European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 09, Issue 03, 2022

ORIGINAL RESEARCH

To Study applicability of Broselow tape for the estimation of weight and size of Endotracheal tube in Indian children

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ABSTRACT

Background:Pediatricanesthesia is a challenging aspect for the Anesthesiologists, the size of ET required for the child is calculated by a standard formula, which considerstheage of patient. Present study was attempted to know the applicability of "Broselowtape"for the estimation of weight and end ot rachea ltubesizein Indian children.

Material and Methods: Present study was cross-sectional study, conducted in children aged 1 month to 10 years including both genders, ASA Grade I or II, undergoing elective surgeries under general anesthesia requiring endotracheal intubation. Length of the child was recorded with the Broselow Paediatric Emergency tape. We correlated the sizes of endotracheal tube estimated by Broselow tape to actual sizeofendotrachealtubeused.

Results: Present study was conducted among 200 children, mean age was 2.66 ± 2.76years. According to validity of estimated weight by Broselow tape with actual weight, majority wereoverestimated (49 %) & least were underestimated weight (41.5%). 19.5%children required tube change during procedure. The average predicted endotracheal tube size of children was observed 4.24 ± 0.78 mm. Average endotracheal tube used was 4.26 ± 0.72 mm. CorrelationcoefficientbetweenpredictedETTsizeand ETT size (mm) was very strong, positive, significant (p<0.0001) whileverysmall,non-significant(p=0.2683)mean difference between predicted andETT size actually required was observed. It was observed that correlation coefficient between Broselow tape predicted weight (range) and actual weight (Kg) recorded was very strong, positive, significant (p<0.0001)whereas Broselow tape overestimate weight as a marginal and significant (p=0.0082) mean difference was observed between predicted and actual weight.

Conclusion: Broselow tape was found to be significantly reliable for estimation of endotrachealtubesizewithcorrelationcoefficientof(P=0.0001)in80.5%ofchildren in age group of 1 month to 10 years.

Keywords: Broselow tape, estimation of ETT, Indianchildren, intubation

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INTRODUCTION

Pediatri can esthesia is a challenging aspect for the Anesthesiologists as he has to manage pediatricpatient under going either electiveore mergen cysurgeryas well as children admitting with respiratory distress, shock or circulatory collapse for resuscitation.[1] Insuch circum stancesac curatean drapid estimation of child'sweight is crucial for the determination of appropriate drug doses and proportionate size of equipment especially "Broselowtape (BT)" used for resuscitation.[2,3,4]Inaccurate weight estimation may result in dosing errors and higher incidence of adverse drug events leading to increased mortality and morbidity.[5]

Routinely, the size of ET required for the child is calculated by a standard formula,which considers the ageofpatient.[6]These lectionof proper size ET also play savital role in providing effective ventilation and protecting air way in such situations.[3]Undersizetube lead stogas leak,loss oftidal volum eandin crease chances of aspiration,where as over sized tub ecanresultin post operative pharygolaryngial complication like stridor,croup,dysphonia, etc.[7,8] High tube exchange rate and prolonged intubation time are also not advisable as it contributes to increase chances of aspiration and hypoxia.[9]

Subramanian et al.[1] reported Brose low tape is an effective tool for prediction of end otrachealtubesizesin children above 6 months of age.However,Asskaryar[7]suggested remodeled BT for higher accuracy in weight calculations.Thus, the results of its usage are varied in Indian children and the study is lacking in the western part of India. Hence, the present study was attempted to know the applicability of "Broselow tape"forthe estimation of weight and end otracheal tube size in Indian children.

MATERIAL AND METHODS

Present study was cross-sectional study, conducted in Department of Anaesthesiology, at Tertiary care center in central India. Study duration was of 2 years (May 2019toApril2021). The present study was approved by Institutional Ethical committee.

