Effect of Implementing Carotid Massage versus Ice Bag Maneuver on Clinical Outcomes for Children with Supraventricular Tachycardia

Amany Khaled Mohamed Shwitah[1], Rahma Soliman Bahgat[2], Doaa Mohamed El Amrousy[3], Nagwa Ramadan Esmail Magor[4]

[1]Demonstrator of Pediatric Nursing, Faculty of Nursing, Tanta University, Egypt.
[2] Professor of Pediatric Nursing, Faculty of Nursing, Tanta University, Egypt.
[3]Professor of Pediatrics, Faculty of Medicine, Tanta University, Egypt.
[4]Assistant professor of Pediatric Nursing, Faculty of Nursing, Tanta University, Egypt.

Corresponding author: Amany Khaled Mohamed Shwitah

Email: Amany.Khaled@nursing.tanta.edu.eg

Abstract:

Background: Supraventricular tachycardia is an emergency condition in children that requires a professional management, as it may lead to serious complications such as hemodynamic compromise resulting in syncope, shock, or even congestive heart failure and death. **Aime of the present study was to** evaluate the effect of implementing carotid massage versus ice bag maneuver on clinical outcomes for children with supraventricular tachycardia. **Subjects and method:** A purposive sampling of 60 children with stable supraventricular tachycardia divided into two equal groups; carotid massage and ice bag maneuver group. **Setting:** Pediatric medical department including pediatric emergency and cardiac intensive care units of Tanta University Main Hospital. **Two tools were used:** Tool (I) Supraventricular tachycardia assessment of children. Tool (II): Assessment of children's clinical outcomes. **Results:** Statistically significant differences were found in the mean scores regarding children's heart rate within the two groups before, immediate and 15 minutes after the intervention. Also, it was found that the return of children's heart rhythm to normal, immediately after implementing each maneuver, was higher in carotid massage group compared to children in ice bag group. **Conclusion:** Despite the opportunity for improvement exists with both maneuvers (carotid massage and ice bag maneuver), however the carotid massage has achieved a higher success rate of SVT conversion to normal heart rhythm than the ice bag maneuver. So, carotid massage is considered more effective in reducing the need for treatment escalation for children with stable SVT. **Recommendation**: Carotid massage and ice bag maneuver should be integrated in the urgent management of stable SVT in children, with providing training to pediatric cardiac intensive care unit nurses and children's caregivers as well.

Keywords: Carotid Massage, Children, Clinical Outcomes, Ice Bag Maneuver, Supraventricular Tachycardia.

Introduction:

Supraventricular tachycardia is a medical condition that refers to any tachycardia originating above the ventricles which involves atrial tissue or atrioventricular nodal tissue **(Brubaker et al., 2018) (Karmegeraj et al., 2018)**. This type of heart rhythm disturbance occurs commonly in children with a normal heart structure and rarely associated with cardiac anomalies. Tachycardia is defined as a heart rate above the average value determined according to the patient's age. The heart rate during supraventricular tachycardia may reach 200-300 bpm in infants and 180-250 bpm in older children **(Bibas et al., 2016)**.

The most common types of supraventricular tachycardia in children are based on the electrical pathway which is taken from the atria, which include: Firstly, atrioventricular nodal reentrant tachycardia, as there is dual atrioventricular nodal inputs with two limbs of the reentrant circuit near the AV node. Secondly, common type is atrioventricular reentrant tachycardia, which characterized by the existence of accessory pathway which pass through the atrioventricular septum and thus provide for a larger re-entry circuit **(Desai & Hajouli, 2023)** (**Hafeez et al., 2023)**. Atrioventricular re-entrant tachycardia is the most commonly observed type of SVT in pediatric patients generally, and in newborns and infants specifically. On the other side, the atrioventricular nodal re-entrant tachycardia is the most common in older children and adolescents **(Kittnar, 2023) (Quattrocelli et al., 2018)**.

The incidence of supraventricular tachycardia is approximately 1 in 250-1000 children in the United States and is a serious health burden in Canada, California and internationally. Manifestations of supraventricular tachycardia may be asymptomatic or may include such symptoms as chest pain, palpitations, shortness of breath, sweating, feeling faint, and rarely, unconsciousness (**Victoria & Larry, 2015) (Desai & Hajouli, 2023)**.

The main diagnostic method for supraventricular tachycardia is recording of a channel electrocardiogram (ECG). As in particular, a narrow QRS complex tachycardia is typically seen on the ECG, the ECG during an attack offers numerous crucial clues for differentiating between SVT and other conditions. A baseline echocardiography is also advised to rule out structural heart disease, especially in children with signs of congestive heart failure **(Bibas et al., 2016)**. Besides, assessing the hemodynamic status, to detect any complications and to initiate the appropriate therapeutic intervention. Also, tests for thyroid function, electrolytes, and blood counts

are recommended to identify any risk factors for SVT **(Page et al., 2016)**.

Treatment of stable supraventricular tachycardia can be achieved by non-pharmacological measures as vagal maneuvers beside pharmacological measures such as adenosine and calcium channel blockers. Indeed, vagus nerve supplies parasympathetic motor fibers to the myocardium which is responsible for bradycardia response at the level of the atrioventricular AV node which can be stimulated through different techniques called vagal maneuvers. These maneuvers can prolong refractoriness of the nodal tissue and disrupt the re-entry circuit. On the other hand, unstable cases of SVT may require cardioversion**,** catheter ablation or even a Pacemaker **(Rohit & Kasinadhuni, 2020)**.

Multiple types of vagal maneuvers have been used for management of SVT, such as bearing down, Valsalva maneuver, modified Valsalva maneuver, gagging reflex, carotid sinus massage and diving reflex **(Smith et al., 2015) (Sohinki & Obel, 2014)**. Cold stimulus to the face technique (diving reflex), involves emerging a child's face in ice-cold water or it can be achieved through ice bag maneuver that includes placing an ice bag or a washcloth soaked in ice water on child's face, it should last about 15 seconds to create a physiological vagal response similar to a person being submerged in cold water. As, the ice bag maneuver works through stimulation of thermoregulatory sensors in the skin by initiating afferent impulses from the trigeminal nerve (cranial nerve V), the predominant sensory nerve of the face leading to increased vagal tone resulting in a bradycardia response by the slowing of AV nodal conduction and prolonged myocardial refractoriness thus the reversion of SVT can occur **(Godek & Freeman, 2022)**.

