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Study of Changes in the Serum Potassium Concentration after Thiopental with Succinylcholine in Childrens at a Tertiary Care Centre

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Abstract
Succinylcholine is a depolarizing muscle relaxant which is most widely used during anaesthesia, because of its short duration of action, lasting for about 4-5 minutes The hazards of potassium imbalance following administration of muscle relaxant during general anaesthesia make it imparative to find out combination of the relaxant and the anaesthetic agent which would minimize the risk of hyperkalaemic and hypokalaemic syndrome. study is aimed to observe changes in the serum potassium concentration after Thiopental with succinylcholine in childrens. The serum potassium level after the administration of thiopental and succinylcholine shows the rise of serum potassium in pediatric age group.

Introduction

Interest has recently been focused on the increase and decrease in serum potassium concentration follow after administration of Thiopental and Succinylcholine in childrens from age of 4 years to 17 years. Transient hyperkalemia following administration of succinylcholine (Paton, 1956; Stevenson, 1960; Powell, 1970; Miller, 1972;) [1,2,3]. It has been uniformly observed that rise In serum potassium concentration has been atributed to muscular fasciculations or contractions which lead to release intracellular potassium into extracellular compartment. Succinylcholine is a depolarizing muscle relaxant which is most widely used during anaesthesia, because of its short duration of action, lasting for about 4-5 minutes /(Gray and Nunn, 1971). The muscle fasciculation produced by succinylcholine have been variously explained. These include an antidentromic response to stimulation of motor nerve terminal, depolarization of the first node of Ranvier in the nerve propagating all impulse to the several terminals of the motor unit and depolarization of the muscle spindle causing a random motor discharge. However, Karozmer (1967) explained it by an initial post-junctional depolarization. Succinylcholine has muscarinic effect, which causes bradycardia and even cardiac arrest.- These cardiac complications were explained initially by many tentative theories like vagal over activity, toxaemia, acidosis and hypokalaemia. But Tolomie, Joyce and Mitchell (1967)[4] found evidence of hyperkalaemia in severely burned patients after succinylcholine prior to cardiac arrest, which was proceeded by the, characteristic E.C.G. signs of hyperkalaemia.

Succinylcholine liberates K^+ from striated muscle, probably because of muscle damage attributable to the synchronous preliminary fasciculation. The concept of muscle damage is supported by the finding of raised serum creatinine phosphokinase 'after pains' (Tammisto, 1967) and presence of myoglobin in the urine. Succinylcholine can cross the placental barrier (Moya,1961), although it still remains a safe drug to use in pregnancy because neonate can tolerate well the depolarizing drug.

The clinical manifestations of hypokalaemia do not usually occur until the serum potassium has fallen below 2.5 mEq/L. The predominant sign is muscular weakness resulting into a picture of dyspnea patients exhibiting 'Fish mouthbreathing' (Weiner, 1970)[5]. Ultimately death can result from respiratory failure, the cardiovascular change includes bradycardia, dysrhythmias and even ventricular fibrillation (wood, 1968), postural hypotention is a common phenomenon. The E.C.G. typically shows prolongation of QT and sagging of the ST segments with an occasional U wave of low amplitude indicating an after potential following action potential.

The hazards of potassium imbalance following administration of muscle relaxant during general anaesthesia make it imparative to find out combination of the relaxant and the anaesthetic agent which would minimize the risk of hyperkalae- mic and hypokalaemic syndrome.

Aim and Objective

The present study is aimed to observe changes in the serum potassium concentration after Thiopental with succinylcholine in childrens.

Materials and Method

The present study was carried out upon 60 healthy childrens presenting for various elective surgical procedures with the age ranging from 4 years to 17 years of both sexes.

Selection of patients:

All patients were belonging to paediatric children age group ranging from 4 to 17 years.

