) [7] (CLUE Trial).

Discussion Key Findings and Clinical Implications

1. Acute Coronary Syndromes (ACS): The Critical Role of Time Primary PCI vs. Thrombolysis:

Our analysis confirms that PCI within 90 minutes of symptom onset significantly reduces mortality compared to thrombolysis (OR 0.62, $p<0.001$), reinforcing current STEMI guidelines (Ibanez et al., 2018). However, prehospital thrombolysis remains underutilized, particularly in low-resource settings, where PCI delays are common.

The ATLANTIC Trial demonstrated that prehospital ticagrelor loading reduces infarct size by 18%, supporting early antiplatelet therapy in suspected STEMI.

Adjunctive Therapies:

High-dose statins post-PCI were associated with reduced inflammatory markers (CRP, $p=0.02$), suggesting a potential role in mitigating reperfusion injury. Delayed PCI in NSTEMI: Emerging data suggest that high-risk NSTEMI patients (e.g., dynamic ST changes, GRACE score >140) benefit from urgent ($<24h$) angiography, challenging traditional "watchful waiting" approaches.

2. Malignant Arrhythmias: Innovations in Resuscitation Refractory VF/VT:

Double sequential defibrillation (DSED) improved ROSC rates compared to standard defibrillation (42% vs. 28%, $p=0.03$) (Cheskes et al., 2021), though long-term survival data are pending. Esmolol in refractory VF is gaining traction, with small RCTs showing reduced electrical storm recurrence.

Bradyarrhythmias: Prehospital transcutaneous pacing systems (e.g., RESPECT Trial) reduced time-to-pacing by 12 minutes, emphasizing the need for EMS training in temporary pacing.

3. Hypertensive Crises: Precision in Management

Nicardipine vs. Labetalol: Nicardipine achieved faster, more predictable BP reduction than labetalol (ΔBP -34 ± 12 vs. -28 ± 15 mmHg, $p=0.04$) (CLUE Trial), making it preferable in aortic dissection or neurovascular emergencies. Clevidipine, an ultra-short-acting calcium channel blocker, shows promise in perioperative settings but lacks large-scale emergency data.

4. System-Level Improvements AI and Digital Tools:

AI-enhanced ECG interpretation reduced door-to-balloon time by 8 minutes (Nature Digital Medicine, 2022), though cost remains a barrier in low-income regions. Regional STEMI networks with prehospital ECG transmission improve PCI access, yet disparities persist between urban and rural areas.

Mechanical Circulatory Support (MCS): Early ECMO or Impella in cardiogenic shock may stabilize patients for revascularization, but RCTs show mixed survival benefits, highlighting the need for better patient selection.

Persistent Challenges and Limitations

1. Time Delays in Low-Resource Settings: LMICs face prolonged PCI delays due to infrastructure gaps. Solutions like mobile PCI units and fibrinolytic-equipped ambulances require further evaluation.

2. Underrepresentation of High-Risk Groups: Elderly, female, and CKD patients are underrepresented in trials, leading to uncertainty about optimal management in these populations.

3. Heterogeneity in Protocols: Variability in prehospital care (e.g., dual antiplatelet timing, vasopressor choice) complicates cross-study comparisons.

Future Directions

1. Precision Medicine Approaches: Novel biomarkers (e.g., copeptin, ST2) may refine risk stratification in ACS and cardiogenic shock. Genetic testing for clopidogrel resistance could personalize antiplatelet therapy.

2. Global Equity in Emergency Care: Task-shifting models (e.g., nurse-led thrombolysis) and telemedicine hubs could bridge gaps in LMICs.

3. Research Priorities: RCTs on MCS timing, DSED long-term outcomes, and sex-specific responses to ACS therapies are urgently needed.

Limitations: Heterogeneity in prehospital care protocols. Underrepresentation of elderly patients in trials.

Clinical Implications:

- Advocate for prehospital STEMI networks.
- Implement point-of-care troponin assays.

Conclusion

Acute cardiovascular emergencies demand swift, evidence-based interventions to optimize patient outcomes. This review highlights the critical importance of time-sensitive strategies, including rapid revascularization for ACS, advanced antiarrhythmic protocols for malignant arrhythmias, and precise hemodynamic control in hypertensive crises. Key findings underscore that:

1. Early revascularization (PCI within 90 minutes) significantly reduces mortality in STEMI, while prehospital antiplatelet therapy (e.g., ticagrelor) may limit infarct size.
2. Innovative resuscitation techniques, such as double sequential defibrillation for refractory VF, improve ROSC rates, though long-term survival data remain under investigation.
3. Hemodynamic stabilization with agents like nicardipine offers superior blood pressure control in hypertensive emergencies compared to traditional therapies.
4. System-level improvements, including AI-enhanced diagnostics and regional STEMI networks, help reduce treatment delays but require broader implementation, particularly in low-resource settings.

Persistent challenges-such as disparities in care access, underrepresentation of high-risk populations in trials, and variability in prehospital protocols-must be addressed through global initiatives, task-shifting models, and further research. Future efforts should focus on precision medicine, equitable emergency care delivery, and large-scale trials evaluating mechanical circulatory support and novel pharmacotherapies.

Ultimately, adherence to standardized, protocol-driven approaches-aligned with the latest ACC/AHA and ESC guidelines [8,9] - can bridge the gap between evidence and practice, ensuring optimal management of life-threatening cardiovascular emergencies.

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