Carotid sinus massage: the technique is performed with the child's neck in an extended position, the head turned away from the side being massaged. Only one side should be massaged at a time. Pressure is applied underneath the angle of the jaw in a gentle circular motion for about 5-10 seconds that in turn stimulates the vagus nerve, as the carotid sinus induces changes in arterial blood pressure and heart rate by means of its baroreceptors, nerve endings of sensory neurons that extend along the first segment of the internal carotid artery, just above the carotid bifurcation. Baroreceptors are stimulated by the stretching of the blood vessel wall by applying gentile massage that increases the firing rate of the nerve fibers, thus inhibiting the sympathetic nervous system and stimulating the parasympathetic nervous system through a centrally acting mechanism resulting in a decrease in blood pressure

and heart rate **(Andani & Khan, 2023) (Godek & Freeman, 2022)**.

Critical care nurse plays an important role in managing such cases by obtaining a detailed history that includes past and present history, present signs and symptoms, time of onset, prior episodes, and current medications. Also, the nurse conducts a physical examination including vital signs (respiratory rate, blood pressure, temperature, and heart rate) and electrocardiogram monitoring to help assessing hemodynamic stability. In addition, the nurse implements interventions to control SVT through applying vagal maneuvers and administering ordered medications **(Hafeez & Armstrong 2023) (Karpas, 2006)**.

Significance of the study

Supraventricular tachycardia is an emergency condition in children that may lead to serious complications as tachycardia-induced cardiomyopathy **(Kafalı & Ergül, 2022)**. Also, congestive heart failure may occur in half of affected infants because of their high heart rates **(Bibas et al., 2016)**. However, some children with cardiac comorbidities may not be able to tolerate the underlying rapid ventricular rate, which may lead to hemodynamic instability, exacerbated congestive heart failure, angina, or even sudden death **(Borquez & Williams, 2021) (Page et al., 2016)**. The mortality rate in SVTs is low (1% in those with concomitant heart disease, 0.25% if the heart is structurally normal) **(Allen et al., 2013)**. Therefore, the importance of emergent management of these cases, that can be managed by non-pharmacological vagal maneuvers which are considered safe and effective in terminating SVT in 20%-40% of children **(Kafalı & Ergül, 2022)**.

Aim of the study

Evaluate the effect of implementing carotid massage versus ice bag maneuver on clinical outcomes for children with supraventricular tachycardia.

Research hypotheses:

1-Implementing carotid massage is expected to relieve supraventricular tachycardia in children.

2-Implementing ice bag maneuver is expected to relieve supraventricular tachycardia in children.

3-Carotid massage is expected to be more effective in relieving supraventricular tachycardia in children than ice bag maneuver.

Operational definition:

Clinical outcomes: Refer to hemodynamic parameters of children as heart rate, time to return to normal rhythm, respiratory rate, blood pressure and oxygen saturation and heart rhythm detected by electrocardiogram.

Subjects and Method:

Research design:

A quasi-experimental research design

was used in the present study.

Setting:

The study was conducted at the pediatric medical department (pediatric emergency and cardiac intensive care units) of Tanta University Main Hospital affiliated to Ministry of Higher Education and Scientific Research.

Subjects:

Purposive sampling of 60 children with supraventricular tachycardia was collected from the above previously mentioned settings and who fulfilled the inclusion criteria. The sample was selected and divided randomly, by using systematic random sampling method, into two equal groups:

1- **Carotid massage group:** It consisted of thirty children who received carotid massage with routine hospital intervention.
2- **Ice bag group:** It included thirty children who received the ice bag maneuver with routine hospital intervention.

Inclusion criteria include children with stable supraventricular tachycardia, ranged from 1 to 12 years from both sexes and are willing and their parents to participate in the study.

Exclusion criteria include children with unstable supraventricular tachycardia. Children with psychiatric disorders. Exclusion criteria for carotid massage include carotid bruit/stenosis, cerebral vascular accident in the last three months, ventricular tachycardia, ventricular fibrillation, or myocardial infarction in the past three month.

Tools of data collection: Two tools were used to collect the data:œ

Tool I: Supraventricular tachycardia assessment of children: This tool was developed by the researcher after reviewing the related literatures **(Younis et al., 2024) (Patti & Ashurst, 2023) (Karpas, 2006)** and it included the following three parts:

Part (1): Children sociodemographic characteristics as child's age, sex, birth order and residence.

Part (2): Children's clinical data including onset of attack, past and present history, family history, risk factors, previous attacks of supraventricular tachycardia, previous techniques used to alleviate tachycardia and anti-arrhythmic medications.

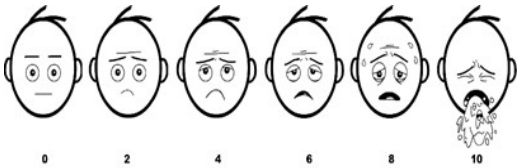
Part (3): Supraventricular tachycardia associated manifestations: It was used to assess supraventricular tachycardia associated manifestations as nausea, dyspnea, palpitation, poor feeding, chest discomfort, fatigue, syncope, and dizziness.

Tool (II): Assessment of children clinical outcomes: This tool was developed by the researcher based on review of recent relevant literature **(Hafeez & Armstrong, 2023)** and it consisted of four parts as the following:

Part (1): Hemodynamic parameters assessment: This part was used by the researcher to assess vital signs such as heart rate, respiration, blood pressure, oxygen saturation, as well as time to return to normal rhythm.

Part (2): Electrocardiogram (ECG) monitoring: This was used to assess type of arrhythmia and heart rhythm before and after the intervention (Patti & Ashurst, 2023). Normal ECG rhythm was scored as 1 and abnormal ECG rhythm was scored as zero.

