

Efficacy of Rotavirus Vaccination in Prevention of Hospital Admission of Gastroenteritis among Children Under Two Years of Age

Suzan Salam M. Hussein*, Saba Abbas Fadhil*, Raed Yehya Salman**

ABSTRACT:

BACKGROUND:

Rotavirus is the most common cause of acute gastroenteritis in children.

OBJECTIVE :

To find out the efficacy of rotavirus vaccine in prevention or reduce the number of cases and hospital admission of gastroenteritis among children under two years of age.

PATIENTS AND METHODS:

A cross-sectional study was conducted in Central Teaching Hospital of Pediatric in Baghdad, from the first of February to 31st of May 2016, on a total of (524) child under two years of age, grouped into two groups, first group (260) vaccinated with rotavirus vaccine, second group (264) non-vaccinated.

RESULTS:

According to development of gastroenteritis and vaccination state of rotavirus vaccine, the acute gastroenteritis in non-vaccinated group was more compared with vaccinated group, 192 out of 264 (72.8%) and 128 out of 260 (49.2%) respectively, and this association statistically significant. The number of cases that is admitted to hospital is 48 (37.5%) in vaccinated group with acute gastroenteritis which is significantly lower as compared to 148 (77.1%) in non-vaccinated group with acute gastroenteritis. This study showed that males and females were found to be equally affected of gastroenteritis.

CONCLUSION:

Rotavirus vaccine have reduced the number of cases and hospital admission of gastroenteritis among children under two years of age in Central Teaching Hospital of Pediatric in Baghdad.

KEYWORDS: acute gastroenteritis

INTRODUCTION:

Rotavirus is the most common cause of severe gastroenteritis in infants and young children worldwide. In developing countries, rotavirus gastroenteritis is a major cause of childhood death and is responsible for approximately half a million deaths per year among children aged <5 years. Rotavirus infects almost all children by 5 years old, but severe, dehydrating gastroenteritis occurs primarily among children aged 3-35 months. The spectrum of rotavirus illness ranges from mild, watery diarrhea of limited duration to severe diarrhea with vomiting and fever that can result in dehydration with shock, electrolyte imbalance, and death ⁽¹⁾.

Rotaviruses are highly communicable, with a small infectious dose of < 100 virus particles; the World Health Organization therefore reports that hygienic measures and improved sanitation are not likely to lead to significant declines in rotavirus burden in unvaccinated populations. For this reason, rotavirus vaccines have been identified as the optimal strategy to decrease the burden associated with severe and fatal rotavirus diarrhea worldwide. ⁽²⁾.

Vaccine development strategies are based on live-attenuated rotavirus vaccines that can be administered by the oral route. The vaccine is a live-attenuated oral monovalent rotavirus vaccine derived from a human rotavirus strain attenuated through serial passages in cell culture. It has a two-dose schedule with the first dose from 6 weeks of age with an interval of >4 weeks till the second dose. The schedule should be completed by 24 weeks of age. IN 2007, the World Health

*Baghdad AL-Russafa Health Directorate
.AL-Baladiat Sector.

**Baghdad AL-karkh Health Directorate Central
Pediatric Hospital.

Organization recommended inclusion of rotavirus vaccine in the immunization programs of Europe and America and, in 2009, expanded the recommendation to all infant over the age of 32 weeks worldwide (3) .

The virus enters the body through mouth, viral replication occurs in the villous epithelial of the small intestine (4).

Detection kits suitable for use in rotavirus surveillance systems, other techniques including electron microscopy, reverse transcription – polymerase chain reaction, nucleic acid hybridization, polyacrylamide gel electrophoresis and culture are used primarily in research settings (5).

OBJECTIVE OF THE STUDY:

1-To find out the efficacy of rotavirus vaccine in prevention or reduce the number of cases of gastroenteritis among children less than two years of age.

2-To find out the efficacy of rotavirus vaccine in prevention or reduce the number of hospital admission of gastroenteritis among children less than two years of age.

PATIENTS AND METHOD:

This is a cross sectional study, started from first February to the 31st of May 2016. The study conducted on a total of (524) child less than two years of age attended to the Central Teaching Hospital of Pediatric in Baghdad.

Children who were attending the out-patient for any simple illness, attended the vaccination department, or admitted to the hospital for acute illness, other than gastroenteritis, and children who were complete their vaccination schedule of rotavirus vaccine, were included in this study.

