A Multicenter Retrospective Evaluation of Specialized Laboratory Investigations in the Workup of Pediatric Patients With New-Onset Supraventricular Tachycardia

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Contribution to Emergency Nursing Practice

- Specialized laboratory evaluation of supraventricular tachycardia in children may occur, but the utility is unknown.
- In this multicenter electronic health record database analysis, we found that cardiac-specific and noncardiac laboratory testing may be ordered for pediatric patients who present with supraventricular tachycardia. Thyroid studies were the most common laboratory testing ordered, but abnormal results only occurred in less than a quarter of subjects.
- These findings may highlight a quality improvement opportunity for emergency nurses and practitioners to change the practice toward ordering laboratory tests based on clinical indication.

Abstract

Introduction: Specialized laboratory evaluation of supraventricular tachycardia in children may occur, but the utility is unknown. The study objectives are to assess the type, frequency, and results of specialized laboratory testing performed in pediatric patients presenting with new-onset supraventricular tachycardia. We hypothesized that when specialized laboratory testing occurs (particularly for cardiac failure, toxicologic, inflammatory, and thyroid diseases), the results are generally within normal limits.

Methods: This is a retrospective descriptive study using an electronic health record database (TriNetX, Inc). We collected and evaluated the following data of subjects aged younger than 18 years with a first-time supraventricular tachycardia diagnosis: demographics, diagnostic codes, deaths, and laboratory codes/results (natriuretic peptide B, natriuretic peptide B prohormone N-terminal, troponin I, toxicology testing, inflammatory markers, and thyroid studies).

Results: A total of 621 subjects (524 [84.4%] without laboratory testing, 97 [15.6%] with laboratory testing) were included. Thyroid studies (65 [10.5%]) were the most frequent laboratory study performed followed by cardiovascular specific studies (35 [5.6%]), inflammatory markers

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J Emerg Nurs 2022;■:1-10.
0099-1767

https://doi.org/10.1016/j.jen.2022.07.002

(21 [3.4%]), and toxicology tests (10 [1.6%]) ($P = .002$). Obtained laboratory testing was more frequent with older subjects, females, and need for emergency, hospital, and critical care services.

Discussion: Cardiac-specific and noncardiac laboratory testing is frequently ordered for pediatric patients who present with supraventricular tachycardia. Thyroid studies were the most common laboratory testing ordered, but abnormal results only occurred in less than a quarter of subjects. These findings may highlight a quality improvement opportunity for emergency nurses and practitioners in the practice of obtaining laboratory tests to better reflect high-value evidence-based care for this vulnerable population.

Key words: Cardiac dysrhythmias; Laboratory examinations and diagnoses; Pediatrics; Supraventricular tachycardia

Introduction

In the pediatric population, cardiac rhythm disturbances make up approximately 5% of hospitalizations per year and certain types are an important cause of morbidity in infants.[1,2] Thus, children with this condition require not only acute treatment but subspecialty pediatric cardiology care and close follow-up to ensure the best possible outcome.[3] Despite the requirement for subspecialty care, this patient population may first be managed by a general emergency medicine, pediatrics provider, and nursing staff, who not only must be able to identify supraventricular tachycardia (SVT) but manage this condition in collaboration with a prescribing provider while supporting the patient and family.[4,5]

The most common cardiac rhythm disturbance in the pediatric population is SVT.[6] It is a dysrhythmia that originates from atrial or atrioventricular nodal tissue above the bundle of His.[7] In children, the mechanism of SVT is most commonly caused by the presence of an accessory electrical pathway creating a reentrant circuit between the atrium and the ventricle or within the atrioventricular node.[8,9] When triggered, it results in increased heart rates and, if not addressed, may result in heart failure and/or death.[8]

After stabilization, oftentimes in the emergency setting, an extensive diagnostic workup may be performed. In addition to routine laboratory evaluation, this may consist of cardiac-specific laboratory and specialty laboratory tests such as thyroid function studies and drug/toxicology screens.[10] However, its utility is unclear given that most patients with SVT have structurally normal hearts and often do not have any noncardiac associated conditions.[9] Thus, extensive testing could lead to unnecessary invasive evaluation of these patients, excess costs, longer lengths of stays in the emergency department, and unnecessary worry for the parents and practitioners.[4] An understanding of how emergency and nonemergency clinicians assess pediatric patients presenting with SVT may help (1) assess the need for laboratory testing and (2) justify whether a high-value evidence-based approach to medical decision making for children with cardiac dysrhythmias is needed.