Inclusion criteria

- Children aged 1 month to 10 years including both genders, ASA Grade I or II, undergoing elective surgeries under general anesthesia requiring endotracheal intubation, parents willing to participate in present study

Exclusion criteria

- Refusalto participate.
- Childrenweighing<3kg.
- Childrenhavinglength<46cmorheight>150cm,
- Age>10years.
- Childrenwithknowndifficultairwayorcongenitalairwayanomalies.
- Historyofsurgeryforleg lengthdiscrepancy.
- Failuretothrive e.g.,cerebral palsy.
- Childrenrequiringemergency care.
- ASAgradeIIIand IV.

Study was explained to parents in local language & written consent was taken for participation & study. Thoroughpre-an estheti cevaluation was done with necessaryin vestigation.Weight of the child was recorded by using digitalized weighing scale to the

nearest 0.1 kg. Care was taken to remove footwear and heavy clothing and proper calibration ofscale was confirmed. Infant weighing scale was used when required.
Children were kept NBM for 6 hours pre-operatively. On the day of surgery, they were pre-medicatedwithpre-calculateddosesofivmidazolam0.02mg/kg,glycopyrrolate4mcg/kg, ketamine 1mg/kg, fentanyl 1 mcg/kg as per routine protocol of institution in the waiting area before separating the child from parents. Then the child was shifted inside the OT and laid supine on the OT table. Length of the child was recorded with the Broselow Paediatric Emergency tape (2017 edition by Amstrong Medical Industry, USA). Whilere cording one hand of the recorder was on the redportion of the tape which was kept at the top of the child's head. The free hand was used to run the tape down the length of the child's body till it approximate the heel of the child. The colour zone of the tape was recorded.
In formation written on that zone was provided the appropriate weight in K g of that child according to Broselow tape. It was also provided the estimation of size of theEndotracheal tube required for that child. Weight and Endotracheal tube size as per Broselow tape were recorded. Standard monitors were applied including ECG, SPO2, NIBP and the base line parameterswasrecorded.Pre-oxygenationwasdonefor3minutes.Patientwasinducedeither with1) iv propofol (1-2mg/kg). After confirming the bag and mask ventilation iv atracurium 0.5 mg/kg was given as a muscle-relaxants for intubation.
The person having more than 2 years of experience of intubation performed the intubation.ThesizeofEndotrachealtubewasselectedaccordingtoage-basedformula(age/4 +4 for uncuffed ETT,age/4+3 for cuffed ETT),which was done as per routine practice atour institute.Children<6monthwereconsideredas5yearsageofthosebetween6monthsto1 year and 6 months were considered 1 year and so on for the estimation of ETTsize by age- based formula. If the selected tube found to be too large for glottis or resistance encountered during intubation0.5cmsmallersizewaschosenforintubationandthatwasrecordedastubechange.
Correctpositionofthetubewasconfirmedbycapnographyandauscultationofbilateral breath sounds. The size of endotracheal tube was considered appropriate if passed smoothly through glottis and have minimal air leak on auscultation and palpation. If the leak was found large delivering insufficienttidal volume tube was changed to 0.5 mm larger size and this was also be recorded as tube change and the size of tube inserted finallywasnoted.The end point of the study was reached on cethe ETT inserted has found to be the best fit.
Maintenance of an esthesiaand furthermanagement was done aspertheroutine protocol of the institution. Height was used as avariabletod eterminetheagreement between them easured weight and weight estimated with Broselow tape. The area under the receiver operating characteristic(ROC)willbeusedtoevaluatethecutoffheight.If the difference of the two estimated weight is with in the limits of the agreem enttheassumption was that BT estimation correlated and if it was out of limits of agreement the estimation did not correlate. While correlating the sizes of endotracheal tube estimated by Broselow tape to actual sizeofendotrachealtubeused,the difference was calculated between the tub esand difference of 0.5 cm was accepted as matched.
Statistical analysis was perform edbyusing the SPSS program for Windows, version 20.0. Continuous variables were presented as mean ±SD, and categorical variables were presented as absolute numbers and percentage. Moreover, categorical variables were analyzed using either the chi square test or Fisher's exact test. Moreover, Pearson' s correlation coefficient was performed between actual and predicted valu esrelated to Broselow tape estimated weight with actual weight of child as well as Broselow tape estimated size of Endotracheal tube (ETT) with actual size of Endotracheal tube (ETT) required. Statistical significance was considered at $P<0.05$ level but $P>0.05$ is not considered significant.