Criteria for selection of patients:

1) All patients included in this study belong to Paediatric age group undergoing elective surgery.
2) Patients should not have metabolic disorder.
3) Patients more than 17 years of age were not in~luded in this study.
4) Special care was taken that patients were not on any drugs therapy or intravenous fluid which will influence potassium levels.

Grouping of the patients:

Total 60 patients were studied and divided into three major groups - Group-I &II

Each group includes of 30 patients was further divided by age - 10 patients (1-5 years old), 10 patients (6-10 years old) and 10 patients (11-17 years old).

The anaesthetic induction for other 60 patients consisted of thiopental 6 mg/kg I/V and Succinylcholine (1.5 mg/kg) followed by tracheal intubation. After tracheal intubation, 30 patients received halothane-nitrous oxide (Group-I).

30 patients maintained on N_20 - Oxygen & non-depolarizing agent (Group-II).

For measurement of serum potassium contraction, the blood samples at various stages were collected from peripheral vein in all cases by insertion of intravenous.

catheter at 0 time (pre-anaesthetic) 1 minute, 3 minutes, 5 minutes and 10 minutes of anaesthesia.

Pre-medication

In all cases· pre-medication was carried out by injecting atropine 10 pg/kg intramuscular half an hour before anaesthesia.

Anaesthetic technique:

Group - I:

Patients were induced with thiopental (6 mg/ kg) Succinylcholine (1.5 mg/kg) & preceded by and intubation was done. Anaesthesia was maintained on O_2,+N_2O + halothane with spontaneous ventilation and blood samples were taken for measurement of serum potassium.

Group - II:

In group II all the Patients were induced with thiopental (6 mg/kg) and intubation was done by succinylcholine (1.5 mg/kg) using of 100% 02 by IPPR, maintained on O_2 + N_20 and non-depolarizing muscle relaxant on close circuit with controlled ventilation. Blood samples were taken for serum potassium concentration.

Monitoring:

A close watch was kept on pulse, blood pressure, respiration and other vital signs. In between collection of blood samples the I.V. catheter was flushed by 'normal saline. The control patients had blood sample drawn at same time comparable to succinylcholine group.

Adequate hydration was maintained and accordingly, intravenous fluid given. Blood loss was estimated clinically and replaced by blood.

The blood samples were collected in plain vial and serum potassium levels were estimated by flame photometry.

Method of Study

(A) Collection of samples

Blood samples from a peripheral vein of children case were collected pre-operativelY for 0 time, then 1 minute, 3 minutes, 5 minutes and 10 minutes of anaesthesia in plain vial.

(B) Estimation of Potassium by flame photometry

This method of estimating electrolyte in solution has revolutionized our knowledge of electrolyte disorders by making it poss b Le.todetermine sodium and potassium with greatly improved speed and accuracy. The principle is simple. The solution is sprayed as a fine mist of droplets into a non-lumen flame with the help of five automizer, then the flame become coloured by the characteristic emission of the particular ion. the light of wave length corresponding to the eliment is filtered through a filter, blocking there of wave length. This light then falls an photocell (Photosensitive cell) and produce electricity which is measured with very sensitive mirror galvanometer.

Normal value: The normal value in children (Serum potassium)

Method

3.5 to 5.0 mEq/L. The blood sample at various stages were collected from a peripheral vein under aseptic condition in test tubes. These were allowed to stand for clot formation and separation of serum. The supernatant serum was then transferred in a centrifuge tube and centrifuged for 10 minutes at 3000 rounds per minute. The supernatant clear serum was removed by a pipette and put in the serum tube. Dilute the, serum 1/100 with a potassium free distilled water (0.2 ml of serum with 19.8 ml of distilled water), compare the sample by flame photometer with series of standard solution containing both sodium and potassium a n equal concentration.