The objective of this study is to (1) assess the type and frequency of specialized laboratory testing (cardiovascular specific serum studies [natriuretic peptide B, natriuretic peptide B prohormone N-terminal, troponin I], toxicology testing, inflammatory markers, and thyroid studies) performed with patients younger than 18 years of age who present with SVT for the first time and (2) determine the frequency that these tests reveal an abnormal result. We hypothesize that, although noncardiac specific laboratory testing is frequently performed, it often produces a result that is within normal limits (a low positivity rate).

Methods

STUDY DESIGN

This is a retrospective observational cohort study that was conducted using the TriNetX electronic health record (EHR) data of pediatric patients younger than 18 years of age with a cardiac dysrhythmia–related diagnostic code. TriNetX is a global federated health research network that provides researchers access to continuously updated data elements on EHRs from participating health care organizations, predominantly in the United States.[11] TriNetX is certified to the ISO 27001:2013 standard and protects health care data by maintaining compliance with the Health Insurance Portability and Accountability Act Security Rule. The EHR data elements are aggregated and deidentified, including demographic characteristics, diagnoses, procedures, medications, laboratory values, and genomics, all in compliance with the deidentification standard outlined in Section §164.514(a) of the Health Insurance Portability and Accountability Act privacy rule. Because no protected health information is received by the user, we were provided a waiver from the Penn State Health Institutional Review Board to perform this study.

DATA COLLECTION

On January 22, 2021, we analyzed the available EHR data of 621 pediatric patients aged 18 years or younger who had a first-time SVT-related international classification of diseases diagnostic code and received the following services (emergency department, hospital, and/or critical care). It was assumed that subjects who had this diagnostic code were seen by a clinician, were evaluated, were diagnosed as having SVT, and had no other reason to have this diagnostic code based on the evaluation that was performed. We excluded patients who had previously undergone cardiac surgery, because these patients frequently have cardiac dysrhythmias and may not receive additional testing. We also excluded children with congenital heart disease. The SVT diagnosis entry dates ranged from April 9, 2002, to January 28, 2021. (Please see Supplementary Table for diagnostic code definitions.)

After the query, we obtained the following data: age, sex, race, ethnicity, and type and results of laboratory testing that was performed within the first day after the first reported instance of an SVT-related diagnostic code. For each unique patient, we analyzed the following specific laboratory testing categories: (1) cardiovascular specific studies (natriuretic peptide B, natriuretic peptide B prohormone N-terminal, troponin I) and (2) noncardiovascular studies. Noncardiovascular specific studies were focused on thyroid studies (free thyroxine [T4], thyrotropin), toxicology testing (qualitative urine [substance presence] and quantitative serum [substance presence and amount]), and inflammatory markers (C-reactive protein, erythrocyte sedimentation rate). We determined whether test results were within normal limits for natriuretic peptide B, natriuretic peptide B prohormone N-terminal, troponin I, C-reactive protein, erythrocyte sedimentation rate, free T4, and thyrotropin. Frequency of results not within normal limits was determined for each laboratory category and individual laboratory tests. Owing to a lack of reference values (and the likelihood that the different health care organizations may use different laboratories with different reference ranges), only qualitative and not quantitative serum for the toxicology tests were reviewed. The reference values for all the other laboratory tests were quantitative. Upon review of the nontoxicology laboratory tests, it was noted that some unique subjects had duplicate codes/values (ie, presence of 2 troponin I levels) and the presence of more than 1 distinct laboratory code/value within a laboratory category (ie, presence of C-reactive protein and erythrocyte sedimentation rate in the inflammatory marker category). For duplicate laboratory codes/values, we counted the laboratory once for each unique subject that had this occurrence and recorded the maximum value (ie, troponin I of 0.014 ng/mL and 0.015 ng/mL, only 0.015 ng/mL was recorded). The only exception was the thyrotropin level, where we recorded the minimum value for this, given that the clinician was likely evaluating for hyperthyroidism. For multiple distinct laboratory codes/values within a laboratory category, it was considered as part of the laboratory category and also counted once. In addition to the above, we evaluated for diagnostic codes specific for heart failure, thyroid disorders, and pre-excitation syndrome.

