Supplementary Table 1. Athlete Classification

Author	Training background of patients	Type of sport/exercise and duration of training	Definition of heavy/intense activity	Age (years)	Gender (male/female)	Referral status
Dagradi et al. 2020[1]	Whole sample: ● Competitive athlete (81%) ● Recreational/noncompetitive (19%) athletes. Patients with reversible pattern: not specifically mentioned	Not specifically mentioned	Not defined	Whole sample: median 14 years (12-18), range 6-56 years Patients with reversible pattern: not specifically mentioned	27/33	All patients were referred by sports medicine physicians due to QT interval prolongation/T wave abnormalities during preparticipation screening
Bains et al. 2023[2]	Not specifically mentioned	Not specifically mentioned	Not defined	Whole sample: 22 ± 14 years Patients with reversible pattern: not specifically mentioned	Whole sample: 174/116 Patients with reversible pattern: not specifically mentioned	Whole sample: ● Self-referred: 58 (20%) ● Referred by physician: 232 (80%) Patients with reversible pattern: not specifically mentioned
Pagani et al. 2023[3]						
Case 1	Military service member	Swimming and running for 2-3 hours per day	Not defined	22 years	1/0	Referred due to QT interval prolongation during Special Forces training application
Case 2	Military service member	2,000 meters of swimming 3-4 times a week and 35 miles of running per week	Not defined	20 years	1/0	Referred due to QT interval prolongation during Special Forces training application, examination was conducted following a 36-hour athletic training competition
Case 3	Military service member, NCAA Division 1 athlete	Lacrosse, 3-4 hours of daily exercise	Not defined	21 years	0/1	Referred due to QT interval prolongation during aviation training application

Roagna et al. 2024[4]	Competitive athlete	Basketball with 11 hours per week of training load and significantly increased in the previous 6 months	Not defined	16 yr	Not mentioned	Referred due to QT interval prolongation and T wave abnormalities
Viskin et al. 2010[5]	Competitive athlete	Not specifically mentioned	Not defined	Not mentioned	0/1	Referred due to QT interval prolongation during preparticipation screening
Napolitano et al. 2006[6]	Competitive athlete	Not specifically mentioned	Not defined	Not mentioned	Not mentioned	Referred due to QT interval prolongation during training period for competition

Supplementary Table 2. Genetic testing and family history

Author	Did this study perform genetic testing?	Genes tested																													Number of patients with reversible pattern after detraining/Number of patients with negative genetic testing	Was the patient's family history reviewed?	Number of patients with positive family history/Number of patients with reversible pattern after detraining
		KCNQ1	KCNH2	KCNI5	KCNE1	KCNE2	KCNE3	KCNDE3	KCNJ2	KCNJ5	AKAP9	ANIC2	ANK2	ANKB	CAV3	CTNNA3	CACNA1C	CALM1	CALM2	CALM3	DMD	DSG2	JUP	PKP2	SNTA1	SCN4B	SCN5A	TBX5	TRDN	HERG			
Dagradi et al. 2020[1]	Yes	✓	✓	▯	✓	✓	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	✓	▯	▯	▯	33/78 (42.3%)	Yes	0/33
Bains et al. 2023[2]	Yes	✓	✓	▯	✓	✓	✓	✓	✓	▯	✓	▯	✓	✓	✓	✓	▯	▯	▯	▯	✓	✓	✓	✓	✓	▯	✓	✓	✓	▯	Not estimable	Yes	Not estimable
Pagani et al. 2023[3]																																	
Case 1	Yes	✓	✓	▯	✓	✓	▯	▯	✓	✓	✓	▯	✓	▯	✓	▯	✓	✓	✓	✓	▯	▯	▯	▯	✓	✓	✓	▯	✓	▯	3/3	Yes	0/3
Case 2	Yes	✓	✓	▯	✓	✓	▯	▯	✓	✓	✓	▯	✓	▯	✓	▯	✓	✓	▯	✓	▯	▯	▯	▯	✓	✓	✓	▯	✓	▯			
Case 3	Yes	✓	✓	✓	✓	✓	▯	▯	✓	▯	✓	✓	▯	▯	✓	▯	✓	✓	✓	✓	▯	▯	▯	▯	✓	✓	✓	▯	✓	▯			
Roagna et al. 2024[4]	Yes	Specific gene not mentioned																													1/1	Yes	0/1
Viskin et al. 2010[5]	Yes	Specific gene not mentioned																													1/1	Yes	0/1
Napolitano et al. 2006[6]	No	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	Not applicable	No	Not applicable