All chronically ill children and those with bloody diarrhea, or history of bloody diarrhea, as well as partially vaccinated children (above 6 months and had received just one dose of the vaccine) and those cases whose mothers did not remember if their children got previous gastroenteritis, were excluded from this study. The study carried out by direct interview with parents after taking

permission from the hospital, and a total of (524) child under two years of age were asked about rotavirus vaccine status and gastroenteritis.

A questionnaire was prepared and it includes the following information:

Demographic feature (age, sex, residency, mother occupation and education, father occupation and education, family number), type of feeding (exclusive breast feeding, bottle feeding, breast and bottle and others), vaccination status of rotavirus vaccine (take at 2 and 4 months of age)by ask the mother if the child has an immunization card, If the mother answers YES, ask her if she has brought the card to the clinic today, If she has brought the card with her, ask to see the card, compare the child's immunization record with the recommended immunization schedule. Decide whether the child has had rotavirus vaccine for the child's age, if the mother says that she does NOT have an immunization card with her ,ask the mother to tell you what immunizations the child has received.

If the child developed gastroenteritis and if he admitted to the hospital for gastroenteritis. Acute diarrhea is defined as sudden onset of excessively loose stools of >10 mL/kg/day in infants, which lasts<14 days. For the patient in this study, gastroenteritis considered positive when there is a history of acute watery diarrhea with or without vomiting, and/or fever⁽⁶⁾, the investigations and the treatment upon the admission to the hospital.

The Stastical analysis of data was carried out using the available statistical package of SPSS-22 (Statistical Packages for Social Sciences- version 22). Data were presented in simple measures of frequency & percentages.

The significance of difference of different percentages (qualitative data) was tested using Pearson Chi-square test (χ^2 -test) with application of Yate's correction or Fisher Exact test whenever applicable. Statistical significance was considered whenever the P value was equal or less than 0.05.

ROTAVIRUS VACCINATION AMONG CHILDREN UNDER TWO YEARS

RESULTS:

The total number of patient was 524 child under two years of age attended to the Central Teaching Hospital of Pediatric in Baghdad were included in this study; according to age the highest percentage of Acute Gastroenteritis AGE was in children 7-12 months old (30.3%) then the proportion of AGE decreased in 13-18months, 19-24 months and 2-6 months to (26.3%, 23.8%, 19,7%) respectively this association statistically is significant , the lowest percentage of AGE was in 2-6 months.

According to sex; although the proportion of males with AGE was (52.5%) more than that of female (47.5%) this association proved to be statistically not significant. According to residency the proportion of Urban was (58.8%) and Rural was (41.3%) and this association statistically not significant, table (1).

According to development of gastroenteritis and vaccination state of rotavirus vaccine, the AGE in non-vaccinated group was more compared with vaccinated group, 192 out of 264 (72.8 %) and 128 out of 260 (49.2%) respectively, and this association statistically significant, table (2).

The admission to hospital according to vaccination status; there is significant association in number of admission to hospital between vaccinated and non-vaccinated groups which develop AGE. The number of cases that is admitted to hospital is 48 (37.5%) in vaccinated group with AGE which is significantly lower as compared to 148 (77.1%) in non-vaccinated group with AGE, table (3).

The sex distribution of vaccinated and non-vaccinated groups with AGE, there is no significant association in the number of admission to the hospital between male 40.3%, female 34.4% in vaccinated group and male78.2%, female 75.8% in non-vaccinated group with AGE table (4).

The relation between the development of AGE in infants 2- 6 months of age and the type of feeding; the total number of infants 2-6 months that develop Acute Gastroenteritis were 63 child and there was difference in the percentage of admission to hospital in those who were exclusive breast, bottle, and mixed feeding in both vaccinated (50.0%, 33.3%, and 37.5% respectively) and unvaccinated patients (77.8%, 64.3%, and 86.7%, respectively) table (5).

Table 1: Distribution of studied sample according to age (months), sex and residence.

		Develop AGE		Not develop AGE		P value
		No.	%	No.	%	
Age (months)	2---6	63	19.7	61	29.9	0.005*
	7---12	97	30.3	37	18.1	
	13---18	84	26.2	53	26.0	
	19---24	76	23.8	53	26.0	
Sex	Male	168	52.5	118	57.8	0.231
	Female	152	47.5	86	42.2	
Residence	Urban	188	58.8	121	59.3	0.898
	Rural	132	41.2	83	40.7	
Total		320	100	204	100	
*Significant association between proportions using Pearson Chi-square test at 0.05 level						

ROTAVIRUS VACCINATION AMONG CHILDREN UNDER TWO YEARS

Table 2: Distribution of studied sample according to development of Gastroenteritis and vaccination state of rotavirus vaccine

			Develop AGE		Not develop				P value
			No.	%	No.	%	total	%	
Take Rota vaccine	Yes		128	49.2	132	50.8	260	100	0.0001*
	No		192	72.8	72	27.2	264	100	

Table 3: Distribution of developed AGE cases (total 320) admission to hospital according to vaccination status.