STATISTICAL ANALYSIS

Summary statistics using mean and standard deviation or proportions were reported for demographic, other diagnoses, and common procedural terminology codes for pediatric patients with an SVT diagnosis. Multiple categories of the race were rare; thus, they were regrouped into White and others for analysis.

Fisher's exact test was applied to compare various categorical clinical characteristics between those who received laboratory testing and not. Given that the distribution of age was highly skewed, the Wilcoxon rank sum test was applied to test the difference between the 2 groups.

We used Cochran's Q test to investigate whether a laboratory category was performed more commonly than others. If the null hypothesis of Cochran's Q test was rejected, we further applied pairwise McNemar's tests to examine whether the most commonly performed laboratory category had a higher frequency than the rest. Bonferroni correction was applied to control the familywise error rate.

To investigate whether there is an association between the laboratory evaluation and clinical characteristics (age, sex, race, and common procedural codes), we first used univariate logistic regressions of each variable of interest on each laboratory category and binary outcome in any laboratory or not. A generalized additive model using the thin plate regression spline was fit to confirm the linearity assumption on continuous variables in the logistic regression. For multivariate analysis, we conducted the multivariate logistic regression with backward stepwise variable selection based on the Akaike information criterion. Odds ratio, 95% confidence interval and P value were calculated to assess the relationship between clinical characteristics and each outcome.

We used statistical software R 4.1.1 (R Foundation for Statistical Computing) with packages tidyverse v1.3.1, arsenal v3.6.3, coin v1.4-,1 and mgcv v1.8-36. Given the exploratory nature of the analysis for this retrospective

TABLE 1
Clinical characteristics

Clinical characteristics	No specialized laboratory testing	Specialized laboratory testing	*P* value
Total number of subjects, *n* (%)	524 (84.4%)	97 (15.6%)	-
Approximate age (y, mean, SD)*	7.0 (SD = 5.5)	10.1 (SD = 5.2)	< .001
Age groups, *n* (%)			
0-5 y	227 (43.3)	22 (22.7)	-
6-10 y	123 (23.5)	21 (21.6)	
11-18 y	174 (33.2)	54 (55.7)	
Sex, *n* (%)			.03
Male	275 (52.5)	39 (40.2)	
Female	249 (47.5)	58 (59.8)	
Race, *n* (%)			.1
American Indian or Alaska Native	3 (0.6)	1 (1.0)	
Asian	11 (2.1)	2 (2.1)	
Black or African American	78 (14.9)	20 (20.6)	
Unknown	84 (16.0)	7 (7.2)	
White	348 (66.4)	67 (69.1)	
Ethnicity, *n* (%)			< .001
Hispanic or Latino	109 (20.8)	5 (5.2)	
Not Hispanic or Latino	317 (60.5)	65 (67.0)	
Unknown	98 (18.7)	27 (27.8)	
Associated diagnoses, *n* (%)			
Heart failure	9 (1.7)	2 (2.1)	.70
Thyroid disorders	5 (1.0)	1 (1.0)	> .99
Pre-excitation syndrome	67 (12.8)	4 (4.1)	-
Common procedural terminology codes, *n* (%)			
Emergency department services	324 (61.8%)	71 (73.2%)	.04
Hospitalization	112 (21.4%)	17 (17.5%)	.50
Critical care services	138 (26.3%)	25 (25.8%)	> .99

* Owing to the deidentified nature of the database, only the year of birth was provided. Thus, these ages are approximate based on the day of arrhythmia diagnosis.

study, no adjustment for multiplicity was applied for the regression model. *P* values of less than or equal to .05 were regarded as statistically significant.

Results

DEMOGRAPHIC CHARACTERISTICS

A total of 621 subjects (524 [84.4%] without laboratory studies and 97 [15.6%] with laboratory studies) were included in this study. Associated diagnoses, race, hospitalization, and critical care services were similar in both groups. Demographic characteristics are summarized in Table 1.

