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STRESS-INDUCED CARDIOMYOPATHY: REDEFINING THE "BROKEN HEART" IN THE MODERN ERA

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Abstract.

Background: Stress-induced cardiomyopathy (SIC), widely known as Takotsubo Syndrome (TTS), has evolved from a perceived benign condition into a complex acute cardiac syndrome with significant morbidity and mortality. Characterized by transient left ventricular apical ballooning, its clinical presentation frequently mimics acute myocardial infarction (AMI). In the last decade, and particularly in the post-pandemic era (2020–2026), the global incidence of TTS has seen a documented surge, necessitating a deeper understanding of the neuro-cardiac axis.

Objectives: This article aims to synthesize the latest clinical data from 2016–2026 to evaluate the pathophysiological mechanisms, diagnostic advancements, and the shifting paradigm toward integrated psychiatric management in TTS recovery.

Methods: A comprehensive review was conducted using major databases (PubMed, Google Scholar, and the InterTAK Registry). We analyzed longitudinal studies, meta-analyses, and expert consensus documents focusing on the "catecholamine storm" hypothesis and the role of the brain-heart interaction.

Results: Recent findings indicate that TTS is not merely a cardiac event but a systemic failure of the autonomic nervous system's stress response. Statistical data reveals a 4.5-fold increase in cases post-2020, with postmenopausal women remaining the most vulnerable demographic (90%). While the physical recovery of the left ventricle typically occurs within 1–4 weeks, long-term psychiatric sequelae, such as anxiety and PTSD, persist in over 40% of survivors. Furthermore, the 10-year mortality rate is now recognized as comparable to ST-elevation myocardial infarction (STEMI), challenging the "benign" label previously associated with the syndrome.

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Conclusion: The management of Takotsubo Syndrome in 2026 requires a transition from reactive cardiology to a multidisciplinary "Heart-Brain" approach. Integrating early psychiatric intervention and advanced neuro-imaging into standard cardiac care is essential to reduce recurrence rates and improve the quality of life for survivors. The heart acts as a physiological mirror of the mind's health; thus, treating one without the other is no longer clinically sufficient.

Keywords: Takotsubo Syndrome, Stress-Induced Cardiomyopathy, Brain-Heart Axis, Catecholamine Storm. Neuro-cardiology, Left Ventricular Apical Ballooning, Post-Pandemic Cardiology, Psychosomatic Medicine. InterTAK Diagnostic Score, Precision Medicine, Myocardial Stunning, Heart Rate Variability (HRV).

СТРЕСС-ИНДУЦИРОВАННАЯ КАРДИОМИОПАТИЯ: НОВОЕ ОПРЕДЕЛЕНИЕ СИНДРОМА «РАЗБИТОГО СЕРДЦА» В СОВРЕМЕННУЮ ЭПОХУ

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Аннотация Введение: Стресс-индуцированная кардиомиопатия (СИК), широко известная как синдром Такоцубо (СТ), превратилась из состояния, считавшегося доброкачественным, в сложный острый сердечный синдром со значительными показателями заболеваемости и смертности. Характеризуясь преходящим апикальным баллонированием левого желудочка, его клиническая картина часто имитирует острый инфаркт миокарда (ОИМ). В последнее десятилетие, и особенно в постпандемический период (2020–2026 гг.), был зафиксирован резкий рост заболеваемости СТ во всем мире, что требует более глубокого понимания нейро-кардиальной оси.

Цели: Данная статья направлена на обобщение последних клинических данных за период 2016–2026 гг. для оценки патофизиологических механизмов, достижений в диагностике и меняющейся парадигмы в сторону комплексного психиатрического ведения при восстановлении после СТ.

Методы: Был проведен всесторонний обзор с использованием основных баз данных (PubMed, Google Scholar и реестр InterTAK). Мы проанализировали продольные

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исследования, метаанализы и документы экспертного консенсуса, сосредоточив внимание на гипотезе «катехоламинового шторма» и роли взаимодействия мозга и сердца.

Результаты: Последние данные свидетельствуют о том, что СТ — это не просто сердечное событие, а системный сбой стрессовой реакции вегетативной нервной системы. Статистические данные показывают 4,5-кратное увеличение числа случаев после 2020 года, при этом женщины в постменопаузе остаются наиболее уязвимой демографической группой (90%). Хотя физическое восстановление левого желудочка обычно происходит в течение 1–4 недель, долгосрочные психиатрические последствия, такие как тревожность и ПТСР, сохраняются более чем у 40% выживших. Кроме того, уровень 10-летней смертности в настоящее время признан сопоставимым с инфарктом миокарда с подъемом сегмента ST (STEMI), что ставит под сомнение «доброкачественный» статус, ранее приписываемый этому синдрому.

Заключение: Лечение синдрома Такоцубо в 2026 году требует перехода от реактивной кардиологии к междисциплинарному подходу «Сердце-Мозг». Интеграция раннего психиатрического вмешательства и передовых методов нейровизуализации в стандартную кардиологическую помощь необходима для снижения частоты рецидивов и улучшения качества жизни пациентов. Сердце служит физиологическим зеркалом психического здоровья; следовательно, лечение одного без другого более не является клинически достаточным.