Part (3): Baxter Animated Faces Scale of nausea: It is a pictorial nausea scale developed by **(Baxter et al., 2011)** and composed of 6 faces (Figure 3), with assigned scores ranging from 0 to 10, with a score difference of 2 between each adjacent faces **(Yurdakul et al., 2021) (Naz et al., 2023)**. These faces show children who feel no nausea at all (0), a little nauseated (2), more nauseated (4), moderately nauseated (6), severely nauseated (8) or have the most possible nausea to feel (10). It has been validated in postsurgical patients, oncology patients and patients in the emergency department by **(Watcha et al., 2018)**.



Part (4): Respiratory rate, accessory muscle use and decreased breath sounds Scale for dyspnea: This scale was modified by the researcher after reviewing related literatures **(Boeschoten et al., 2020) (Arnold et al., 2011)** to assess severity of dyspnea in children. The scale consists of three items (respiratory rate, accessory muscle use and oxygen saturation), each item takes score from zero to three according to the condition of the child. The total score ranged from 0 – 9 and the scoring system was as the following:

0 = No dyspnea
1 - 3 = Mild dyspnea
4 – 6 = Moderate dyspnea
7 – 9 = Severe dyspnea

Method

The study was accomplished through the following steps:

1-Administrative process:

An official permission to conduct the study was obtained from Faculty of Nursing Tanta University to the directors of the pediatric medical department (pediatric emergency and cardiac intensive care units) of Tanta University Main Hospital after explaining the aim of the study to obtain their approval and cooperation to conduct the study.

2-Ethical and legal considerations:

a) Ethical and legal approval was obtained from Faculty of Nursing Scientific Research Ethical Committee (Code No**.** 381- 2/2024) and a trial registry by Pan African Clinical Trial Registry at https://pactr.samrc.ac.za/

(Registration No. PACTR202405504971616).

b) Children's privacy and confidentiality were taken into consideration.

c) Informed consent was taken from the parents of children to participate in the study after explaining the aim of the study and their right to withdraw from the study at any time without providing a reason and without affecting the care provided to their children.

d) The nature of the study would not cause any harm or pain to the entire subjects.

3- Tools development:

Two tools were developed by the researcher for data collection: **Tool I:** Supraventricular tachycardia assessment of children that included three parts, and **Tool (II):** Assessment of children clinical outcomes, which was composed of four parts.

4- Content validity: The study tools were presented to a jury of five experts in the area of pediatrics to check content validity, clarity, comprehensibility, applicability and ease of tool implementation.

5- Reliability statistics of the developed tools were tested through internal consistency: Cronbach's Alpha for tool I was 0.906, for tool II was 0.878 and for the sheet in total was 0.881 for 28 items.

6- A pilot study was carried out on 10% of the sample (six children) to test the tool for its clarity, applicability, feasibility, and the necessary modifications were done. Pilot sample was included in the total sample of the study.

Phases of the study: The study was conducted through four phases:

1- Assessment phase: The researcher was present through the morning and afternoon shifts for 5 days per week (Saturday, Sunday, Monday, Tuesday and Wednesday) to collect the data.

Once the child arrived at the department, the child and his/her parent were interviewed by the researcher, before any intervention, to explain the purpose of the study and gain their participation consent. The researcher collected child's full history from the parent, including sociodemographic data, clinical data and the associated manifestations of supraventricular tachycardia as included in Tool I.

In addition to assessing children's hemodynamic status, severity of nausea and dyspnea with recording the ECG findings as reported by the attending pediatric cardiologist (Tool II).

2- Planning Phase: The researcher first met the pediatric emergency and pediatric cardiac intensive care unit nurses and resident doctors to explain the purpose of the study to gain their cooperation. Objectives of vagal maneuvers (carotid sinus massage or ice bag maneuver) were established. The researcher prepared herself about the

maneuvers of the study via receiving training by the attending pediatric cardiologist at the pediatric cardiac intensive care unit for one month.

The preparation of unit's beds, ECG and monitor devices was checked. The atmosphere of surrounding environment was ensured to be quiet, reassuring and not terrible for children. Equipment needed to perform the maneuvers were prepared including (monitor device – clean gloves – hand watch – alcohol 70% – documentation sheet). In addition to a stethoscope for the carotid massage maneuver, also an ice bag and towel for the ice bag maneuver.

3- Implementation Phase: After detecting the type of arrhythmia and stability of hemodynamic parameters, the researcher ensured the children met the inclusion criteria. The researcher applied the vagal maneuvers as follows:

-The researcher connected the child with a monitor device.

-Carotid massage group:

-The child was placed on a supine position with the neck in an extended position, the head turned away from the side being massaged. The stethoscope was used to auscultate the carotid sinus (underneath the angle of the jaw with the upper level of thyroid cartilage) to exclude the presence of bruits.

-Massage was applied over carotid sinus in a gentle circular motion, by using the finger pads of the index and middle fingers, for about 5-10 seconds. Only one side was massaged at a time. If unsuccessful, the massage was repeated up to 3 attempts for each side with time interval of one minute in between **(Ceylan et al., 2019)**.

-Ice bag group:

The child was placed on supine or semi-fowler position. The ice bag was applied on the face, using an underlying clean cloth towel, covering most of child's face as possible for about 15 seconds. If unresponsive, the maneuver was repeated for another 15 seconds with a time interval of one minute in between, up to 3 attempts **(Ceylan et al., 2019)**.

4- Evaluation Phase: The researcher reassessed and recorded the clinical outcomes immediately, and 15 minutes after the intervention (tool I &II) in the term of:

-Hemodynamic parameters (heart rate, respiration, and blood pressure and oxygen saturation).

-ECG findings and the time to return to normal heart rhythm.

-Associated manifestations that appeared on the child.

-Severity of nausea and dyspnea.

This phase took about 5 minutes.

The data was collected over a period of ten months, from the beginning of May 2024 to the end of February 2025.

Statistical analysis:

The collected data was organized, tabulated and statistically analyzed using SPSS software statistical

computer package version 26. For quantitative data, the range, mean and standard deviation were calculated. For qualitative data, comparison was done using Chi-square test (χ^2). For comparison between means of two variables in a group, paired samples t-test was used. For comparison between means for variables during three periods of intervention in a group, or for more than two variables, the F-value of analysis of variance (ANOVA) was calculated.