FREQUENCY OF SPECIFIC LABORATORY TESTS PERFORMED

A higher frequency of thyroid laboratory studies was performed (65 [10.5%]) compared with cardiovascular specific studies (35 [5.6%]), inflammatory markers (21 [3.4%]), or toxicology tests (10 [1.6%]) ($P = .002$). Of the cardiovascular specific tests, a greater frequency of

TABLE 2
Frequency of specific laboratory tests performed

Laboratory studies	Frequency of unique subjects	*P* value
Any thyroid study	65 (10.5)	.002
Free thyroxine (T4) (LOINC 3024-7)	31 (5.0)	
Thyrotropin minimum value (LOINC 11580-8)	60 (9.7)	
Any cardiovascular specific laboratory study	35 (5.6)	
Natriuretic peptide B (LOINC 30934-4; 42637-9)	10 (1.6)	
Natriuretic peptide B prohormone N-terminal (LOINC 33762-6)	3 (0.5)	
Troponin I (LOINC 10839-9, 42757-5; 49563-0; 76399-5; 89579-7)	27 (4.3)	
Any inflammatory marker level	21 (3.4)	
C-reactive protein (LOINC 1988-5; 11039-5; LP15023-2)	16 (2.6)	
Erythrocyte sedimentation rate (LOINC 4537-7; 30341-2; 82477-1; LP16409-2)	10 (1.6)	
Any drugs and toxicology screen or serum level	10 (1.6)	

Data are number (%) unless otherwise indicated.
LOINC, logical observation identifiers names and codes.

troponin I (27 [4.3%]) was reported than natriuretic peptide B (10 [1.6%]) and natriuretic peptide B prohormone N-terminal (3 [0.5%]). Of the inflammatory marker studies, C-reactive protein (16 [2.6%]) and erythrocyte sedimentation rate (10 [1.6%]) laboratory tests were performed. Of the thyroid studies, 31 (5.0%) were free T4 and 60 (9.7%) were thyrotropin. Toxicology tests had 10 (1.6%) qualitative results available. These results were all negative or unknown (Table 2).

ASSOCIATION OF SPECIALIZED LABORATORY TESTING WITH DEMOGRAPHIC CHARACTERISTICS

Analysis of demographic characteristics indicated an association between specialized laboratory testing and older age (1.11 [1.06-1.16], $P < .001$) and emergency department services (1.69 [1.04-2.73], $P = .04$). Male sex was associated with lower odds of specialized laboratory testing (0.61 [0.39-0.95], $P = .03$). Similar findings were observed after fitting multivariable logistic regression models, with the exception that hospitalization (2.47 [1.19-5.16], $P = .02$) and critical care services (2.73 [1.32-5.62], $P = .007$) were observed to be associated with specialized laboratory testing (Table 3).

FREQUENCY OF LABORATORY RESULTS NOT WITHIN NORMAL LIMITS

The frequencies of laboratory results not within normal limits (occurring once within each category) were nominally similar for cardiovascular (8 [22.9%]) and thyroid (15 [23.1%]) study categories with a higher frequency noted in the inflammatory marker (8 [38.1%]) category. Specific laboratory value results are summarized in Table 4.

Discussion

In this study, we aimed to investigate the type, frequency, and results of laboratory testing performed in pediatric patients presenting with SVT for the first time. We found that thyroid studies were most frequently ordered, but an abnormal result occurred in less than a quarter of subjects where this testing occurred. Laboratory testing was noted to be associated with older subjects (>11 years of age), females, and different types of medical services (emergency, hospital, and critical care). These findings may have implications for the management of pediatric patients who present with new-onset SVT in the emergency and hospital setting, particularly when it is appropriate to send specialized laboratory testing and if quality improvement initiatives are necessary to reduce potentially unwarranted testing.

After stabilizing a child with SVT, clinicians may order additional diagnostic testing. This is often done to evaluate for noncardiac diseases or conditions that are known to

TABLE 3
Association of specialized laboratory testing with sex, race, age, and type of medical services received

Variable	Univariate analysis		Multivariate analysis	
	Odds ratio (95% CI)	*P* value	Odds ratio (95% CI)	*P* value
Male	0.61 (0.39-0.95)	.03	0.57 (0.36-0.90)	.02
Caucasian	1.13 (0.71-1.80)	.61	-	-
Age	1.11 (1.06-1.16)	< .001	1.12 (1.07-1.18)	< .001
Emergency department services	1.69 (1.04-2.73)	.04	2.97 (1.41-6.27)	.004
Hospitalization services	0.78 (0.45-1.37)	.40	2.47 (1.19-5.16)	.02
Critical care services	0.97 (0.59-1.59)	.91	2.73 (1.32-5.62)	.007