RESULTS

Present study was conducted among 200 children majority were from age group of <1 year (48 %) followed by the age groups of 1.1-4 years (28.5 %) and 4.1-10 years (13 %), mean age was 2.66 ± 2.76years. 137 (68.5%) children were males, and 63 (31.5%) children were females. Mean height of children was 80.64 ± 26.62 cm while mean weight of children was 9.89 ± 4.72 Kg. 75% children were ASA grade 1 and 25% children were ASA grade 2.

Table 1: General characteristics

Characteristics	No. of patients	Percentage
Age groups (in years)		
≤1	96	48.0
1.1–4	57	28.5
4.1–7	26	13.0
7.1–10	21	10.5
Mean ±SD	2.66±2.76years	
Gender		
Male	137	68.5
Female	63	31.5
Height(cm) (Mean ±SD)	80.64±22.62cm	
Weightrange (Kg) (Mean ±SD)	9.89±4.72kg	
ASAGrade		
1	150	75%
2	50	25%

Majority of children underwent surgeryfor gastrointestinal system (47%) followed by other systems (44,22%) Hernia (8.5%) ,urinarysystem (16,8%), genitalsystem (7.5%),respiratorysystem(2.5%), hepatobiliary system (2.5%), neuro system (1.5%) & cardiovascular system (0.5%).

Table2:Distribution ofsubjectsaccordingtotheirsurgery

Diagnosis	Numberofchildren	Percentage
Gastrointestinal	94	47%
Genital	15	7.5%
Urinary	16	8%
Respiratory	5	2.5%
Hepatobiliary	5	2.5%
Neurological	3	1.5%
cardiovascular	1	0.5%
Hernias	17	8.5%
Others	44	22%

According to colourcodefrequencydistribution,majority had Grey colour code (22.5%) followed by Blue (16%), Red (15.5 %), White (15 %),Yellow (13 %)andPurple(11.5 %).

Table3:Distributionofsubjectsaccordingtotheircolourcode

Colourcode	Noofsubjects	percentage
Grey	45	22.5
Blue	32	16
Red	31	15.5

White	30	15
Yellow	26	13
Purple	23	11.5
Pink	13	6.5

As per weight estimated by Broselow tape, majority children were of weight rangeof3-5Kg (22.5 %), followed8-9Kg(16 %) and 15-18Kg (16 %),19-22Kg (15 %),and12-14Kg (14.5 %). Theaverage(mean± SD) estimated weight of children was observed as 11.28 ± 5.69 Kg. Differenceinestimatedweightby Broselow tape and actual weight among the children in was noted in 58.5% children.

Table4:Distributionofsubjectsaccordingtoweightestimatedby Broselowtape

Weightrange(Kg)	**Noofsubjects**	**Percentage**
3-5	45	22.5
6-7	13	6.5
8-9	32	16.0
10-11	19	9.5
12-14	29	14.5
15-18	32	16.0
19-22	30	15.0
Mean ±SD	11.28±5.69kg	
Differenceinweight(estimatedweightby Broselow tape vs actual weight)		
Yes	117	58.5
No	83	41.5

According to validity of estimated weight by Broselow tape with actual weight, majority wereoverestimated (49 %) & least were underestimated weight (41.5%). 19.5%children required tube change during procedure.

Table5:Distributionof subjectsonvalidityofestimatedweightbyBroselowtape with actual weight & requirement of tube change

Levelof Accuracy	**Noofsubjects**	**%**
Accurate (Nodifference)	83	41.5
Underestimate	19	9.5
Overestimate	98	49.0
Tube change		
Yes	39	19.5
No	161	80.5

According to predicted endotracheal tube size among the children, majority had tube size 3.5 mm (43.5 %), followed by tube size of 5.5 mm (16 %), 5 mm (15 %), 4.5 mm (14.5 %) and 4 mm (10.5 %). The average ETT of children was observed 4.24 ± 0.78 mm.