Correlation between variables was evaluated using Pearson and Spearman's correlation coefficient r. A significance was adopted at $P<0.05$ for interpretation of results of tests of significance (*). Also, a high significance was adopted at $P<0.01$ for interpretation of results of tests of significance (**) **(Gerstman B., 2019)**.

Results:

Figure (1) illustrates distribution of studied children regarding their age in years. It was evident that more than half of children 53.33% and 56.67% were between 6 -12 years old, with the mean age was 6.40±1.031 and 6.43±1.023 years, respectively in carotid massage and ice bag maneuver groups.

Figure (2) clarifies distribution of the studied children regarding their birth order and gender. It shows that about 46.67% and 36.67% were at the second birth order in carotid massage and ice bag maneuver group respectively. In relation to gender, it was noticed that 53.33% of carotid massage group were females, while 56.67% of ice bag maneuver group were males.

Table (1) shows distribution of the studied children regarding their clinical data, past medical and family history. Regards the onset of current supraventricular tachycardia attack, it was clear that nearly two thirds of studied children 60% and 66.67% started the current attack during the last 24 hours, with a mean of 1.47±0.629 and 1.60±1.037 days respectively in carotid massage and ice bag maneuver group. Also, it was found that the commonly used anti-arrhythmic medications were amiodarone 40% and 20% and betacor 26.67% and 30% for children in carotid massage and ice bag maneuver groups, respectively.

By monitoring the type of arrhythmia using electrocardiogram (ECG), it was clear that more than half (60% and 53.33%) of children in carotid massage and ice bag maneuver groups respectively, have atrioventricular reentrant tachycardia (AVRT) type of arrhythmia.

Considering the presence of previous SVT attack, it was found that 53.33% and 60% of children have a previous attack, with the mean age of onset 31.81±3.269 and 51.83±4.671 months in carotid massage and ice bag maneuver groups, respectively.

Additionally, the date of the previous attack was between 15 to 30 days with percentage of 40% in both groups similarly. Regarding the vagal maneuvers used previously to alleviate tachycardia, carotid massage was the most commonly used one for 46.67% and 60% of the studied children in carotid massage and ice bag maneuver groups, respectively.

In relation to children's family history, it was evident that the majority 93.33% and 90% of children in carotid massage and ice bag maneuver groups, respectively have a negative history for presence of SVT in their families. While the presence of family history for other chronic diseases, hypertension was obviously present in 43.33% and 50% of children's families in carotid massage and ice bag maneuver groups, respectively.

Table (2) illustrates the percentage distribution of supraventricular tachycardia associated manifestations among the studied children in both groups throughout the periods of implementation. As regard to cardiac and respiratory manifestations, palpitation was the most frequently detected manifestation in 93.33%, 40% and 40% of children in carotid massage group before, immediate and 15 minutes after the intervention respectively, while in ice bag maneuver group it was 80%, 53.33% and 53.33% before, immediate and 15 minutes after the intervention, respectively.

On the other side, the most commonly found gastrointestinal manifestation was nausea in more than one third of children in carotid massage group and nearly half of children in ice bag maneuver group throughout the three periods of the implementation. The main cerebral manifestation that was observed among studied children was fatigue 60%, 60% and 40% in carotid massage group, compared to 80%, 80% and 60% in ice bag maneuver group before, immediate and 15 minutes after the intervention, respectively.

Table (3) presents the mean scores of hemodynamic parameters of the studied children among the two groups throughout the periods of implementation. The mean scores of children's heart rate within carotid massage group were 240.83±56.658, 189.13±69.361 and 175.07±84.007 before, immediate and 15 minutes after the intervention respectively, compared to 251.63±46.436, 195.47±66.810 and 179.63±80.713 before, immediate and 15 minutes after the intervention in ice bag maneuver group respectively. There was a statistically significant difference within the two groups throughout the three periods of the study, with no significant differences between the two groups.

Regarding systolic blood pressure, the mean scores were 97.63±8.062,

98.03±7.876 and 98.07±8.428 before, immediate and 15 minutes after the intervention, respectively for carotid massage group, while they were 104.30±22.695, 103.87±21.924 and 103.77±22.402 before, immediate and 15 minutes after the intervention respectively for ice bag maneuver group. Also, the mean scores of diastolic blood pressure were 65.83±7.101, 66.67±6.850 and 65.53±7.619 before, immediate and 15 minutes after the intervention for carotid massage group, while they were 69.80±16.061, 70.00±15.161 and 69.97±14.910 before, immediate and 15 minutes after the intervention for ice bag maneuver group.

In relation to respiratory rate, the mean scores were 34.73±1.543, 33.27±1.693 and 31.33±1.315 throughout the three periods of the study respectively for carotid massage group, compared to 36.07±10.891, 33.60±9.888 and 31.27±9.903 for ice bag maneuver group respectively. Concerning oxygen saturation, the mean scores were 94.90±3.220, 95.43±3.451 and 96.40±3.212 for carotid massage group, respectively throughout the three periods of the study, compared to 93.27±6.264, 94.57±4.446 and 95.27±4.556, respectively for ice bag maneuver group, with no significant difference between the two groups in terms of blood pressure, respiratory rate and oxygen saturation.

Table (4) shows distribution of the studied children's time of return to normal heart rhythm among the two groups throughout the three periods of implementation. It was found that the heart rhythm returned to normal in 46.67% of children in carotid massage group, compared to 40% of children in ice bag group immediately after implementation of the two maneuvers. Although the rate of response of children in carotid massage group was higher, there was no statistically significant difference between the two groups (p=0.795). As regard to time of return to normal heart rhythm, the range of time was 35-50 seconds with mean of 42.50±6.455 in carotid massage group, compared to 10-35 seconds with mean of 22.50±11.902 in ice bag maneuver group, with a statistically significant difference between the two groups (p=0.025).