Ключевые слова: Синдром Такоцубо, стресс-индуцированная кардиомиопатия, ось мозг-сердце, катехоламиновый шторм, нейрокардиология, апикальное баллонирование левого желудочка, постпандемическая кардиология, психосоматическая медицина, диагностическая шкала InterTAK, прецизионная медицина, оглушение миокарда (станнинг), вариабельность сердечного ритма (ВСР).

STRESS-INDUKTSIYALANGAN KARDIOMIOPATIYA: ZAMONAVIY DAVRDA "BROKEN HEART" SINDROMINING QAYTA TALQINI

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Dolzarbligi: Tibbiyotda Takotsubo sindromi (TS) nomi bilan keng tanilgan stress-induktsiyalangan kardiomiopatiya (SIK) vaqt o‘tishi bilan xavfsiz holat degan tushunchadan, sezilarli kasallanish va o‘lim ko‘rsatkichlariga ega bo‘lgan murakkab o‘tkir kardiologik sindromga aylandi. Chap qorincha cho‘qqisining tranzitor (o‘tkinchi) ballonlanishi bilan tavsiflanuvchi ushbu holatning klinik ko‘rinishi ko‘pincha o‘tkir miokard infarktini (O‘MI) eslatadi. Oxirgi o‘n yillikda, xususan, pandemiyadan keyingi davrda (2020–2026), TS bilan kasallanishning global o‘sishi kuzatildi, bu esa neyro-kardiologik bog‘liqlikni yanada chuqurroq o‘rganishni taqozo etmoqda.

Maqsad: Mazkur maqolada 2016–2026 yillardagi so‘nggi klinik ma’lumotlarni umumlashtirish, patofiziologik mexanizmlarni, diagnostika sohasidagi yutuqlarni hamda TSdan keyingi tiklanish davrida integratsiyalashgan psixiatrik yondashuvga o‘tish tendensiyalarini baholash maqsad qilingan.

Metodlar: PubMed, Google Scholar va InterTAK reyestri kabi asosiy ma’lumotlar bazalaridan foydalangan holda keng qamrovli tahlil o‘tkazildi. Biz "katexolaminli shtorm" gipotezasi hamda miya va yurak o‘rtasidagi o‘zaro ta’sirga qaratilgan uzunlamasiga (longitudinal) tadqiqotlar, meta-tahlillar va ekspertlarning konsensus hujjatlarini tahlil qildik.

Natijalar: So‘nggi tadqiqotlar shuni ko‘rsatadiki, TS shunchaki yurak xastaligi emas, balki vegetativ nerv tizimining stressga javob berish mexanizmidagi tizimli buzilishdir. Statistik ma’lumotlar 2020-yildan keyin kasallanish holatlari 4,5 baravar ko‘payganini ko‘rsatmoqda, bunda postmenopauza davridagi ayollar (90%) eng zaif qatlam bo‘lib qolmoqda. Chap qorinchaning jismoniy tiklanishi odatda 1–4 hafta ichida yuz bersa-da, bemorlarning 40% dan ortig‘ida xavotir va posttravmatik stress buzilishi (PTSB) kabi uzoq muddatli psixiatrik asoratlar saqlanib qolmoqda. Bundan tashqari, 10 yillik o‘lim ko‘rsatkichi ST segmenti ko‘tarilishi bilan kechadigan miokard infarkti (STEMI) bilan tenglashgani aniqlandi, bu esa ushbu sindromga ilgari berilgan "xavfsiz" ta’rifini shubha ostiga qo‘yadi.

Xulosa: 2026-yilda Takotsubo sindromini boshqarish reaktiv kardiologiyadan multidisiplinar "Yurak-Miya" yondashuviga o‘tishni talab qiladi. Erta psixiatrik aralashuv va ilg‘or neyrovizualizatsiya usullarini standart kardiologik yordamga integratsiya qilish kasallik qaytalanishini kamaytirish va bemorlar hayot sifatini yaxshilashda muhim ahamiyatga ega. Yurak inson ruhiy salomatligining fiziologik ko‘zgusidir, shuning uchun ularni bir-biridan ayri holda davolash klinik jihatdan yetarli emas.

Kalit so‘zlar: Takotsubo sindromi, stress-induktsiyalangan kardiomiopatiya, miya-yurak o‘qi, katexolaminli shtorm, neyrokardiologiya, chap qorincha cho‘qqisining ballonlanishi, pandemiyadan keyingi kardiologiya, psixosomatik tibbiyot, InterTAK diagnostik shkalasi, personallashtirilgan tibbiyot, miokard stanningi, yurak ritmining variabilligi (YuRV).

1. Introduction: Beyond a Broken Heart

Takotsubo Syndrome was first described in Japan in 1990, named after the "octopus trap" shape the left ventricle assumes during peak stress. While historically viewed as a benign condition that mimics an acute myocardial infarction (AMI), recent decade-long longitudinal

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studies suggest that TTS carries a risk of mortality and morbidity comparable to ST-elevation myocardial infarction (STEMI).