		Develop AGE				
		Admission to hospital for AGE				
		Yes		No		Total
		No.	%	No.	%	No.
Take Rota vaccine	Yes	48	37.5	80	62.5	128
	No	148	77.1	44	22.9	192
P value		0.0001 *				
*Significant association between proportions using Pearson Chi-square test at 0.05 level						

Table 4: Sex distribution of vaccinated and non-vaccinated groups with AGE.

	Take Rota vaccine				Not take Rota vaccine			
	Develop AGE				Develop AGE			
	Admitted to hospital		Not admitted		Admitted to hospital		Not admitted	
	No.	%	No.	%	No.	%	No.	%
Male	27	56.2	40	50	79	53.3	22	50
Female	21	43.7	40	50	69	46.6	22	50
total	48	100	80	100	148	100	44	100
P value	0.493				0.694			

ROTAVIRUS VACCINATION AMONG CHILDREN UNDER TWO YEARS

Table 5: Distribution of AGE in infants 2-6 months of age according to type of feeding.

	Take Rota vaccine						Not take Rota vaccine					
	Develop AGE						Develop AGE					
	Admitted to hospital		Not admitted		Total		Admitted to hospital		Not admitted		Total	
	No	%	No.	%	No.	%	No.	%	No.	%	No	%
Exclusive BF	4	50.0	4	50.0	8	100	7	77.8	2	22.2	9	100
Bottle feeding	3	33.3	6	66.7	9	100	9	64.3	5	35.7	14	100
Mixed	3	37.5	5	62.5	8	100	13	86.7	2	13.3	15	100
P value	0.771						0.364					

DISCUSSION:

In this study the highest percentage of AGE 30.3% was in age group 7-12 months. This result is nearly similar to study done in Iraq in the city of Mosul that found AGE in 32.7 % in the age group 7-12 months ⁽⁷⁾, and the second study in Baquba city found that AGE in 28.7% of children ,equal and less than one year ⁽⁸⁾. Other study from Iran found that rotavirus gastroenteritis in 20.8% of children in age group (9-11 months) ⁽⁹⁾ and 40.8 % of children in age group (7-12 months) in Jordan ⁽¹⁰⁾, also other study from England and Wales in 37.8% of children in the age group 7-12 months ⁽¹¹⁾.

In contrast in this study the lowest percentage of AGE in 19.7% in age group(2-6months) which is similar to study done in in Iraq AL-Mosul city ⁽⁷⁾.

This study showed that males and females were found to be almost equally affected of gastroenteritis, which is Similar to another study in Baghdad ⁽¹²⁾ and study in northern Iraq found no significant association between rotavirus infection and sex ⁽¹³⁾. On other hand a study in Thi-qar Governorate found male children more affected than females ⁽¹⁴⁾, another studies from India ⁽¹⁵⁾ and Bangladesh ⁽¹⁶⁾ reported that males are more affected than females.

Although children who live in rural areas were found to be exposed to rotavirus gastroenteritis more than others, but this difference was not significant this finding is similar to most studies on rotavirus gastroenteritis in United State ⁽¹⁷⁾.

The result of this study shows that rotavirus vaccine is the best way to protect against rotavirus infections, these viruses are the leading causes of diarrhea among young children, the rotavirus vaccine decreases the development of AGE from 72.8 % to 49.2 % and this result, which is statistically significant, is similar to study done in Misan Iraq showed Rotavirus vaccine decrease the cases of rotavirus gastroenteritis from 36% to 22% ⁽¹⁸⁾, similar studies in Saudia Arabian ⁽¹⁹⁾, in Iran with vaccination coverage of 97% found the cases of diarrhea in the outpatient care decrease 4 times ⁽²⁰⁾, in Jorden found rotavirus vaccine shown to be effective against rotaviruses gastroenteritis ⁽²¹⁾ and study in belgium found vaccine effectiveness was 66% against rotavirus gastroenteritis ⁽²²⁾. In United States study found the vaccine effectiveness of a complete Rota vaccine series was 89% and 85% with rotavirus AGE and acute respiratory infection control patients, respectively ⁽²³⁾. Regarding the admission to the hospital the study shows that there is significant difference in number of admission to hospital