CI, confidence interval.

cause cardiac dysrhythmias. For example, thyrotoxicosis is known to induce cardiovascular effects including sinus tachycardia and a predisposition to arrhythmias.[12] Similarly, different forms of cardiac dysrhythmias may be induced by illicit drug abuse.[13,14] Although most pediatric patients who present with a new-onset SVT are unlikely to have one of these conditions as the underlying cause, in the right clinical context, it may be necessary to maintain a low threshold of investigation for one of these causes.[15]

However, even though clinicians obtained thyroid function tests, our study found that less than a quarter of the results were outside normal limits. Perhaps this is because the incidence of hyperthyroidism occurring in children without any predisposing risk factors is rare.[16] Children presenting with thyroid storm account for less than 3% of all patients with hyperthyroidism.[12] Although sinus tachycardia is commonly reported, the presence of other cardiac dysrhythmias is rare with atrial fibrillation and less common forms of SVT ranging from only 2% to 20% in all patients in a hyperthyroid state.[12,15] In our study, the infrequency of elevated thyroid function tests in the setting of a pediatric patient presenting with new-onset SVT suggests routine use of these tests may be unwarranted in the diagnostic workup of these patients.[17] These findings point to the understanding that cardiac dysrhythmias are usually cardiac related, especially in an otherwise healthy pediatric patient. In general, we found that thyroid testing is one of the most commonly ordered laboratory tests but it

TABLE 4
Frequency of abnormal test results

Laboratory value	Frequency of abnormal test result, *n* (%)
Cardiovascular laboratory studies	8 (22.9)
Natriuretic peptide B (LOINC 30934-4; 42637-9)	3 (30.0)
Natriuretic peptide B prohormone N-terminal (LOINC 33762-6)	2 (66.7)
Troponin I (LOINC 10839-9, 42757-5; 49563-0; 76399-5; 89579-7)	12 (44.4)
Inflammatory markers	8 (38.1)
C-reactive protein (LOINC 1988-5; 11039-5; LP15023-2)	5 (31.3)
Erythrocyte sedimentation rate (LOINC 4537-7; 30341-2; 82477-1; LP16409-2)	4 (40.0)
Thyroid studies	15 (23.1)
Free thyroxine (T4) above normal limit (LOINC 3024-7)	3 (9.7)
Free thyroxine (T4) below normal limit (LOINC 3024-7)	3 (9.7)
Thyrotropin minimum above normal limit (LOINC 11580-8)	9 (15.0)
Thyrotropin minimum below normal limit (LOINC 11580-8)	2 (3.3)

LOINC, logical observation identifiers names and codes.

TABLE 5
Laboratory workup recommendations for pediatric patients with supraventricular tachycardia after hemodynamic assessment and stabilization

Type of patient	Practice recommendation
All patients	Perform a comprehensive history and physical examination to guide medical decision making.
All patients	Before testing, consider multidisciplinary communication to obtain high yield laboratory tests and avoid unwarranted laboratory testing.
Patient with hyperthyroidism and/or family history of autoimmune thyroid disease	Consider thyroid function testing.
Patient with underlying heart disease (ie, cardiomyopathy or viral myocarditis)	Consider testing of cardiac biomarkers (troponin, natriuretic peptides) and markers of inflammation (C-reactive protein and/or erythrocyte sedimentation rate).

is generally unrevealing, and when abnormal, it may not change clinical decision making especially if the symptoms of the clinical presentation are nonspecific.[18] All clinicians should be aware of this and only obtain such ordered testing if it is clinically justified and warranted.

Cardiac testing also was noted to be ordered with an abnormal result that also occurred in less than a quarter of the subjects in our study. Elevated cardiac enzymes, particularly troponin, are can indicate myocardial cell injury.[19] Thus, elevated troponin levels are frequently measured to evaluate for ischemic heart disease and risk stratify adult patients for the need for emergent cardiac catherization.[20] However, in children, myocardial injury is rare and elevated troponin can be from cardiac or noncardiac causes and alone does not reveal the etiology of myocardial injury.[20] In these instances, elevated troponin levels may be present owing to reversible cell damage and not necessarily cell death.[19] In particular, elevated troponin is common in patients presenting with cardiac dysrhythmias and is most often thought to be rate related rather than ischemic in nature.[20] Hence, unlike in adults, elevated troponin in pediatric patients is less specific and diagnostic and does not usually require emergency cardiac catherization.[19]