Table (5) illustrates the distribution of the studied children's levels of nausea throughout the periods of implementation. This table indicates that 26.67% of children within carotid massage group suffered from the most possible nausea to feel before applying the maneuver, then the percentage decreased to 20% immediately and 15 minutes after the intervention. Compared to 40% of children in the ice bag group who suffered from the most possible nausea to feel before the maneuver, the percentage decreased to

6.67% immediately and 15 minutes after applying the maneuver.

No statistically significant difference was observed among carotid massage group throughout the periods of the intervention. However, a statistically significant difference was observed among ice bag maneuver group throughout the periods of the intervention as P= 0.000.

Table (6) clarifies the percentage distribution of the studied children's levels of dyspnea throughout periods of implementation. As regard to carotid massage group, the percentages of children who suffered from mild dyspnea were 33.33%, 13.33% and 6.67% before, immediate and 15 minutes after the intervention, respectively. While in the ice bag maneuver group 33.33%, 33.33% and 20.00% of children suffered from moderate dyspnea before, immediately and 15 minutes after the intervention, respectively with a statistically significant difference P= 0.035.

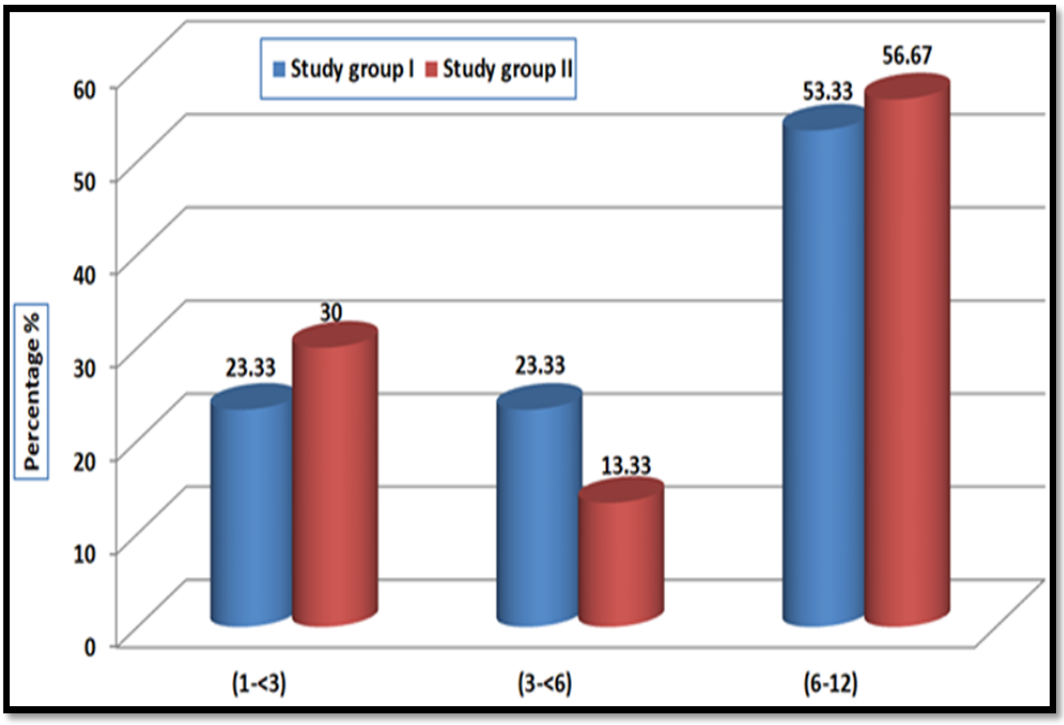


Figure (1) Studied children's age in years.

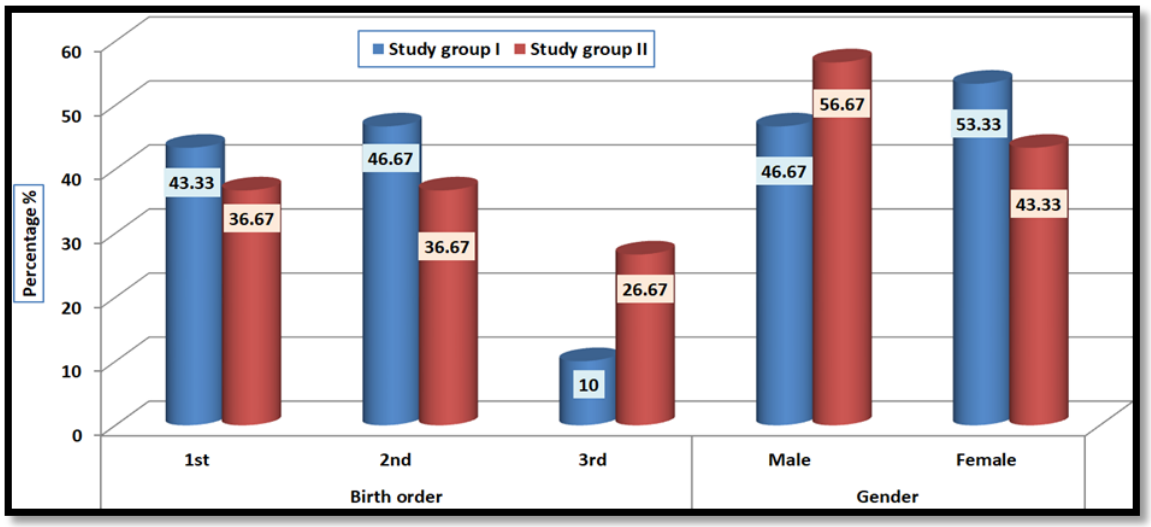


Figure (2): Studied children's birth order and gender.

Table (1): Percentage distribution of the studied children regarding their clinical data, past medical and family history.