Supplementary Table 3. Additional examinations

Author	Additional Examination	Findings
Dagradi et al. 2020[1]	- Exercise stress test - Holter ECG - Planned for echocardiography	- The findings from the Holter are as follows: a. HRmin from 42 ± 5 to 42 ± 5 bpm post-detraining b. Reduced HRmax from 132 ± 16 to 125±22 bpm post-detraining c. Increased HRmean from 71 ± 13 to 72 ± 20 bpm post-detraining d. Reduced QTcmax from 497 ± 32 to 454 ± 23 ms post-detraining - The findings from the exercise stress test are as follows: a. Reduced HR_{basal} from 78 ± 10 to 81 ± 18 bpm post-detraining b. Reduced HR_{peak} from 169 ± 11 to 165 ± 21 bpm post-detraining c. Reduced $HR_{1st\text{-}rec}$ from 133 ± 25 to 139 ± 26 bpm post-detraining d. Reduced $QTc_{4th\text{-}rec}$ from 465 ± 57 to 422 ± 23 ms post-detraining - Echocardiography was not performed or reported in this study.
Bains et al. 2023[2]	Epinephrine or isoproterenol testing	- Twenty-four patients were misdiagnosed due to overestimation of the QT interval. - Echocardiography was not performed or reported in this study.
Pagani et al. 2023[3]		
Case 1	- Transthoracic echocardiography - Exercise stress test	- Transthoracic echocardiogram showed no structural abnormalities, and there was no evidence of physiological mechanisms of cardiac adaptation reported in this case. - The stress test was normal, showing appropriate QTc shortening, with a recovery QTc that did not exceed 470 ms at 4 minutes.
Case 2	- Transthoracic echocardiography - Cardiac magnetic resonance imaging - Exercise stress test	- Transthoracic echocardiography and cardiac MRI showed no structural pathology, aside from mild LV and LA enlargement consistent with physiological adaptation to high-volume endurance training such as swimming and long-distance running.

		- The stress test was normal, showing typical QTc shortening
Case 3	- Transthoracic echocardiography - Cardiac magnetic resonance imaging	Transthoracic echocardiography and cardiac MRI showed no structural abnormalities, and there was no evidence of physiological cardiac adaptation reported in this case.
Roagna et al. 2024[4]	- Cardiac ultrasound - Holter ECG - Exercise stress test	- Cardiac ultrasound during the detraining phase showed no structural or functional abnormalities, and no physiological cardiac adaptation was reported in this case. - Holter ECG confirmed the presence of a second dynamic component of ventricular repolarization, resulting in a significantly prolonged QT (QTc max >550 ms). The QTc interval was typically between 375 and 400 ms. - The QTc adaptation during exercise and recovery was preserved, with a recovery QTc of 401 ms at the fourth minute
Viskin et al. 2010[5]	Quick standing test	- The patient responded to the test, marked by “Highly abnormal QT-stretching”. - Echocardiography was not performed or reported in this study.
Napolitano et al. 2006[6]	Not mentioned in the study	Echocardiography was not performed or reported in this study.