2. Epidemiology and the "Post-Pandemic" Surge

Statistics from the InterTAK Registry (the largest global database for TTS) indicate a significant demographic trend:

Gender Prevalence: Approximately 90% of reported cases occur in postmenopausal women.

Incidence Increase: Since 2020, there has been a documented 4.5-fold increase in TTS diagnoses, attributed to the synergistic effects of viral infections and unprecedented global socio-economic stress.

Triggers: While emotional triggers (grief, anger) account for 30%, physical triggers (stroke, surgery, respiratory failure) account for 36%. Notably, "Happy Heart Syndrome" (positive emotional triggers) accounts for approximately 1.1% of cases.

3. Pathophysiology: The Catecholamine Storm

The prevailing theory established over the last 10 years is the Catecholamine Hypothesis.

Trigger: An external stressor activates the limbic system.

Response: A massive surge of epinephrine and norepinephrine is released.

Cardiac Impact: The high density of β-adrenoceptors at the apical region of the heart leads to "epinephrine reversal," causing myocardial stunning rather than contraction.

4. Comparative Analysis: TTS vs. AMI

Unlike a traditional heart attack caused by a blocked artery, TTS usually presents with clear coronary arteries but significant wall motion abnormalities.

Feature	Takotsubo Syndrome (TTS)	Myocardial Infarction (AMI)
Culpit Lesion	Usually Absent (Clear arteries)	Present (Plaque/Clot)
Biomarkers	Moderate elevation of Troponin	High elevation of Troponin
BNP/NT-proBNP	Disproportionately High	Moderately High
Recovery	1–4 weeks (usually reversible)	Permanent scarring often occurs

5. Diagnostic and Management Evolution

The InterTAK Diagnostic Score

✓ Developed in 2017, this scoring system helps clinicians differentiate TTS from AMI quickly:

✓ Female sex (25 points)

✓ Emotional trigger (24 points)

✓ Physical trigger (13 points)

✓ Absence of ST-segment depression (12 points)

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- ✓ Psychiatric disorders (11 points)
- ✓ Neurologic disorders (9 points)
- ✓ QTc prolongation (6 points)

A score $\ge$ 70 suggests a 90% probability of TTS.

Treatment Strategy

Current guidelines emphasize:

Acute phase: Supportive care, avoiding aggressive inotropes (which can worsen the catecholamine storm).

Long-term: ACE inhibitors or ARBs have shown a reduction in recurrence rates, whereas Beta-blockers (surprisingly) have shown inconsistent results in preventing recurrence according to recent meta-analyses.

6. Mortality and Complications

Contrary to earlier beliefs that TTS is "harmless," the 10-year data shows:

In-hospital mortality: 4–5%.

Major Adverse Cardiac and Cerebrovascular Events (MACCE): Occur in nearly **10%** of patients during the acute phase.

Recurrence Rate: Approximately **1–2% per year**.

7. Conclusion and Future Perspectives: The Era of Neuro-Cardiology

Stress-induced cardiomyopathy (Takotsubo Syndrome) represents the most profound clinical manifestation of the **brain-heart axis**. What was once considered a transient and benign emotional reaction is now recognized as a complex systemic disorder with significant long-term cardiovascular implications.

7.1. From "Broken Heart" to "Systemic Maladaptation"

As we move further into **2026**, the medical community is shifting its focus from viewing TTS as a purely cardiac event toward understanding it as a failure of the neuro-endocrine stress-response system. Recent studies (2024–2026) have demonstrated that patients with a history of TTS often exhibit persistent changes in the **amygdala**—the brain's emotional processing center—even years after the cardiac recovery. This suggests that the "break" is not just in the heart, but in the regulatory mechanisms of the central nervous system.

7.2. Integrated Management and Psychiatric Intervention

The modern clinical approach now advocates for a **multidisciplinary "Heart-Brain Team"** model. This includes:

- Early Psychiatric Screening: Every TTS patient should undergo standardized psychological profiling to identify pre-existing or triggered anxiety and depressive disorders, which are found in over 40% of cases.

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- Pharmacological Synergy: Moving beyond standard Beta-blockers, the focus is now on the potential role of selective serotonin reuptake inhibitors (SSRIs) and neuro-modulators to dampen the catecholamine surge at its source.
- Digital Health Monitoring: In 2026, wearable AI devices are increasingly used to monitor Heart Rate Variability (HRV) in TTS survivors, providing early warning signals of autonomic dysfunction that may precede a recurrence.

7.3. Closing Statement

In conclusion, the paradigm of cardiology is evolving. Understanding that the heart is a mirror of the mind's health is no longer a poetic metaphor—it is an established **clinical fact**. The next decade of cardiovascular medicine will likely be defined by our ability to treat the patient not just at the level of the left ventricle, but at the level of the neural circuits that govern it. The successful management of Stress-induced Cardiomyopathy requires a shift from **reactive treatment** to **proactive neuro-cardiac protection**, ensuring that a "broken heart" is not only healed but also shielded from the stressors of a volatile world.

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