Table6:Distributionofsubjectsaccordingtopredictedendotrachealtubesize

Tubesize(mm)	**Noofsubjects**	**Percentage**
3	1	0.5
3.5	87	43.5
4	21	10.5
4.5	29	14.5

5	30	15.0
5.5	32	16.0
Mean ±SD	4.24±0.78	

According to endotracheal tube used among the children, majority required tube size 3.5 mm (32 %) followedbythetubesizeof5mm (20 %),4mm (19 %),4.5mm (16.5 %)and5.5mm (10.5 %), average ETT length required was 4.26 ± 0.72 mm.

Table7:Distributionofsubjectsaccordingtoendotrachealtubesize

Tubesize (mm)	Noofsubjects	Percentage
3	4	2.0
3.5	64	32.0
4	38	19.0
4.5	33	16.5
5	40	20.0
5.5	21	10.5
Mean ±SD	4.26±0.72	

CorrelationcoefficientbetweenpredictedETTsizeand ETT size (mm) was very strong, positive, significant (p<0.0001) whileverysmall,non-significant(p=0.2683)mean difference between predicted andETT size actually required was observed.

Table8:CorrelationbetweenpredictedETTsizeandETT sizeactuallyrequired (mm)

	R	P value
Correlationcoefficient	0.9452	0.0001
Meandifference(mm)	0.02	0.2683

It was observed that correlation coefficient between Broselow tape predicted weight (range) and actual weight (Kg) recorded was very strong, positive, significant (p<0.0001)whereas Broselow tape overestimate weight as a marginal and significant (p=0.0082) mean difference was observed between predicted and actual weight.

Table9:CorrelationbetweenBroselow tapepredictedweightandactual weight (Kg) recorded

	Spearman'sRho	P value
Correlationcoefficient	0.9338	0.0001
Meandifference(Kg)	11.28-9.89= 1.39	0.0082

DISCUSSION

Various studies provide ample evidence on dosing errors in pediatric emergency settingwithhighincidenceofadverseevent.[10,11,12,13]Inpaststudies,agederivedmethodsusing Nelson's formula[14,15] orAPLS guidelines[1,16]in pediatric are often used for estimating the weight and calculating drug doses for children. Moreover, others commonly used age-based formulae such as Best Guess formulae,[17] Argall formula[18] and Luscombe formulae,[19] etc.

All these formulae related to age length or weight are observed time consuming. However,inemergency,thechildpresentsincriticalsituationslikeshockorrespiratorydistress and immediate treatment is the priority, hence, no time is available for calculating the doses of drug or instrument size.[20] The knowledge and experience of the person managing the patient and errors in calculations can also affect the outcome.[21]

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The correlation coefficientbetween Broselow tapepredicted weight(range) and actual weight(Kg)recordedinwhichverystrong,positive,significant(p<0.0001)correlationbetween BroselowtapepredictedweightandactualweightrecordedwasobtainedwhileBroselowtape overestimate weight as a marginal and significant (p=0.0082) mean difference was observed between predicted and actual weight.

Inthepresentstudy,asimilarobservationwasfoundasperthestudyof Pukaretal.[22]in Nepalese children where categorized the children into 3 groups according to their estimated weightbythe BTas<10Kg,10-18 Kg,and >18Kg.A total agreementofthe estimated colorzone accordingtotheBTwiththeactualweightinthegrayzonewasfoundsignificant(P=0.01).They observed a positive correlation between the actual body weight and the estimated body weight, which was significant (P=0.01) and accuracy was (r^2 = 94%). It was noted that the accuracy of estimated weight with the BT decreased with increased weight of children.

Few studies were observed BT-predicted weight versus actual weight of the children in the context of international and national studies. Hofer et al.[3] studied its validity in European children and found it to be an accurate mean to assess the body weight and ETin smaller children weighing <20 kg. Other studies by Al-Busaidi et al.[23] revealed that average value of actual weightwas13.9 ±6.7 kg while the meanBT-predictedweightwas14.4 ±6.9 kg in Omani children and Jang et al.[4] observed 1.54 kg heavier than the BTestimates (1.24 to 1.85 Kg) in Korean children, was also found a useful adjuvant for estimating body weight and ET sizes.