Procedure

Insert the potassium filter and switch on the motor and wait for 10 minutes. Switch on the galvanometer light turn the gas supply full all, ignite the flame and turn on the air supply. Regulate the air pressure from 10-15 lb/Sq. inch. Then reduce the gas supply until individual blue canes of the flame are found. Then vaporise potassium free bottle and set the gal venometer to zero. Then spray the highest potassium standard solution 1.6)mEq/L and adjust the sensitivity controlled. So that the galvenometer gives reading 45, then spray one by one all standard solution and note the reading of the galvenometer. After spraying each standard solution spray distilled water to clean the automiser and tobring back the galvenometer to 0 reading, then spray the test solution and take the reading of the galvenometer. Now as the test solution is diluted to 1100 multiply the drived figure with 100.

Solution:

(1) Distilled water - It should be free of sodium and potassium. The ordinary distilled water can effectively purified by passing it through a column of suitable ion exchange resine, this water is used for making all solution for rinsing glassware.

(2) Stock potassium standard (10 mEq/L). 746 grams of pure dry potassium chloride per litre in water.

Observations

Observations were carried out ln 60 patients of both sexes, age ranging from 4 years to 17 years. The patients were divided into three major group according to technique of anaesthesia, group I, II. Each group is again divided into three sub-groups according to the age. Serum potassium levels are estimated in each group as follows

Table No.1 Showing the distribution of 60 cases in various Groups

Group	Anaesthetic technique	Total Cases	Age group (Range in years)		
			1-5	6-10	11-17
Group I	Induction by thiopental + Succinylcholine + intubation and maintain on 02 N_20 + halothane.	30	10	10	10
Group II	Induction by thiopental + Succinylcholine maintained on N_20 + Non-depolarizer M.relaxant	30	10	10	10

Table No. 2 Showing the operative procedures in Group I

S. No.	Operative Procedures	No. of Cases
1	Tonselectomy	9
2	F.B. Romoval	4
3	Cleft lip repair	5
4	Cystolithotomy	5
5	Incision and drainage	1
6	Cyst excision	3
7	Cleft palate repair	2
8	Dental wiring	1
	Total	30

Table No. 3 Showing the operative procedures in Group II

S. No.	Operative Procedures	No. of Cases
1	Mastoidectomy	7
2	Laparotomy	5
3	Appendisectomy	3
4	Herniorrhaphy	5
5	Cystolithotomy	5
6	Sequestrectomy	2
7	Ext. Fixation	2
8	Skin grafting	1
	Total	30

Table No. 4: Showing the sex incidence in all groups

Group	Male	Female	Total
Group - I	25	5	30
Group – II	24	6	30
Group – III	20	10	30

Table No. 5 : Statistical analysis of serum potassium levels in group – I (1-5 years) (n = 10 Patients)

Statistical value	0 time pre-anaesthetic	1 min. after Induction	3 min. after Induction	5 min. after Induction	10 min. after Induction
Minimum	4.2	4.3	4.4	4.3	4.3
Maximum	5.3	5.3	5.2	5.3	5.3
Mean	4.64	4.7	4.85	4.88	5.2
S.D. ±	.695	.632	.542	.563	.602
T. Paired	-	5.48	5.42	5.54	5.32
P Value	-	>.05	<.05	<.05	<.05
Significance	-	N.S.	S.	S.	S.

Table No. 6: Statistical analysis of serum potassium levels in group –I (6-10 years)

Statistical value	0 time pre-anaesthetic	1 min. after Induction	3 min. after Induction	5 min. after Induction	10 min. after Induction
Minimum	4.3	4.3	4.2	4.2	4.8
Maximum	5.2	4.95	5.3	5.4	5.4
Mean	4.91	4.98	5.2	4.9	4.94
S.D. ±	.658	.631	.505	.621	.654
T. Paired	-	5.42	5.58	5.11	5.21
P Value	-	<.01	<.01	<.05	<.05
Significance	-	N.S.	S.	S.	S.

