

ESCHERICHIA COLI DIARRHEA

A Small Hospital Outbreak Among Infants Caused by Serotype O55:B5*

Muvaffak Akman, M.D., M.P.H.**

Introduction

It is known that certain types of *E. coli* which contain a special kind of antigen, called B, may play a principal role in the etiology of epidemic diarrheas among infants and small children. Although noted previously by some other authors, this relationship could not fully be understood until the work of Kauffmann et al., in 1943, made possible the serological classification of the group of *Escherichia*. In 1945, Bray reported an outbreak caused by an *E. coli* strain first named *Escherichia coli neapolitanum*, which proved later to be enteropathogenic *E. coli* serotype O111:B4.¹ Since then, many reports have been published dealing with this etiological relationship, with some epidemics caused by these organisms, and with new serotypes found to be related to cases or outbreaks of infantile diarrhea.²⁻¹¹

In recent years in Turkey, Aksoykan,¹² and also Demirağ and Yalçinkaya¹³ have isolated the most common serotypes, namely O55:B5, O111:B4, O26:B6 and O86:B7 from gastroenteritis cases in children. But to date, as far as we could determine, there have been no publications about epidemics which proved to be etiologically related to any of the enteropathogenic types of *E. coli*.

In a previous review article we have summarized present knowledge of the enteropathogenic types and their role in infantile gastroenteritis.¹⁴ During a period of three years (September 1957 through September 1960) in our laboratory a total of 52 strains of enteropathogenic *E. coli* were isolated from children. Of these, 36 were O55:B5, 7 were O111:B4, 6 were O127:B8, and 3 were O26:B6. But, with the exception of a few cases, there was not enough evidence to establish a direct correlation between the clinical cases and the strains isolated. The clinical symptoms, contagiousness, season, incubation period and age

* Presented before the Fourth National Pediatric Congress, Ankara, Sept. 28-31, 1960, and also before the Ninth National Microbiology Congress, İstanbul, Sept. 21-24, 1960.

** Microbiologist, Ankara University Faculty of Medicine, Research Institute of Child Health, Hacettepe Children's Hospital.

of the patients did not coincide with the characteristics specified for *E. coli* diarrheas. It is known that a single finding, such as the isolation of an enteropathogenic type of *E. coli* from the stool of a person with diarrhea, is not sufficient to implicate the strain isolated as the etiologic agent of the sickness. As discussed later in the text, some other factors must also be encountered in order to establish a relationship.

At our hospital, 11 infants with diarrhea repeatedly revealed *E. coli* type O55:B5 in their stools. This finding, and the results of the other clinical and bacteriological investigations, assure us that the strain isolated from these infants was the cause of the diarrhea. This outbreak is the subject of the present paper.

Material and Methods

Rectal swabs were streaked over the surfaces of Endo plates. After eighteen to twenty-four hours' incubation at 37 C., *E. coli* colonies were tested first with polyvalent and then with individual *E. coli* (OB) agglutinating sera, on slides. We used O55:B5, O111:B4, O26:B6 and O127:B8 antisera, which were all obtained from Lederle. Only strongly positive complete agglutinations which were easily visible with the naked eye and appeared within a few minutes were considered to be positive. All results were subjected to the confirmation of the National Salmonella and Shigella Center (Dr. Namık Aksoyca, Refik Saydam Central Institute of Hygiene, Ankara Turkey) by slide and tube tests.

Results

The results with which we are concerned here, are summarized in figure 1.

As will be seen, the serotype O55:B5 was isolated first on June 23, 1960, from a 13 day old baby (N. S.) with diarrhea, in the premature ward. This was followed by seven successive isolations from infants with diarrhea in the same ward, and three from another ward called the Şaban Şifai. All of the strains isolated during this outbreak belonged to the serotype O55:B5.

During the same period, repeated stool cultures from the other infants, diarrheal or healthy, as well as from 12 of the personnel working in these two wards, were also carried out, but none were found to be positive for the serotype O55:B5.

Infant stools were typical for this kind of diarrhea: watery and explosive in character, and containing no blood or pus at any time. New cases, as is seen, occurred always within the incubation period, i.e. six to twelve days, as reported for this kind of diarrhea.