Mishra et al.[2]indicated the usefulness is up to 18 Kg in Indian children while Shih et al.[16]reportedupto10Kg inChinesechildren.Subramanianetal.[1]reportedthatitisaneffective tool for prediction of endotracheal tube sizes in children above 6 months of age. However, Asskaryar[7]suggestedremodeledBTforhigheraccuracyinweightcalculations. Thus, the results of its usage are varied in Indian children and the study is lacking in the westernpartofIndia.

The correlation coefficient betweenBroselow tape predicted ETT size andETT size (mm)actuallyrequiredinwhichverystrong,positive,significant(p<0.0001)correlationbetween predicted andETT size was obtained while very small non-significant (p=0.2683) mean difference betweenBroselow tape predicted andETT size actually required was observed.

AccordingtoSubramanianetal.,[1]theresultsofIndianchildrenrevealedthatthechildren aged<6months,theETTusedwassignificantlycorrelatedwithlength(P =0.044)andfingernail width (P< 0.001) among children while the children >6 months, the ETT usage was correlated with tha tpredicted fromage,BT,length,and finger nailwid tham ong the children.Theyobserved BT has an overall correct predictability rate of about 50.3% while the age-based formula has recordedacorrectpredictionrateofabout59.8%andlength-basedformula wasfoundaccuracy ofabout48.7%.Ourstudyiscorroborated the earlierstudyin which the length ofchild hasgood correlation with size of ETT among Indian children across all age groups and BT is an effective tool to predict ETT size in children >6 months.

Interestingly, Waseem et al.[24] observed that the BroselowPediatric Emergency Tape underestimatedweight(measuredweightwasgreaterthanpredictedweight)ofabout29.4%and overestimated (measured weight was lesser than predicted weight) of about 12.6%. Of the 158 underes tima tedinfants,138 were off by 1 colorzone,16 by 2 color zones,and 4 by more

than 2 color zones.

Hence, most of the times the approximate guess of the weight according to the built and height of the child is considered for calculationsofdrug doses,which again add to the errors.[21] In such situationssome ready made toolguiding about the estimation of weight,properdoses of drugand various equipment size sif available will be very helpful. Use of Brose low tape in Indian children with in the age range of 1 month to 10 years for is useful for estimation of endotracheal tube It is also reduced the strain on managing person for recollecting formulae and difficult calculations.[1]

CONCLUSION

Broselow tape was found to be significantly reliable for estimation of end otrachealtube size with correlation coefficientof(P=0.0001)in80.5%ofchildren in age group of 1 month to 10 years. Hence the study recommends the use of Brose low tapein Indian children with in the age range of 1 month to 10 years for estimation of endotracheal tube size but it is not reliable for estimation of weight as it overestimates weight in Indian children in above age group.