Table No. 7: Statistical analysis of serum potassium levels in group -I (11-17 years)

Statistical value	0 time pre-anaesthetic	1 min. after Induction	3 min. after Induction	5 min. after Induction	10 min. after Induction
Minimum	4.2	4.4	4.3	4.5	4.2
Maximum	5.2	5.2	5.5	5.5	5.4
Mean	4.60	4.72	4.82	4.82	4.75
S.D. ±	.632	.558	.737	.751	.685
T. Paired	-	4.58	3.95	4.54	4.24
P Value	-	>.05	<.05	<.05	<.05
Significance	-	N.S.	S.	S.	S.

Group 'I: (Thiopental + succinylcholine + Halothane)

This group comprised of 30 patients of which 24 were males and 6 females. The operative procedures carried out in these patients is shown in Table No. III. The age wave ranging in this group was 5-17 years. Range of body weight was 15-40 Kg. The duration of anaesthesia ranged from 45 minutes to 1.30 hours.

Chpnges in Serum potassium levels:

The mean value and the range of serum potassium preoperativelY, 1 min, after 3 min, after 5 min. and 10 minutes of anaesthesia along with the statistical analysis and the P value are given in Table.

After applying paired 't' test, the serum potassium level after the administration of thiopental and succinyl choline as follows. This show rises of serum potassi~ is significant (P <.05) in 0-5 years and 6-10 years age group at 3 min, 5 min. and 10 minutes of anaesthesia. There were no significant change in 11-17 years (P >.05). The largest increases in serum potassium level in two patients 11-17 years age at 3, 5 & 10 minutes of anaesthesia (P <.05).

Table No. 8 : Statistical analysis of serum potassium levels in group - II (1-5 years) (n =10 patients)

Statistical value	0 time pre-anaesthetic	1 min. after Induction	3 min. after Induction	5 min. after Induction	10 min. after Induction
Minimum	3.7	3.7	3.9	3.9	3.9
Maximum	5.0	5.1	5.2	5.2	5.1
Mean	4.47	4.75	4.60	4.65	4.55
S.D. ±	.558	.658	.632	.658	.579
T. Paired	-	4.85	3.52	3.54	3.85
P Value	-	>.05	>.05	<.05	<.05
Significance	-	N.S.	S.	S.	S.

Table No. 9: Statistical analysis of Serum Potassium levels in group - II (6-10 years)

Statistical value	0 time pre-anaesthetic	1 min. after Induction	3 min. after Induction	5 min. after Induction	10 min. after Induction
Minimum	3.8	3.7	3.7	3.8	3.8
Maximum	5.1	5.1	5.2	5.2	5.24
Mean	4.48	4.47	4.55	4.87	4.57
S.D. ±	.653	.631	.737	.747	.705
T. Paired	-	3.85	3.52	3.28	3.14
P Value	-	>.05	<.01	<.01	<.01
Significance	-	N.S.	S.	S.	S.

Table No. 10 : Statistical analysis of Serum Potassium levels in group - II (11-17 years)

Statistical value	0 time pre-anaesthetic	1 min. after Induction	3 min. after Induction	5 min. after Induction	10 min. after Induction
Minimum	3.8	3.9	3.9	3.95	3.97
Maximum	5.2	5.4	5.5.	5.5	5.3
Mean	4.42	4.81	4.88	4.84	4.81
S.D. ±	.505	.621	.653	.695	.615
T. Paired	-	4.24	4.88	3.95	3.82
P Value	-	<.01	>.05	>.05	>.05
Significance	-	N.S.	S.	S.	S.

Group – II: (Thiopental + Succinyl Chop This group comprised of 30 patients in which 20 were male and 10 were female. The operative procedure carried out in these patients is shown in Table.

The age of the patients was ranging from 4 years to 17 years and weight was ranged from 15 Kg to 40 Kg.

Changes in Serum potassium levels:

The mean value and range of serum potassium, preoperatively (0 time), 1 min, 3 min, 5 min. and 10 minutes along with the statistical analysis and the p value are given in Table.