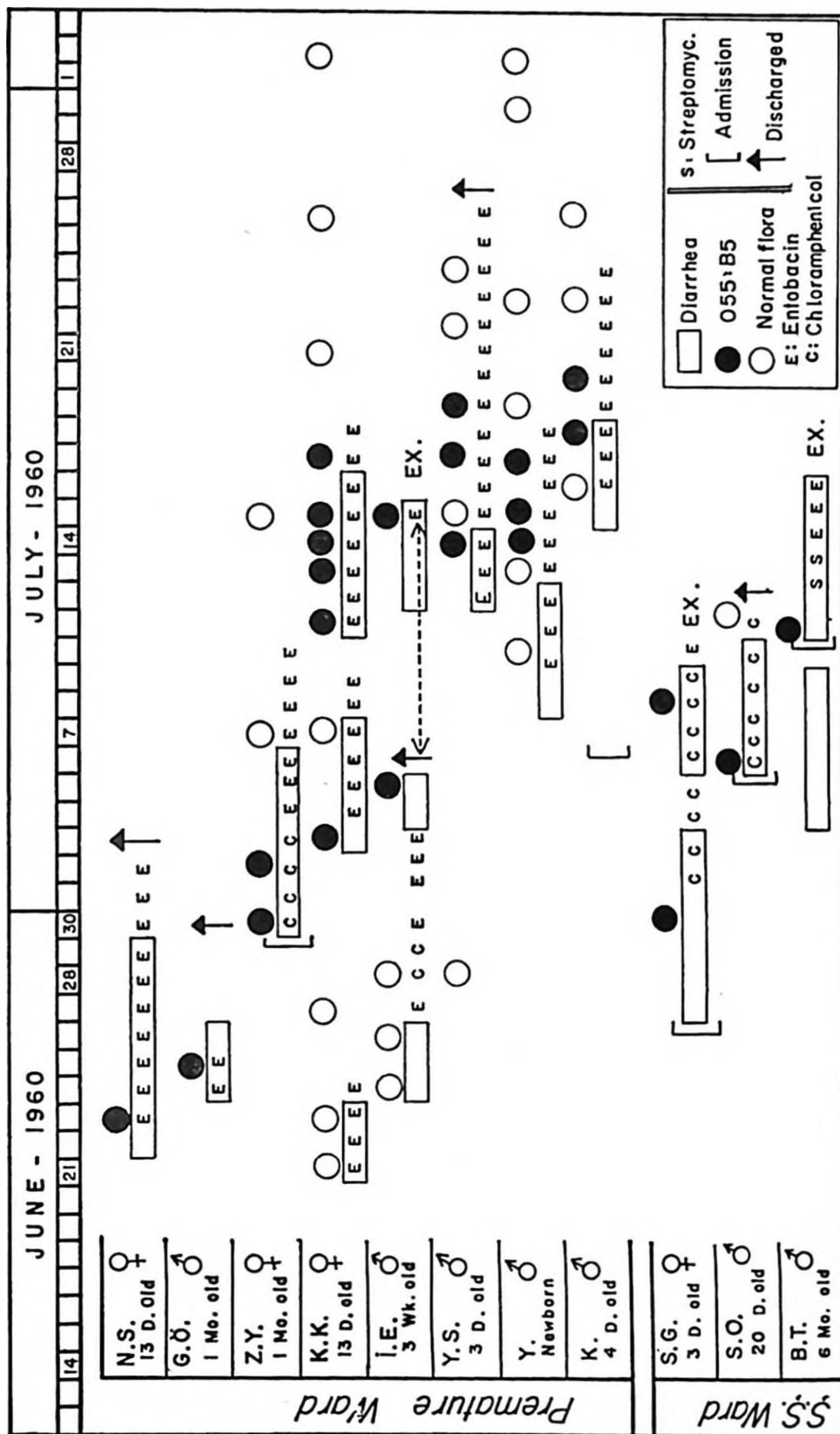


Fig. 1. Table summarizing the essential information gained from an epidemic of O55: B5 Escherichia coli diarrhea.

In spite of repeated cultures on special culture media, no other organisms capable of causing diarrhea, such as *Salmonella*, *Shigella*, *Staphylococcus*, etc., were isolated. It is assumed that the strain responsible was introduced to the hospital by a patient with prodromal signs, or by a healthy baby or adult with no signs of diarrhea, or perhaps by food.

By way of treatment, in addition to general precautions, 6 infants were given only Entobacin (i. e. neomycin plus bacitracin) as antibiotic, 20-40 mg. per kilogram of body weight per day; 1 was given only chloramphenicol, 20-40 mg. per kilogram of body weight per day; 3 were treated with a combination of Entobacin and chloramphenicol; and 1 with Entobacin and streptomycin, 50 mg. per kilogram of body weight per day.