Clinical data	The studied children (n=60)			
	Carotid massage group (n=3٠)		Ice bag group (n=3٠)	
	No	%	No	%
Onset of current supraventricular tachycardia (SVT) attack (in days)				
- Last 24 hours	18	60.00	20	66.67
- >1–3 days	12	40.00	8	26.67
- >3–6 days	0	0.00	2	6.67
Range	**(1-3)**		**(1-5)**	
Mean ± SD	**1.47±0.629**		**1.60±1.037**	
Current anti-arrhythmic medications				
- Adenosine	0	0.00	2	6.67
- Amiodarone	12	40.00	6	20.00
- Betacor	8	26.67	9	30.00
- Inderal and lasix	4	13.33	8	26.67
Type of arrhythmia by ECG				
- Atrioventricular reentrant tachycardia (AVRT)	18	60.00	16	53.33
- Atrioventricular nodal reentrant tachycardia (AVNRT)	12	40.00	14	46.67
Past medical history				
History of congenital heart disease				
- Atrial septal defect	1	3.33	1	3.33
- **Congenitally corrected transportation of great arteries**	1	3.33	0	0.00
- Ebstein anomaly	0	0.00	1	3.33
History of heart surgery				
- Glenn shunt	1	3.33	0	0.00
- Mitral and tricuspid valves replacement	2	6.67	0	0.00
History of previous SVT attack				
- No	14	46.67	12	40.00
- Yes	16	53.33	18	60.00
Age of onset (in months)				
Range	(1-108)		(1-132)	
Mean ± SD	31.81±3.269		51.83±4.671	
Date of previous attack of supraventricular tachycardia (in days)				
- <7	2	6.67	2	6.67
- 7-<15	2	6.67	4	13.33
- 15-<30	0	0.00	0	0.00
- ≥30	12	40.00	12	40.00
Range	**(2-365)**		**(5-365)**	
Mean ± SD	**99.50±2.890**		**88.33±1.229**	

Previous vagal maneuvers used to alleviate tachycardia				
- Valsalva maneuver	1	3.33	3	10.00
- Carotid massage	14	46.67	18	60.00
- Ice bag maneuver	4	13.33	4	13.33
Family history				
Presence of SVT				
- No	28	93.33	27	90.00
- Yes	2	6.67	3	10.00
Presence of cardiac diseases				
- Congenital	0	00.00	0	00.00
- Acquired	3	10.00	3	10.00
Presence of other chronic diseases				
- Hypertension	13	43.33	15	50.00
- Diabetes mellitus	12	40.00	10	33.33
- Bronchial asthma	3	10.00	1	3.33
- Hypothyroidism	2	6.67	1	3.33
- Liver cirrhosis	2	6.67	1	3.33

More than one answer was chosen.

Table (2): Percentage distribution of supraventricular tachycardia associated manifestations among the studied children in both groups throughout the periods of implementation.

# Manifestations	The studied children (n=60)													
	Carotid massage group (n=30)						χ^2 P	Ice bag group (n=30)						χ^2 P
	Before		Immediate		After 15 min			Before		Immediate		After 15 min		
	No	%	No	%	No	%		No	%	No	%	No	%	
1. Cardiac and respiratory manifestations	8	26.67	6	20.00	6	20.00		14	46.67	10	33.33	8	26.67	0.010
- Dyspnea	28	93.33	12	40.00	12	40.00	0.244	24	80.00	16	53.33	16	53.33	0.922
- Palpitation	4	13.33	4	13.33	2	6.67	0.993	8	26.67	8	26.67	8	26.67	
- Chest discomfort														
2. Gastrointestinal manifestations														
- Nausea	14	46.67	14	46.67	10	33.33	0.127	16	53.33	16	53.33	14	46.67	1.475
- Vomiting	10	33.33	8	26.67	6	20.00	0.722	10	33.33	4	13.33	2	6.67	0.961
- Poor feeding	2	6.67	2	6.67	2	6.67		4	13.33	4	13.33	4	13.33	
3. Cerebral manifestations														
- Fatigue	18	60.00	18	60.00	12	40.00	0.249	24	80.00	24	80.00	18	60.00	0.933
- Dizziness	4	13.33	4	13.33	4	13.33	0.933	8	26.67	8	26.67	6	20.00	0.988
4. Other														
- Fever	2	6.67	2	6.67	1	3.33		2	6.67	2	6.67	2	6.67	
- Sleepy	1	3.33	1	3.33	1	3.33	0.251	0	0.00	0	0.00	0	0.00	1.475
- Crying, headache and blurred vision	0	0.00	0	0.00	0	0.00	0.953	3	10.00	3	10.00	2	6.67	0.961

More than one answer was chosen

Table (3): Mean scores of hemodynamic parameters of the studied children among the two groups throughout the periods of implementation.

Hemodynamic parameters	The studied children (n=60) Range Mean ± SD							
	Carotid massage group (n=30)			F P	Ice bag group (n=30)			F P
	Before	Immediate	After 15 min		Before	Immediate	After 15 min	
1. Heart rate	(150-300) 240.83±56.658	(100-280) 189.13±69.361	(87-286) 175.07±84.007	**7.16 0.001***	(165-297) 251.63±46.436	(90-290) 195.47±66.810	(73-288) 179.63±80.713	**9.809 0.000***
Gp I Vs Gp II t , P	0.808 , 0.423	0.360 , 0.720	0.215 , 0.831					
2. Blood pressure								
▪ Systolic	(89-112) 97.63±8.062	(89-110) 98.03±7.876	(89-110) 98.07±8.428	0.03 0.974	(87-190) 104.30±22.695	(88-185) 103.87±21.924	(86-188) 103.77±22.402	0.005 0.995
Gp I Vs Gp II t , P	1.516 , 0.135	1.371 , 0.176	1.304 , 0.197					
▪ Diastolic	(53-80) 65.83±7.101	(54-78) 66.67±6.850	(50-80) 65.53±7.619	0.20 0.819	(50-130) 69.80±16.061	(56-128) 70.00±15.161	(50-127) 69.97±14.910	0.001 0.999
Gp I Vs Gp II t , P	1.237 , 0.221	1.097 , 0.277	1.450 , 0.152					
3. Respiration rate	(19-63) 34.73±1.543	(20-62) 33.27±1.693	(18-64) 31.33±1.315	0.70 0.501	(19-56) 36.07±10.891	(18-56) 33.60±9.888	(18-55) 31.27±9.903	1.649 0.198
Gp I Vs Gp II t , P	0.460 , 0.647	0.125 , 0.901	0.024 , 0.981					
4. O_2 saturation	(85-99) 94.90±3.220	(84-99) 95.43±3.451	(86-99) 96.40±3.212	1.60 0.209	(77-99) 93.27±6.264	(83-99) 94.57±4.446	(82-99) 95.27±4.556	1.162 0.318
Gp I Vs Gp II t , P	1.270 , 0.209	0.843 , 0.402	1.114 , 0.270					

Gp I:Group I: Carotid massage group. * Statistically significance at level P<0.05

Gp II: Group II: Ice bag group.