between vaccinated and not vaccinated groups which develop AGE. The number of cases that is admitted to hospital is 48 (37.5%) in vaccinated group with AGE which is significantly lower as compared to 148 (77.1%) in non-vaccinated group with AGE. This result showed that rotavirus vaccine reduced the number of hospital admission for gastroenteritis among young children, unlike those who did not received the vaccine. And this result is similar to study performed in Belgium, showed that rotavirus vaccination is effective for the prevention of admission to hospital for rotavirus gastroenteritis among young children. Results of an observation to vaccination outcome showed that at least one dose of any rotavirus vaccination can provide 91% protection against hospital admission⁽²⁴⁾. In the Australia study found in the target population for the rotavirus vaccine, a decrease of hospitalization rates due to rotavirus gastroenteritis of 74% was observed compared to the era before the introduction of the vaccine⁽²⁵⁾, and other study in Australia, vaccine efficacy in Queensland has been estimated at 89.3%⁽²⁶⁾, also study in Milan Italy⁽²⁷⁾. Other study showed considerable reduction in rotavirus infections and related admissions among young children have been reported after introduction of rotavirus vaccine, with vaccination associated with a significant decline in overall deaths related to diarrhea among children aged under 5 in Mexico⁽²⁸⁾. This study also shows that there is no significant effect between the type of feeding and the frequency of acute gastroenteritis for infants aged 2-6 months for both vaccinated and non-vaccinated group. Unlike other studies, first study done in Tehran that found children up to 2 years of age, 21.1% who were breast – fed and 44.8% who were bottle-fed had positive stool samples for rotavirus ($p < 0.01$)⁽²⁹⁾, and second study in Thailand⁽³⁰⁾.

CONCLUSION:

1. Rotavirus vaccine has reduced the development of acute gastroenteritis in young children.
2. Rotavirus vaccine has reduced the number of children hospitalized due to gastroenteritis in Central Teaching Hospital of Pediatric in Baghdad.

REFERENCES:

1. Umesh D Parashar, Margrate M Cortese. Prevention of rotavirus gastroenteritis among infants and children: recommendation of the advisory committee on immunization practices (ACIP). MMWR Recommendation and Reports 2009;58:1-13.
2. Daniel C Paye, Mary Wikswo, Umesh D Parashar. Centers for Disease Control and Prevention. Manual for surveillance of vaccine preventable diseases 2015; 13:24-27.
3. Guandalini S, Dhawan A, Branski D. Textbook of pediatric gastroenterology, hepatology and nutrition. 1st ed. University of Chicago. 2016;13:159-71.
4. Haber P, Patel M, Pan M, Michael H, Oidda M, Xin Yue, Manish Patel, et al. Intussusception after rotavirus vaccines reported to U.S. VAERS, 2006-2012. Pediatrics, 2013;131:1042-49.
5. Robert M Kliegman, Richard E Behrman, Hal B Jenson, Bonita F Stanton. Nelson text book of pediatrics 18 th edition. Saunders Elsevier. 2015; 262:1400-2.
6. Demmler GJ, Kaplan SL, Bernstein DI. Feigin and Cherry textbook of Pediatric Infectious Diseases. 5th ed. Philadelphia: Saunders. 2004; 2119-33.
7. Salih NE. Rota virus Association diarrhea among children less than 5 years in Mosul city. Tikrit Journal of pure science. 2009, 14:76-80.
8. Hasan A Sh, Al-Duliamin AA, Al-Azawi M SH. The Prevalence of Rotavirus Infection in Baquba – Diyala Province. Iraqi Journal of Community Medicine. 2011;24:200-4.
9. Kargar M, Jafarpour T, Najafi A. Burden and Typing of Rotavirus Group A in Children with Acute Gastroenteritis in Shiraz, Southern Iran. Iran Red Crescent Med J. 2013;15:175.
10. Khuri-Bulosa N, Al Khatiba M. Importance of rotavirus as a cause of gastroenteritis in Jordan: A hospital based study. 2006; 38:639-44.
11. Djuretic T, Wall P, Felming D, Gay N, Ryan M. Proportion of diarrheal episodes attributed to rotavirus in children under 5 years of age in England and Wales. Arch Pediatr Infect Dis. 2012; 1:23-26.
12. Abas NI, Al-Hadithi TS, Al-Attar A, Omer AR, Al-Obaidi S. Incidence of rotavirus gastroenteritis among infants and young children in Baghdad. J Comm Med Iraq 1988;1:39-45.