In our study, laboratory testing was significantly associated with older subjects and a similar association was noted between laboratory testing and different medical services rendered (emergency, hospital, critical care). Invasive evaluation of younger children (such as in our study) may not occur owing to phlebotomy difficulty, clinicians recognizing the possibility of a lower yield in positive results, or a clinician's desire to avoid additional stress and anxiety on a sick patient or their caregivers.[21] Even though our retrospective study was limited, these results may reinforce the notion that laboratory testing is not without risk and only should be obtained in children with SVT if clinically indicated. In addition, if our interpretation of these findings is correct, there are other drawbacks, especially in a hospital-based setting. Some of these include increased health care costs, increased length of hospital stays, and attainment of inconclusive or unactionable test results, which could lead to additional anxiety for the patient and their families.[17] In these circumstances, more testing could mean an increased risk of false-positive test results that could trigger unnecessary further investigations or treatment. Furthermore, in a situation where there is a low pretest probability for a particular condition, ordering additional tests also can elicit an aspect of unease for the provider to interpret the test result and determine the next best course of action in the context of a clinically indeterminate patient. From a nursing perspective, when performing phlebotomy, there is a risk of losing future intravenous sites.[22] This is especially important in young children, who may have a smaller superficial vein size and often require multiple venipunctures.[23] This can lead to multiple phlebotomy experiences resulting in additional stress and trauma inflicted on the patient. Repeated laboratory draws, especially if the first result is abnormal, also can lead to anemia.[24,25] Thus, when a child presents to the emergency or hospital setting with a condition (even as serious as SVT), risk stratification needs to occur for all types of patients to best select the necessary tests and interventions for these patients and avoid reflexively ordering laboratory tests.

Based on our study findings, an alternative approach to the diagnostic workup of pediatric patients presenting with new-onset SVT in the emergency and hospital setting should be considered. First, a thorough and comprehensive history and physical examination should be performed on all patients to guide clinical suspicion and decision making.[19] All laboratory testing that is ordered, whenever possible, should be guided by clinical indication and consideration of the patient's comprehensive history to prompt the necessary investigations that need to be performed. This may be challenging in an emergency department, especially when this may be the first time the patient presents with a condition with an acute onset, but there may be particular clinical features that can assist the clinician. Hyperthyroidism is more common in children with other autoimmune conditions and in children with a family history of autoimmune thyroid disease.[16] Therefore, it would be reasonable to obtain thyroid function tests in these patients to evaluate for thyroid disease as a potential underlying cause of the patient's cardiac dysrhythmia. From a cardiac perspective, although elevated troponin is specific for myocardial injury, it alone does not indicate any particular mechanism or etiology.[19] In fact, multiple studies have shown that troponin levels are poor predictors of acute myocardial infarction in the setting of cardiac dysrhythmias.[20] Therefore, isolated elevated troponin levels may have limited usefulness in the investigation of patients with cardiac dysrhythmias without additional testing and workup to determine the underlying etiology of suspected myocardial injury.[19] Therefore, we suggest that cardiac tests such as troponin levels be reserved for patients with a high clinical suspicion such as those who possess additional risk factors that make underlying heart disease (such as a cardiomyopathy or viral myocarditis) more likely or those who present with electrocardiogram changes indicative of ischemic heart disease. Before phlebotomy for ordered laboratory tests, interprofessional communication should be considered. The use of multidisciplinary communication and/or a checklist can reduce the number of unwarranted laboratory testing.[25] Communication in this fashion, so that all contributing services can decide which laboratory tests are necessary, proper, and ultimately unavoidable, may prevent the risk of additional blood loss. In addition, it may reduce the loss of future intravenous sites on patients; reduce trauma, stress, and anxiety on the part of the patient and their family; and reduce institution/patient expenditure. Previous studies in other clinical settings have demonstrated that this type of approach can be a safe and effective method to direct laboratory testing needs.[25] Future study through interprofessional quality improvement initiatives may be necessary (Table 5).