Most of the children responded satisfactorily to treatment. As will be seen in figure 1, diarrhea disappeared within five to fifteen days after starting the antibiotics and simultaneously *E. coli* O55:B5 also disappeared from the stools. Again, as is seen, there was a fairly close correlation between the clinical and what we may call the bacteriological recovery.

Out of these 11 patients, 3 (I. E., S. G., and B. T.) were, unfortunately, lost. In one case, (I. E.; see fig. 1), the following information might be of value in explaining the death: this infant was discharged on July 6, 1960 at the insistence of his family while he still was carrying the serotype O55:B5 in his intestine although he seemed to be slightly recovered. A prescription for antibiotics was given to the family, but whether they used the drugs or not we do not know. After eight days they returned with a story of diarrhea continuing for four days; the child was admitted to the hospital, *E. coli* O55:B5 was cultured again from the stool on the day of admission and he died the next day.

The last isolation of the same type of *E. coli* occurred on July 20, 1960. After that date, all cultures from children in these two wards both healthy and diseased, were negative for the type responsible.

Discussion

According to our present knowledge, enteropathogenic *E. coli* strains can be found in the intestinal tracts of both healthy and diarrheal infants and adults, but less often among healthy subjects than among infants with specific diarrhea. For example, Dunni-Horkawicz¹⁵ found that enteropathogenic types could be isolated from 50 per cent of 345 diseased children and, by contrast in a control group of 1000

healthy children there were only 35 (or 3.5 per cent) enteropathogenic *E. coli* isolations. Gamble and his co-workers¹¹ estimate that 1-2 per cent of healthy adults discharge enteropathogenic *E. coli* types. Cooper¹⁶ reported that the rate for healthy carriers for these types of *E. coli* is 8.3 per cent and Keil¹⁷ reported that he was successful in isolating enteropathogenic *E. coli* strains from 1.8 per cent of the personnel working in the hospital.

Thus it is clear that even if one of the enteropathogenic *E. coli* types is isolated from a single case, or from an epidemic of diarrhea, before one may be certain about its role in the etiology some other circumstances must generally be present. These can be summarized as follows :

1. The patient must be of an age susceptible to this type of diarrhea. Those most susceptible are premature babies, the newborn, and infants under six months of age. The incidence rate is extremely high during the first three months of life. Diarrhea caused by enteropathogenic types is very rare after one year.¹

2. The stools must be watery and explosive in character, generally without blood or pus.

3. The diarrhea must be a highly contagious type; it is difficult and almost impossible to control the spreading of *E. coli* in a ward.

4. The serotype responsible must be found in almost pure culture where it is the etiological agent. Other bacteria either do not grow or are very few in number.

5. The incubation period must vary between six and twelve days.

6. There must be a close correlation between the clinical recovery and the disappearance of the responsible *E. coli* type from the stool.

7. The majority of children with diarrhea in an epidemic must carry the type responsible.

8. From the stools of the patient it must not be possible to isolate any other organism, such as *Salmonella*, *Shigella*, or *Staphylococcus*, which could explain the present diarrheal disease.

9. Diarrhea epidemics caused by enteropathogenic types are usually seen during the summer months.

10. Antibiotics which are known to be more or less effective against *E. coli* strains, such as neomycin and chloramphenicol, should be capable of curing the disease. Diet and non-specific treatment alone are usually not beneficial.

According to the information summarized in figure 1, it is evident that, in the small outbreak detected in our hospital, the

findings coincide well with the requirements set forth above. Basing our conclusion upon this information, we believe that the enteropathogenic *E. coli* type O55:B5, which we isolated repeatedly from the stools of the infants, was the cause of the outbreak.

In addition to the findings discussed above, it has also been reported that a significant rise in the hemagglutination titer, performed with the patient's serum and erythrocytes modified with the soluble antigen of the *E. coli* strain isolated, has a value in confirming the diagnosis. According to these authors, since there is no rise in the titer of ordinary bacterial agglutinins, the hemagglutination test gives pretty good information in this type of diarrhea.¹ Despite the value of the hemagglutination test as a diagnostic aid, it is still subject to discussion. There is as yet no standard procedure and interpretation of the hemagglutination test in *E. coli* diarrheas. In the present outbreak this test was not performed.