Table (4): Percentage distribution of the studied children's time of return to normal heart rhythm among the two groups throughout the three periods of implementation.

Return to normal heart rhythm	The studied children (n=60)													
	Carotid massage group (n=30)						χ^2 P	Ice bag group (n=30)						χ^2 P
	Before		Immediate		After 15 min			Before		Immediate		After 15 min		
	No	%	No	%	No	%		No	%	No	%	No	%	
Yes	0	0.00	14	46.67	14	46.67	**28.68**	0	0.00	12	40.00	12	40.00	**23.62**
No	30	100.00	16	53.33	16	53.33	**0.000***	30	100.00	18	60.00	18	60.00	**0.000***
Gp I Vs Gp II χ^2 **P**	-		FE 0.795		FE 0.795									

Time of return to normal heart rhythm (in seconds)			
No (%)	4 (13.33%)	4 (13.33%)	
Range	(35-50)	(10-35)	**t=8.727**
Mean ± SD	42.50±6.455	22.50±11.902	**P=0.025***
Time of return to normal heart rhythm (in minutes)			
No (%)	10 (33.33%)	8 (26.67%)	
Range	(1-10)	(2-10)	t=1.176
Mean ± SD	3.80±2.700	5.25±2.964	P=0.294

Gp I:Group I: Carotid massage group. * Statistically significance at level P<0.05
Gp II: Group II: Ice bag group.

Table (5): Percentage distribution of the studied children's levels of nausea throughout the periods of implementation.

Nausea	The studied children (n=60)													
	Carotid massage group (n=30)						χ^2 P	Ice bag group (n=30)						χ^2 P
	Before		Immediate		After 15 min			Before		Immediate		After 15 min		
	No	%	No	%	No	%		No	%	No	%	No	%	
- None	14	46.67	14	46.67	18	60.00		14	46.67	14	46.67	16	53.33	
- Little nauseated	2	6.67	4	13.33	2	6.67		0	0.00	2	6.67	6	20.00	
- More nauseated	0	0.00	0	0.00	0	0.00	2.88	0	0.00	0	0.00	2	6.67	**34.36**
- Moderately nauseated	4	13.33	4	13.33	2	6.67	0.942	4	13.33	10	33.33	2	6.67	**0.000***
- Severely nauseated	2	6.67	2	6.67	2	6.67		0	0.00	2	6.67	2	6.67	
- Most possible nausea to feel	8	26.67	6	20.00	6	20.00		12	40.00	2	6.67	2	6.67	
Range	**(0-10)**		**(0-10)**		**(0-10)**		F=0.466	**(0-10)**		**(0-10)**		**(0-10)**		**F=3.205**
Mean ± SD	**4.13±4.424**		**3.60±4.149**		**3.07±4.258**		P=0.629	**4.80±4.745**		**3.33±3.536**		**2.27±3.226**		**P=0.045***
Gp I Vs Gp II														
χ^2	6.351		5.429		7.076									
P	0.174		0.246		0.215									

Gp I: Group I: Carotid massage group. * Statistically significance at level P<0.05

Gp II: Group II: Ice bag group.

Table (6): Percentage distribution of the studied children's levels of dyspnea throughout periods of implementation.

Dyspnea	The studied children (n=60)													
	Carotid massage group (n=30)						χ^2 P	Ice bag group (n=30)						χ^2 P
	Before		Immediate		After 15 min			Before		Immediate		After 15 min		
	No	%	No	%	No	%		No	%	No	%	No	%	
- None (0)	14	46.67	20	66.67	22	73.33		14	46.67	20	66.67	20	66.67	
- Mild dyspnea (1-3)	10	33.33	4	13.33	2	6.67	8.28	4	13.33	0	0.00	4	13.33	**13.58**
- Moderate dyspnea (4-6)	6	20.00	6	20.00	6	20.00	0.082	10	33.33	10	33.33	6	20.00	**0.035***
- Severe dyspnea (7-9)	0	0.00	0	0.00	0	0.00		2	6.67	0	0.00	0	0.00	
Range	**(0-5)**		**(0-5)**		**(0-5)**		F=0.67	(0-8)		(0-6)		(0-6)		F=1.58
Mean ± SD	**1.47±0.925**		**1.07±0.874**		**0.93±0.760**		P=0.513	2.47±2.776		1.73±2.504		1.33±2.187		P=0.211
Gp I Vs Gp II														
χ^2	6.440		**5.556**		0.775									
P	0.092		**0.038***		0.679									

Gp I: Group I: Carotid massage group. * Statistically significance at level P<0.05
Gp II: Group II: Ice bag group.

Discussion:

The most common type of arrhythmias in children is supraventricular tachycardia (SVT), which is divided into two most common subtypes in children: Atrioventricular nodal re-entrant tachycardia and atrioventricular re-entrant tachycardia **(Abbasi et al., 2023)**. It is an emergency condition in children as it may lead to serious complications such as hemodynamic compromise resulting in syncope, shock, or even congestive heart failure and death **(Kafalı & Ergül, 2022)**. Therefore, the importance of emergent management of such cases, that can be managed by non-pharmacological measures called vagal maneuvers which are considered safe and effective in terminating SVT (**Ceylan et al., 2019)**.

The results of the current study revealed that the incidence of supraventricular tachycardia in pediatrics peaks at 6 years. This is coming in same direction with **(Yap et al., 2022) (Borquez & Williams, 2021)** who reported that the incidence of SVT peaks during the first year of life and then again at the age of 6 to 9 years.