Supplementary Table 4. Detraining protocol

Author	Detraining Protocol	Follow-up Period	Clinical Manifestation Before Detraining	Clinical Manifestation After Detraining	Additional Interventions Besides Detraining
Dagradi et al. 2020[1]	A 3-6 months period of detraining.	- The specific duration of the follow-up period was not reported. - No cardiac adverse events were recorded during follow-up. - QTc re-prolongation was observed in 7 patients after returning to competitive sports such as rugby and swimming, with some patients experiencing no recurrence during low-intensity sport activities	- Thirty-three patients of cases (reversible pattern) with an average QTc interval of 492 ± 37 ms. - Schwartz score at the initial presentation was 3.0 ± 1.2 - 26 out of 33 patients showed a QTc ≥ 470 ms. - 29 out of 33 patients had ventricular repolarization abnormalities. - There were no other cardiac-related symptoms or events in any of the patients.	- QTc shortening to 423 ± 25 ms. - The Schwartz score decreased (0.06 ± 0.24) significantly after detraining (P < 0.001).	12 out of 33 patients, including those with a cases (reversible pattern), were taking β-blockers. The administration of β-blockers was given due to worsening LQTS, without waiting for the genetic test results. When the genotype results were negative and the ECG was normal, the β-blocker was discontinued. The study does not specify how many remained on β-blockers during the post-detraining QTc assessment.
Bains et al. 2023[2]	Not mentioned in the study	- The follow-up duration was 3±5 years. - All six patients showed normalized QTc intervals after detraining, confirming the initial prolongation was reversible. - No cardiac events or symptoms	- Whole sample: ● QTc prolongation following vasovagal syncope. ● 44 out of 290 patients were diagnosed with isolated or transient QTc prolongation due to various causes, including panic	Six patients returned to normal QTc after undergoing detraining.	- Whole sample: A total of 232 of 290 patients were initially prescribed β-blockers. However, β-blocker treatment was discontinued in 194 patients after the removal of the LQTS diagnosis. - The number of patients receiving β-blocker therapy at the time of post-detraining QTc assessment was not explicitly reported. - Patients with reversible pattern: not specifically mentioned

		occurred in the six patients during follow-up.	attacks, metabolic disturbances, anorexia, drug-induced QT prolongation, sinus arrhythmias, and pregnancy. ● 5 out of 290 patients had a history of seizures. ● 3 out of 290 patients had a history of sudden cardiac arrest. ● 3 out of 290 patients had a misdiagnosis of Jervell and Lange-Nielsen Syndrome. ● Patients with reversible pattern: not specifically mentioned		
Pagani et al. 2023[3]					
Case 1	1-month period of detraining	- The follow-up duration was 5 months. - No cardiac adverse events were reported during follow-up. - During follow-up, the QTc interval normalized to	- One patient with a QTc interval of 480 ms. - Reported having 1 episode of syncope at the age of 13. - There were no other cardiac-related symptoms or events.	One patient with a QTc interval had it reduced to 440 ms.	The patient was not taking any medication.

		440 ms after one month of detraining and remained within the normal range (440–450 ms) after resuming swimming or running. - The patient resumed 2–3 hours/day of swimming or running and remained asymptomatic; stress test normal.			
Case 2	6-week period of detraining	- The follow-up duration was 15 weeks. - No cardiac adverse events were reported during follow-up. - During follow-up, QTc reduced to 440–450 ms after 6-week detraining; stable on follow-up. - During follow up, the patient returned to running (35 miles/week) and swimming also remained	- One patient with a QTc interval of 486 ms. - There were no other cardiac-related symptoms or events.	One patient with a QTc interval had it reduced to 440-450 ms.	The patient was not taking any medication.

		asymptomatic; stress test normal			
Case 3	A 2-3 months period of detraining.	- The follow-up duration was 3 years (2019-2022). - No cardiac adverse events were reported during follow-up. - During follow-up, the QTc interval normalized (420–440 ms) after 2–3 months of detraining, with no QT prolongation observed during stress testing. - The patient resumed daily NCAA-level training, remained asymptomatic, and had a stable QTc interval (410 ms in 2022).	- One patient with a QTc interval of 475 ms. - There were no other cardiac-related symptoms or events.	- Not detect any arrhythmias. - One patient with a QTc interval had it reduced to 420 ms on an ECG post retraining.	Patient was taking propranolol due to QTc prolongation.

Roagna et al. 2024[4]	A complete 6-month detraining period.	- The follow-up duration was 6 months. - No cardiac adverse events were reported during follow-up. - During follow-up, QTc normalized (from >550 ms on Holter to 401 ms on ECG); repolarization abnormalities resolved except transient U-wave post-HR spike; LV function and electromechanical parameters preserved. - Return to play permitted with reduced load (6 h/week); ECG normal at 3-month follow-up	One patient exhibited the following ECG findings: - Notched T waves in lead V2-V3 and late T wave peaks in other leads. - Mild QTc prolongation in lead DII (455 ms) and severe QTc prolongation in leads V2-V3 (>550 ms on Holter ECG). - A second dynamic component of ventricular repolarization, especially after sudden heart increases.	- Normalized QTc and resolution of morphological abnormalities on resting ECG (QTc in lead DII reduced to 401 ms). - QTc mostly ranged between 375-400 ms on Holter ECG - Preserved QTc adaptation during exercise and recovery (4th minute recovery QTc: 401 ms). - Echocardiography showed preserved left ventricular ejection fraction (LVEF 62%), global longitudinal strain (-23%), and improved electromechanical dispersion parameters.	Not mentioned in the study
Viskin et al. 2010[5]	4-month period of detraining	- The follow-up duration was 4 months. - No cardiac adverse events were reported during follow-up.	- There were no other cardiac-related symptoms or events - QTc interval ranging from 461 to 473 ms (97th to 99th percentile for healthy women). - A positive response to the quick standing	The QTc interval was partially but significantly reduced to 403 ms.	Only one patient was reported to have post-detraining QTc measurements while receiving β-blocker therapy.