Limitations

This study had several limitations. This was a retrospective study; thus, the associations we found are not causation. Owing to database limitations, clinical documentation is not available for review. Thus, we do not know why these patients received additional testing, including how the patient presented or the risk associated with the patient's condition. We also were unable to investigate why male subjects and younger subjects underwent less laboratory testing. It is possible that the patients provided a clinical history that warranted a thorough workup or were seen at a nonpediatric emergency department. The data were restricted to institutions that participate in this database retrieval system. Owing to database limitations, we were unable to confirm the disease state reported by clinicians potentially resulting in bias. In addition, it is possible that not all EHR data were reported or all subjects who presented with a cardiac dysrhythmia were coded. Because we were not provided the reference ranges for quantitative serum toxicology results, it is unknown whether there were findings that were not within normal limits.

Implications for Emergency Nurses

Pediatric patients who present with new-onset SVT in the emergency and hospital setting require early recognition and treatment. However, after stabilization, they may not need extensive diagnostic testing. The results of this study may indicate that quality improvement initiatives to change practice toward ordering of laboratory tests based on clinical indication are needed to create a high-value evidence-based framework for the workup of pediatric patients presenting with new-onset SVT.

Conclusions

Our study found that both cardiovascular and noncardiovascular testing may be ordered for pediatric patients who present with SVT. Thyroid studies were the most common laboratory testing ordered, but an abnormal result only occurred in less of a quarter of subjects where this testing occurred. Although the providers may have performed this

testing to confirm a negative result, the low positivity rate may potentially call into question the utility of noncardiac laboratory testing in the emergency and hospital setting for patients presenting with new-onset SVT. It also may highlight a quality improvement opportunity for emergency nurses and practitioners in the practice of obtaining laboratory tests to better reflect high-value evidence-based care for this vulnerable population.

Author Disclosures

Conflicts of interest: none to report.

The project described was supported by the National Center for Advancing Translational Sciences, National Institutes of Health (grant number UL1 TR002014), including TriNetX network access. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Ethical Statement

TriNetX is a global federated health research network that provides researchers access to continuously updated data elements on EHRs from participating health care organizations, predominantly in the United States.[11] TriNetX is certified to the ISO 27001:2013 standard and protects health care data by maintaining compliance with the Health Insurance Portability and Accountability Act Security Rule. The EHR data elements are aggregated and deidentified, including demographic characteristics, diagnoses, procedures, medications, laboratory values, and genomics, all in compliance with the de-identification standard outlined in Section §164.514(a) of the Health Insurance Portability and Accountability Act privacy rule. Because no protected health information is received by users of this network, the Penn State Health Institutional Review Board provided a waiver for users from our institution to perform these type of studies.

Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jen.2022.07.002.

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SUPPLEMENTARY TABLE

Diagnostic code supplemental table

Category	Description
Supraventricular tachycardia	"427" (ICD-9-CM: "Paroxysmal supraventricular tachycardia"); "427.2" (ICD-9-CM: "Paroxysmal tachycardia, unspecified"); "I47.1" (ICD-10-CM: "Supraventricular tachycardia"); "I47.9" (ICD-10-CM: "Paroxysmal tachycardia, unspecified")
Heart failure	"428" (ICD-9-CM: "Heart failure"); "428.42" (ICD-9-CM: "Chronic combined systolic and diastolic heart failure"); "428.21" (ICD-9-CM: "Acute systolic heart failure"); "428.9" (ICD-9-CM: "Heart failure, unspecified"); "I50.21" (ICD-10-CM: "Acute systolic (congestive) heart failure"); "I50.9" (ICD-10-CM: "Heart failure, unspecified"); "I50.30" (ICD-10-CM: "Unspecified diastolic (congestive) heart failure"); "I50.41" (ICD-10-CM: "Acute combined systolic (congestive) and diastolic (congestive) heart failure")
Thyroid disorders	"244.9" (ICD-9-CM: "Unspecified acquired hypothyroidism"); "E03.1" (ICD-10-CM: "Congenital hypothyroidism without goiter"); "E06.3" (ICD-10-CM: "Autoimmune thyroiditis"); "E03.9" (ICD-10-CM: "Hypothyroidism, unspecified")
Pre-excitation syndrome	"426.7" (ICD-9-CM: "Anomalous atrioventricular excitation"); "I45.6" (ICD-10-CM: "Pre-excitation syndrome")

ICD, International Classification of Diseases; CM, Clinical Modification.