REFERENCES

1. Subramanian S, Nishtala M, Ramavakoda CY, Kothari G. Predicting endotracheal tube size from length: Evaluation of the Broselow tape in Indian children. Journal of Anaesthesiology, Clinical Pharmacology. 2018 Jan;34(1):73.
2. Mishra DG, Kole T, Nagpal R, Smith JP. A correlation analysis of Broselow™ Pediatric Emergency Tape-determined pediatric weight with actual pediatric weight in India. World Journal of Emergency Medicine. 2016;7(1):40-3.
3. Hofer CK, Ganter M, Tucci M, Klaghofer R, Zollinger A. How reliable is length-based determination of body weight and tracheal tube size in the paediatric age group? The Broselow tape reconsidered. British Journal of Anaesthesia. 2002 Feb 1;88(2):283-5.
4. Jang HY, Do Shin S, Kwak YH. Can the Broselow tape be used to estimate weight and endotracheal tube size in Korean children?. Academic Emergency Medicine. 2007 May 1;14(5):489-91.
5. Varghese A, Vasudevan VK, Lewin S, Indumathi CK, Dinakar C, Rao SD. Do the length-based (Broselow) Tape, APLS, Argall and Nelson's formulae accurately estimate weight of Indian children. Indian Pediatr. 2006 Oct 1;43(10):889-94.
6. Dorsch JA, Dorsch SE. Tracheal tubes and associated equipment in understanding anesthesia equipment. Understanding Anesthesia Equipment. Philadelphia: Lippincott Williams and Wilkins. 2008; pp.561-632.
7. Asskaryar F, Shankar R. An Indian pediatric emergency weight estimation tool: prospective adjustment of the Broselow tape. International Journal of Emergency Medicine. 2015 Dec;8(1):28.
8. Luten RC, Wears RL, Broselow J, Zaritsky A, Barnett TM, Lee T, et al. Length-based endotracheal tube and emergency equipment in pediatrics. Annals of emergency medicine. 1992 Aug 1;21(8):900-4.
9. Turkistani A, Abdullah KM, Delvi B, Al-Mazroua KA. The 'Best fit'endotracheal tube in children. Middle East J Anesth. 2009;20:383-7.
10. Kaushal R, Bates DW, Landrigan C, McKenna KJ, Clapp MD, Federico F, et al. Medication errors and adverse drug events in pediatric inpatients. Jama. 2001 Apr 25;285(16):2114-20.
11. Garfield S, Reynolds M, Dermont L, Franklin BD. Erratum to: Measuring the Severity of Prescribing Errors: A Systematic Review. Drug Safety. 2014;37:199.
12. Sharek PJ, Classen D. The incidence of adverse events and medical error in pediatrics.

Pediatric Clinics. 2006 Dec 1;53(6):1067-77.
13. Davey AL, Britland A, Naylor RJ. Decreasing paediatric prescribing errors in a district general hospital. Quality &Safety in Health Care. 2008 Apr 1;17(2):146.
14. Penlington GN. Letter: Endotracheal tube sizes for children. Anaesthesia. 1974 Jul;29(4):494-5.
15. Kliegman RM, Behrman RE, Jenson HB. The first year. In: Behrman R, Kliegman R, Jenson HB, eds. Nelson textbook of pediatrics. 17th ed. Philadelphia: Saunders; 2004; pp. 32- 38.
16. Thompson-Chagoyán OC, Maldonado J, Gil A. Aetiology of inflammatory bowel disease (IBD): Role of intestinal microbiota and gut-associated lymphoid tissue immune response. Clin Nutr. 2005 Jun;24(3):339-52.
17. Tinning K, Acworth J. Make your Best Guess: an updated method for paediatric weight estimation in emergencies. Emerg Med Australas. 2007 Dec;19(6):528-34.
18. Argall JA, Wright N, Mackway-Jones K, Jackson R. A comparison of two commonly used methods of weight estimation. Arch Dis Child. 2003 Sep;88(9):789-90.
19. Luscombe M, Owens B. Weight estimation in resuscitation: is the current formula still valid? Arch Dis Child. 2007 May;92(5):412-5.
20. Porter E, Barcega B, Kim TY. Analysis of medication errors in simulated pediatric resuscitation by residents. West J Emerg Med. 2014 Jul;15(4):486-90.
21. Wells M, Goldstein LN. An algorithm to improve the accuracy of emergency weight estimation in obese children. Pan Afr Med J. 2018 Oct 5;31:90.
22. Pukar KC, Jha A, Ghimire K, Shrestha R, Shrestha AP. Accuracy of Broselow tape in estimating the weight of the child for management of pediatric emergencies in Nepalese population. International Journal of Emergency Medicine. 2020 Feb 12;13:9.
23. Al-Busaidi AA, Jeyaseelan L, Al-Barwani HM. The Accuracy of the Broselow™ Pediatric Emergency Tape for Weight Estimation in an Omani paediatric population. Sultan Qaboos University Medical Journal. 2017 May;17(2):e191.
24. Waseem M, Chen J, Leber M, Giambrone AE, Gerber LM. A Reexamination of the Accuracy of the Broselow Tape as an Instrument for Weight Estimation. PediatrEmerg Care. 2019 Feb;35(2):112-6.