One could also determine the phage types of enteropathogenic *E. coli* types isolated. This procedure might throw some light on the subject by showing a connection between strains of the same type isolated from an outbreak. If most or all of the strains proved to belong to the same type, the probability of their implication in the outbreak would be strengthened. Starting from this point of view, all strains of *E. coli* type O55:B5 which were isolated during this outbreak were sent to Dr. P. Nicolle, Chief of the Phage Typing Center, Paris Pasteur Institute, France, for the determination of phage types. Since no reply has yet been received, unfortunately we can not give the results of this investigation.

Although *E. coli* diarrheas are highly contagious, our outbreak was limited to eleven cases. Good care, proper isolation facilities, carefully performed disinfection and, finally, the antibiotics made it possible to control the outbreak. However, three deaths out of eleven cases can be taken as indicating the serious prognosis of enteropathogenic *E. coli* diarrheas.

We believe that careful future surveys would reveal many other outbreaks and epidemics of enteropathogenic *E. coli* diarrhea all over Turkey.

Summary

The first report of an outbreak of enteropathogenic *E. coli* diarrhea in Turkey is presented. Methods used in the isolation and treatment are discussed.

REFERENCES

1. Herweg, J. C., Middlekamp, J. N., and Thornton, H. K.: *Escherichia coli* diarrhea; The relationship of certain serotypes of *Escherichia coli* to sporadic and epidemic cases of infantile diarrhea. *J. Pediat.* 49:629, 1956.
2. Ogawa, T., and Ogawa, J.: *Escherichia* in infantile diarrhea. *Lancet*, 268: 671, 1955.
3. Quaiser, K.: Pathogene Colistämme und Säuglingsdyspepsie. *Öst. Z. Kinderheilk.*, 11:274, 1955.
4. Grönroos, J. A.: The occurrence of *Escherichia coli* O groups 1-25, O group 78 and the serotypes 26:B6, 44:7L, 55:B5, 86:B7, 111:B4 and 126:B16 in feces of healthy infants and infants suffering from infantile diarrhea. *Acta Path. Microbiol. Scand.*, 38:132, 1955.
5. Stock, A. H., and Shuman, M. E.: Epidemiologic studies on enteropathogenic *Escherichia coli* diarrhea. *Ann. N. Y. Acad. Sci.*, 66:108, 1956.
6. Curtin, M., and Clifford, S. H.: Incidence of pathogenic serologic types of *Escherichia coli* among neonatal patients in New England area. *New England J. Med.*, 255:1090, 1956.
7. Orskov, F.: Biochemical and serological examinations of a number of *E. coli* strains isolated from cases of infantile diarrhea. *Acta Path. Microbiol. Scand.*, 111:133, 1955.
8. Kauffmann, F.: *Enterobacteriaceae*, 2nd ed. Einar Munksgaard, Denmark, 1954.
9. Ewing, W. H., Tatum, H. W., Davis, B. R., and Reavis, R. W.: Studies on the serology of the *Escherichia coli* group. Communicable Diseases Center Publication, U. S. A., 1956.
10. Huet, M. Resultat des coprocultures chez 400 enfants diarrhéiques pendant la période estivale en Tunisie. *Arch. Inst. Pasteur Tunis.*, 34:233, 1957.
11. Gamble, D. R., and Rowson, K. E. K.: The incidence of pathogenic *E. coli* in routine fecal specimens. *Lancet*, 273:619, 1957.
12. Aksoycan, N.: Ankarada çocuk gastro-antritlerinden tecrit edilen *E. coli* cinsleri hakkında. *Ankara Üniv. Tıp Fak. Mec.*, 9:137, 1956.
13. Demirağ, B., ve Yalçınkaya, P.: Süt çocuğu ishalleri. *Pediatrici*, 2:39, 1959.
14. Akman, M.: Yeni doğmuş çocukların ve süt çocuklarının epidemik ishallerinde enteropatojenik *Escherichia coli*'nin rolü. *Çocuk Sağlığı ve Hast. Dergisi*, 3:33, 1960.
15. Dunni-Horkawicz, H., Kraj-Francowa, I., and Sadowska, M.: Role d'*Escherichia coli* des types alpha et beta dans l'enterocolite du nourisson. *Pediatrici*, 12:765, 1957.
16. Cooper, M. L., Keller, H., and Walters, E. W.: Comparative frequency of detection of enteropathogenic *E. coli*, *Salmonella* and *Shigella* in rectal swab cultures from infants and young children. *Pediatrics*, 19:411, 1957.
17. Keil, R., and Herrmann, K.: Dyspepsiecoli-befunde bei routine Untersuchungen. *Klin. Wschr.*, 36:9, 1958.