ROTAVIRUS VACCINATION AMONG CHILDREN UNDER TWO YEARS

13. Ahmed HM, Brian J, Coulter S, Nakagomi O, Hart CA, Zaki JM et al. Molecular Characterization of Rotavirus Gastroenteritis Strains, Iraqi Kurdistan. *Emerging Infectious Disease* 2006; 12: 824–26.
14. Hasson AJ. Prevalence of Rotavirus infection among children with acute gastroenteritis in Thi-Qar Governorate. *Thi-Qar Medical Journal (TQMJ)* 2009;3:88-100.
15. Kelkar SD, Purohit SG, Simha KV. Prevalence of rotavirus diarrhea among hospitalized children in Pune, India *J Med Res.* 1999;109:131-35.
16. Fun B, Bnau N, Poer J, Caryn B, Leanne U. Rotavirus associated diarrhea in Bangladesh. *J Clin Micro.* 1991; 29;1359-63.
17. Denny PH, Begue RE, Nila J, Leslie Z, Nancy M. A case control study to determine risk factors for hospitalization for rotavirus in U. S. children. *Pediatr Infect Dis J.* 2006; 25:1123-31.
18. Alattwani SH, Alsaad RK. Effectiveness of Rota vaccine in prevention of rotavirus gastroenteritis. *Asian Journal of Multidisciplinary Studies* 2015; 3:1-4.
19. Khalil M, Azhar E, Kao M, AL-Kaiedi N, Alhani H, Al Olayan I et al. Gastroenteritis attributable to rotavirus in hospitalized Saudi Arabian children in the period 2007–2008. *Clin Epidemiol.* 2015;7:129–37.
20. Javanbakht M, Moradi-Lakeh M, Yaghoubi M, Yasamman M, Sayed M, Nader S, Ali S, et al. Cost-effectiveness analysis of the introduction of rotavirus vaccine in Iran. 2016;12: 794–800.
21. Salem K, Bdour S, Zeller M, Van Ranst M, Matthijnsens J. Genotypes of rotavirus strains circulating in Amman, Jordan in 2006/07 and their significance for the potential effectiveness of rotavirus vaccination. *Arch Virol* 2011;156:1543-50.
22. Braeckman T, Van Herck K, Meyer N, Pircon JY, Soriano-Gabarro M, et al. Effectiveness of rotavirus vaccination in prevention of hospital admissions for rotavirus gastroenteritis among young children in Belgium: case-control study. *BMJ* 2012; 345: 4752-63.
23. Boom JA, Tate JE, Sahni LC, Rench MA, Hull JJ, Gentsch JR, Baker CJ. Effectiveness of pentavalent rotavirus vaccine in a large urban population in United State. *Pediatrics* 2010;125:199-207.
24. Zeller M, Rahman M, Heylen E, De Vos S, Arijis I, Novo L, Van RM, et al. Rotavirus incidence and genotype distribution before and after national rotavirus vaccine introduction in Belgium. *Vaccine* 2012;28:7507-13.
25. Paulke-Korinek M, Rendi-Wagner P, Kundi M, Pamela MD, Michael MD, Kronik Renate. Universal mass vaccination against rotavirus gastroenteritis: impact on hospitalization rate in Austrian children. *Pediatr Infect Dis J* 2010; 29:319-23.
26. Buttery JP, Lambert SB, Grimwood K, Nissen MD, Field EJ, et al. Reduction in rotavirus associated acute gastroenteritis following introduction of rotavirus vaccine into Australia's national childhood vaccine schedule. *Pediatr Infect Dis J* 2011; 30:25-29.
27. Rimoldi SG, Stefani F, Pagani C, Cheol W, Dong Sup, Jihyun C. Epidemiological and clinical characteristics of pediatric gastroenteritis associated with new viral agents. *Arch Virol* 2011; 156:1583-89.
28. Quintanar-Solares M, Yen C, Richardson V, Jon Gentsch, Duncan Steele, Baoming J, et al. Impact of rotavirus vaccination on diarrhea related hospitalizations among children <5 years of age in Mexico. *Pediatr Infect Dis J* 2010; 30:11-15.
29. Zarnani AH, Modarres SH, Jadali F, Sabah S, Moazzeni M, Vazirian F. Role of rotavirus in children with CUTE diarrhea in Iran. *J Clin Virol* 2003; 30:1-6.
30. Rerksupphaphol S, Rerksupphaphol L. Prevalence and clinical manifestation of rotavirus diarrhea in children of rural area of Thailand: International Journal of Collaborative Research on Internal Medicine and Public Health 2011; 3:669-75.