After applying paired 't' test, the serum potassium level are as follows **:-**

There is increased in serum potassium levels after the administration of succinyl choline, this rise is highly significant as p <.01 at 5 and 10 minutes of anaesthesia in 6-10 years of age and significant in 1-5 years, P <.05. There was no fall in serum potassium levels, which is not significant as P >.05 in 11-17 years of age.

Discussion

Group I: (Thiopental +Succinyl Choline + Halothane)

After applying the paired 't' test, the serum potassium levels are as follows. There is rise in serum potassium levels after the administration of succinyl choline, this rise in ~erum potassium is

significant as (p <.05) in 1-5 years and 6-10 years of age group at 3, 5 and 10 minutes after Succinyl Choline.

There were no significant change in 11-17 years of age group. The largest increase in serum potassium level was 5.5 mEq/L found in two patient's Case No.51 and 53 in 13 and 15 years of age, at 3 and 5 minutes after the administration of succinylcholine as (p <.05).

It has been found that raised serum potassium level after succinylcholine administration followed by return to normal post-operatively. According to the study of Stephen, F. and Thomas, M. Wolfe (1984), serum potassium decreased after thiopental and succinylcholine in 1-5 years of age and 6-10 years of age group and didn't change in 11-17 years of age group. In our study there were rise in serum potassium level after the administration of succinylcholine. This rise in serum potassium were significant in 1-5 years and 6 to 10 years of age group at 3 and 5 minutes of succinyl choline. So our study is differ with mentioned study of Stephene study. Succinylcholine used in this group was given in one single dose only never exceeded 2 mg/kg. Administration of halothane after succinylcholine did not produced any change in level of serum potassium. The maximum rise in serum potassium level was 5.4 mEq/L in about all age groups, there was no arrhythmia in these patients. Pre-operative serum potassium level was high in 3 cases, mear 5.25 mEq/L, in which two patients were 7 and 9 years of age one case was of 5 years of age in which no cardiac arrhythmia found.

Group-II- (Thiopental +Succinylcholine +Non-depola. relaxant)

After applying paired 't' test, the serum potassium levels are found to be as follows.

There were increased in serum potassium levels after the administration of Succinylcholine, this rise is significant as (p <.01) at 5 and 10 minutes of anaesthesia in 6-10 years of age group and significant in 1-5 years p)<.05). There was no fall in serum potassium levels, as which is not significant (p >.05) in 11-17 years of age group. There were rise in serum potassium after succinylcholine administration followed by a return to near normal after using the non-depolarizing muscle relaxant. Rise in serum potassium level after succinylcholine admini'stration and a fall in raised serum potassium level after D.T.C. has also been reported by Hanssom (1958) and List (1967). In our study the raised serum potassium return to normal after non- depolarizing muscle relaxant in all age group. Our study is coincides with Hanssom & List study.

William, L .Mc Nice & Haselby observed that there were decrease in serum potassium in 1-5 and 6-10 years of age group after thiopental and succinylcholine anaesthesia and slight increase in serum potassium in 11-17 years of age group.

In our study in Group II, the serum potassium level is increased a n 1-5 years and 6-10 years age group after thiopental and succinylcholine at 3 and 5 minutes of anaesthesia and significantly raised in 11-17 years age group.

Our study is differ with above study.

Succinylcholine used in this group was given in single dose onlynot more than 2 mg/kg administration of non-depolarizer agent did not produce any change in level of serum potassium. In some cases potassium levels fall at 5 and 10 minutes in group II. The maximum rise in serumpotassium level was 5.3 mEq/L and there was no cardiac arrhythmia in these patients. The minimum value of serum potassium level was about 4.3 mEq/L pre-operativelyin this group.

Conclusion

In Group I & II: - The serum potassium level after the administration of thiopental and succinylcholine shows the rise of serum potassium in 1-5 years and 6-10 years age group. There were largest increase in serum potassium level in five patients 11-17 years age at 3 and 5 minutes of anaesthesia.

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