Considering the presence of previous SVT attack, it was found that more than half of children have a previous SVT attack. This result is in line with **(Bah et al., 2023) (Moore et al., 2022)** who stated that SVT is a recurrent disorder under certain conditions. Regarding the vagal maneuvers used previously to alleviate tachycardia, carotid massage was the most commonly used technique in nearly half of children and this comes in track with **(Hindy A., 2022)** who reported that the carotid sinus massage was one of the commonly used vagal maneuvers for converting supraventricular tachycardia to sinus rhythm.

In addition, the results of the present study found that the commonly used anti-arrhythmic medication was amiodarone, that comes in line with **(Nizami et al., 2024) (Hill et al., 2019)** who reported that amiodarone is commonly used as a maintenance prophylaxis therapy and has achieved meaningful arrhythmia control in 78% of pediatric patients with recurrent SVT. This may be attributed to the mechanism of action of this drug, as amiodarone decreases the automaticity of sinoatrial (SA) node and the atrioventricular (AV) node conduction velocity. This action occurs by blocking potassium ion channels (prolonging repolarization), blocking sodium ion channels, and antagonizing alpha- and beta-adrenergic receptors **(Taylor & Watts, 2024)**.

In relation to children's family history, it was noticed that the majority of studied children have a negative family history for the presence of SVT, respectively in carotid massage and ice bag groups. This result may be due to the limited sample size at the current study, as this result disagrees with **(Adam & Prince, 2021)** who stated that SVT is highly related to

genetic abnormalities and requires genetic testing, in their study titled (Genetic Arrhythmia Syndromes).

Regarding supraventricular tachycardia associated manifestations, the result of the current study found that palpitation and dyspnea were the frequently detected cardiac and respiratory manifestations respectively in carotid massage and ice bag groups, that agrees with the result of **(Nizami et al., 2024) (Yetkin et al., 2020)** who reported that palpitation is the most noticeable manifestation of SVT in children and dyspnea may accompany palpitation. Palpitation and dyspnea occur as a result of altered cardiac output by the effect of rapid filling and emptying of the heart **(Levine G., 2021)**. It is worth mentioning in the current study that palpitation was better responded to carotid massage maneuver as it decreased from 93.33% before the implementation, to 40% after the implementation. While for dyspnea it was better responded to ice bag maneuver as it decreased from 46.67% before the implementation, to 26.67% after the implementation with a statistically significant difference.

On the other side, the most commonly found gastrointestinal manifestations were nausea and vomiting that come on track with **(Jeon et al., 2019)** who revealed that abdominal pain and vomiting are common gastrointestinal manifestations of SVT presented in children. Also, this result is consistent with the study of **(Uysal et al., 2023)** who mentioned that nausea is one of the common symptoms that accompany SVT in children, while this finding is in contrast with **(Yetkin et al., 2020)** who mentioned that nausea is rare during episodes of SVT attack. However, nausea occurs secondary to disturbed blood supply to digestive system, as the arrhythmia negatively affects the cardiac output **(Levine G., 2021)**. It is worth mentioning that a statistically significant difference was observed among ice bag maneuver group throughout the periods of the intervention, while no statistically significant difference was observed among carotid massage group.

The main cerebral manifestation observed among studied children was fatigue, which was also reported by other studies of **(Abbasi et al., 2023)**, **(Borquez & Williams, 2021)** and **(Quattrocelli et al., 2018)**, who found that fatigue was from the commonly detected manifestations among children with SVT. The results of the current study revealed that nausea is better decreased by implementing carotid massage, compared to vomiting which was better relieved by ice bag maneuver.

Regarding the return to normal heart rhythm and the hemodynamic parameters throughout periods of intervention, it was observed that children in carotid massage group returned to normal heart rhythm immediately after the intervention, which was significantly better than those in the ice bag group with a statistically

significant differences in the heart rate within the two groups throughout the three periods of the study. This result is consistent with European Society of Cardiology (ESC) guidelines for the management of supraventricular tachycardia 2019, stated that Valsalva maneuver and carotid massage had a high success rate of SVT conversion reaching 54% **(Costache et al., 2023) (Katritsis et al., 2020)**. On the other hand, the review of **(Nizami et al., 2024)** stated that the ice bag maneuver has achieved a lower success rate of the studied cases compared to the Valsalva maneuver. This may be attributed to the effect of applying carotid massage maneuver and its action on the vagus nerve to slow heart rate, as carotid sinus baroreceptor has a crucial role in the control of blood pressure and heart rate through the afferent signals that travel from carotid baroreceptors to the cardiovascular control center in midbrain via the glossopharyngeal nerve. Then, the efferent signals transmit via parasympathetic and sympathetic nerves to the heart and blood vessels. This response brings appropriate changes to maintain heart rate and blood pressure in normal physiological limits, which is known as carotid sinus baroreflex **(Andani & Khan, 2020)**. However, this result does not match with **(Abbasi et al., 2023)** who found that the carotid massage had a lower success rate for SVT conversion compared with ice bag maneuver, but this difference appears as **(Abbasi et al., 2023)** cited this result from an old study that was conducted on adults by **(Wen et al., 1998)**.

Conclusion

Based on the results of the current study, it can be concluded that despite the opportunity for improvement exists with both maneuvers that applied in the current study, which were carotid massage and ice bag maneuver, however the carotid massage has achieved a higher success rate of SVT conversion to normal heart rhythm than the ice bag maneuver. So, carotid massage is considered more effective in terminating SVT attacks and in reducing the need for treatment escalation for children with stable SVT.

Recommendations:

Based on the findings of the present study, the following recommendations are suggested:

For clinical practice:

- Carotid massage and ice bag maneuver should be integrated in the urgent management of children with stable SVT in pediatric emergency and cardiac intensive care units.
- Training should be provided to pediatric critical care nurses and children's caregivers on the application of carotid massage and ice bag maneuver.

For further nursing research studies:

- Future research studies that focus on studying the risk of developing

psychological difficulties in children suffering from supraventricular tachycardia compared to healthy peers.

- Replication of the study using a larger probability sample from different geographical areas, to attain more generalization of the results.

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