		- During follow-up, QTc partially normalized (461–473 ms to lower range); T-wave abnormalities improved post-detraining.	test indicating the presence of LQTS symptoms.		
Napolitano et al. 2006[6]	5-month period of detraining	- The follow-up duration was 5 months. - No cardiac adverse events were reported during follow-up. - During follow-up, QTc and T-wave abnormalities normalized after detraining and the initial ECG changes suggestive of LQTS resolved.	- Patients with a prolonged QTc interval. - Changes in the morphology and duration of cardiac repolarization.	Patient showed completely normal repolarization after detraining.	Not mentioned in the study.

Supplementary Table 5. Exercise-Induced QT Prolongation and Detraining Outcomes

Study	Population	Baseline QT Interval	Genetic Testing	Detraining Outcomes	Schwartz Score	Key Conclusions
Dagradi et al. 2020[1]	199 patients: 121 genotype-positive LQTS, 78 genotype-negative. 33 cases exhibited reversible ECG abnormalities after detraining.	QTc baseline: 492 ± 37 ms (cases group).	Negative in 78 genotype-negative patients.	QTc shortened significantly after detraining to 423 ± 25 ms. Holter monitoring showed QTc shortening from 497 ± 32 ms to 454 ± 23 ms.	Schwartz scores decreased significantly from 3.0 ± 1.2 to 0.06 ± 0.24 post-detraining.	QT prolongation in some athletes is reversible after detraining, distinguishing it from congenital LQTS.
Bains et al. 2023[2]	290 referred patients; 6 misdiagnosed with exercise-induced QT prolongation; mean age 22 ± 14.	Referral QTc: 504 ± 39 ms; corrected QTc post-evaluation: 427 ± 25 ms.	68 tested positive for a variant, but specific cases had negative genetic findings.	QTc normalization occurred post-detraining (specific values not mentioned).	Not mentioned in the study.	Exercise-induced QT prolongation may lead to misdiagnosis; detraining helps clarify the diagnosis and avoid overtreatment.
Pagani et al. 2023[3]	3 military service members with exercise-induced QT prolongation.	QTc baseline: Case 1 – 480 ms; Case 2 – 486 ms; Case 3 – 475 ms.	Negative for all cases.	QTc normalized after detraining: Case 1 – 440 ms (1 month); Case 2 – 440-450 ms (6 weeks); Case 3 – 420-440 ms (2-3 months).	Not mentioned in the study.	QTc prolongation resolved within 1–2 months of detraining; no recurrence even after return to physical activity.
Roagna et al. 2024[4]	1 competitive basketball player, 16 years old, with increased training load.	Mild QTc prolongation (455 ms in DII); Holter QTc max >550 ms.	Negative genetic testing.	QTc normalized after 6 months of detraining to 401 ms; T-wave abnormalities resolved, and exercise stress showed recovery.	Not mentioned in the study.	Intense exercise can cause ventricular repolarization abnormalities; detraining helps differentiate from true LQTS.

Viskin et al. 2010[5]	1 competitive athlete with QTc prolongation during screening.	Baseline QTc: 461–473 ms.	Negative genetic testing.	QTc normalized after 4 months of detraining to 403 ms.	Not mentioned in the study.	Customized management, including detraining, may allow athletes to safely return to sports without overtreatment.
Napolitano et al. 2006[6]	1 competitive athlete referred for QTc prolongation during intense training.	Baseline QTc: 511 ms in DII.	Not mentioned in the study.	QTc shortened significantly to 392 ms after detraining.	Not mentioned in the study.	The interpretation of QT interval normalization post detraining lacks scientific evidence at the time of writing.

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