Antibiotic Sensitivity of *Escherichia Coli* Isolated From Diarrheic Calves

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Summary

The antibiotic sensitivity of non-specific strains of *Eschericia coli* isolated from calves with diarrhea was tested. Out of a total of 25 drugs tested, only the nitrofurans, gentamicin, chloramphenicol, tribrissen® and polymixin B were effective *in vitro* against *E. coli* more than 63% of the time.

Introduction

Eschericia coli is a common inhabitant of the gastrointestinal tract and is often implicated as a major cause of neonatal enteritis[5,6,15,16]. In diarrheic outbreaks fecal cultures and antibiotic resistance of gram negative organisms are often used as a means of implementing therapy[1].

This study was undertaken to test the *in vitro* efficacy of various antibiotics in inhibiting bacterial growth of *E. coli* isolated from diarrheic neonatal calves. It must be appreciated that the presence of *E. coli* does not necessarily indicate enteropathogenicity as only 13 to 28% of *E. coli* strains isolated are proven pathogens[1,7,9]. Additionally, bacterial numbers may increase due to virally-induced diarrheas[2,9,14]. However, high death losses are seen in animals known to be infected with enteropathogenic *E. coli*[15,16].

Materials and Methods

Antibiotic sensitivity was determined using the Kirby-Bauer technique[3]. Mueller-Hinton Agar plates provided the nutrient media. All samples tested were derived from field cases of diarrhea in calves as presented to the Colorado State University Diagnostic Laboratory during 1976 and 1977.

Results

Responses of non-specific isolated strains of *E. coli* to various antibiotics are indicated in Tables 1 through 5. Drugs are grouped under broad family headings and listed individually. The individual drugs are indicated by trade and/or generic designation.

Discussion

Fifteen of the 25 drugs tested exhibited less than 20% effective inhibition of the *E. coli* strains tested. This finding of lack of antibiotic sensitivity in *E. coli* strains has been well-documented[1,15,16]. According to this *in vitro* study, only the nitrofurans as a group plus gentamicin showed effective inhibition of 95% or more while tribrissen® and polymyxin B inhibited 64-73% of the cultures tested. Thus only these drugs could be considered "effective" in treatment of neonatal calf diarrhea caused by enteropathogenic *E. coli. In vitro* results, however, cannot always be translated to the animal. Modifying influences in the gastrointestinal tract may alter the clinical effectiveness of oral drugs. There is also the potential that *E. coli* cultured from feces may not be the cause of disease.

During diarrhea, bacteria in the small intestine may produce a number of detrimental actions. These include: (1) alterations in dietary nutrients causing increased luminal osmolality, (2) small bowel bacterial overgrowth associated with malabsorption of fats, xylose, vitamin B^{12}, and possibly protein[4], (3) alterations of intestinal functions such as deconjugating bile salts which will decrease absorption[4,8], (4) elaboration of toxins which increase secretory rate[1,9,11], and (5) penetration of intestinal epithelium causing bacteremia and endotoxemia[10,13]. The treatment of diarrhea in the calf using orally administered antibacterial drugs which are ineffective against enteropathogenic *E. coli* may kill other bacteria colonizing the intestinal tract and thus allow the unfettered growth of the pathogen with resultant detrimental effects as listed above. Careful selection of a drug to which an isolated *E. coli* pathogen is sensitive is thus imperative in calf diarrhea therapy.

It must be remembered that neither chloramphenicol nor tribrissen® are approved for use in food-producing animals. Further, the nitrofurans are now being carefully scrutinized by the FDA as potential carcinogens. If data suggests that they may be carcinogenic they will be removed from the market in the near future. Gentamicin is approved for use in food-producing animals, but it is extremely expensive. Its use in large animals may not be economically feasible. Polymixin B, although potentially toxic to the kidneys when administered parenterally, may be given orally as it is not absorbed through the gut wall. According to this study and in conjunction with current and pending drug regulations, this polypeptide agent may be the only one indicated as

effective and generally available for treatment of non-specific *E. coli* infection in calves.

Results of other studies in calves suffering from acute undifferentiated diarrhea and treated with several of the antibiotics indicated as effective in this study have shown no statistical differences in survival rates among calves treated and those not treated[12]. No data was collected, however, concerning diarrheal etiology.

It seems, then, that several factors must be weighed in considering oral administration of antibacterial drugs in treatment of the neonatal calf with diarrhea. These include: identification of the pathogen or etiologic factors whenever possible, drug sensitivity testing of that agent, and evaluation of the success of therapy if it is instituted.

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Table 1. Antibiotic Sensitivity* of *Eschericia coli* from Diarrheic Calves to Penicillins and Tetracyclines

	1976	1977	Total Percent Susceptible
Ampicillin	19/42**	11/31	41
Tetracycline	8/42	2/30	14
Terramycin	5/42	2/32	9
Aureomycin	2/42	0/9	4
Oxacillin	ND***	0/20	0
Penicillin	0/40	0/29	0

* *Kirby-Bauer technique*[3]

** *Numerator* = Number susceptible to the drug
Denominator = Number of cultures tested

*** ND = Not done

Table 2. Antibiotic Sensitivity* of *Eschericia coli* from Diarrheic Calves to Sulfonamides

	1976	1977	Total Percent Susceptible
Tribrissen® (Trimethoprim + Sulfadiazine)	ND***	22/31	71
Gantrisin (Sulfasoxazole)	10/44**	2/29	16
Triple Sulfa	8/42	2/31	14
Sulfadiazine	9/43	1/30	14
Sulfathiazole	7/27	1/30	14
Madribon (Sulfadiamethoxine)	4/39	2/30	9

* *Kirby-Bauer technique*[3]

** *Numerator* = Number susceptible to the drug
Denominator = Number of cultures tested

*** ND = Not done

Table 3. Antibiotic Sensitivity* of *Eschericia Coli* from Diarrheic Calves to Aminoglycosides

	1976	1977	Total Percent Susceptible
Gentamicin	44/45**	28/31	95
Neomycin	18/43	7/30	34
Kanamycin	ND***	3/22	14
Streptomycin	9/41	1/31	14

* *Kirby-Bauer technique*[3]

** *Numerator* = Number susceptible to the drug
Denominator = Number of cultures tested

*** ND = Not done

Table 4. Antibiotic Sensitivity* of *Eschericia coli* from Diarrheic Calves to Nitrofurans

	1976	1977	Total Percent Susceptible
Furacin	42/43**	30/31	97
Furadantin/ Macrodantin	43/44	28/30	96
Furoxone	42/43	29/31	96

* *Kirby-Bauer technique*[3]

** *Numerator* = Number susceptible to the drug
Denominator = Number of cultures tested

Table 5. Antibiotic Sensitivity* of *Eschericia coli* from Diarrheic Calves to Miscellaneous Antibiotics

	1976	1977	Total Percent Susceptible
Chloramphenicol	31/43**	23/31	73
Polypeptides			
Polymixin B	21/44	26/29	64
Bacitracin	0/40	0/31	0
Cephalosporins			
Cephalothin	18/43	17/31	47
Macrolides			
Erythromycin	5/43	8/30	18
Lincomycin	0/43	0/29	0

* *Kirby-Bauer technique*[3]

** *Numerator* = Number susceptible to the drug
Denominator = Number of cultures tested

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