Role of Dietary Restriction in the Prevention of Infection in Leukaemia

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SUMMARY

Sterilisation of the gastro-intestinal tract is believed to be important in the prevention of infection in leukaemic patients. This has been achieved by the use of isolator units, non-absorbable oral antibiotics and restriction of diet to cooked foods only.

The importance of dietary restriction is examined and a comparison made of cultures taken from various foods and ward utensils.

As pathogenic micro-organisms were isolated only from uncooked vegetables grown in soil, it is considered that, provided these items are avoided, general dietary restriction is of little importance in the prevention of infection in the treatment of leukaemia.

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The most important cause of death in patients treated for acute leukaemia is infection. Levine *et al.*[1] report 79% deaths attributable to infection.

It is generally accepted that the bowel is the major source of infection in leukaemia patients.[2] The two cornerstones in the prevention of bacterial contamination of the bowel are isolator units, and sterilisation of the gastro-intestinal tract (GIT). The different uses of the former have been described in detail elsewhere.[3-5] Limitation of the bacteria in the GIT depends on the use of oral non-absorbable antibiotics together with dietary restriction, aiming at eliminating the ingestion of bacteria from food.

It was thought that food with a high degree of bacterial contamination is more likely to be a source of severe infection than food containing a small number of bacteria.[6] Patients are therefore maintained on a cooked food diet. Modern chemotherapy causes noticeable deterioration of the mental state of these individuals who are already depressed by the seriousness of their illness. The strict dietary restrictions as practised at present aggravate the position even further. The fact that a patient is not permitted fresh fruit, a cold drink, or any kind of sweet or chocolate very often initiates an acute state of depression.

We decided, therefore, to analyse the bacterial content of uncooked foods such as fruit, vegetables which are usually consumed raw, confectionery and cold drinks, and to compare the results with the bacterial content of cooked foods as supplied in a general medical ward in our hospital, in order to assess the validity of strict dietary restriction.

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METHODS

A spot test sample of a variety of cooked food was taken from the food trolley usually used for distribution of meals to the patients. For this purpose a sterile cotton wool swab was dipped into the various food compartments in the trolley.

Samples of fresh fruit were washed and then peeled, using ward utensils for this purpose. A random sample was placed in a sterile nutrient broth. Uncooked food other than fruit was neither washed nor handled with special precautions before a sample was placed in sterile nutrient broth. Uncooked vegetables, particularly those grown in soil, like radishes, cucumbers and lettuces, were also investigated. These were washed without special precautions in tap water in the hospital kitchen, before being placed on top of the food trolley. A spot test in the form of a random sample was taken and homogenised, and 0,1 ml was added to Trypticose soy broth.

Eating utensils used by patients were chosen at random, after they had been cleaned and washed by the ward staff and placed in the ward kitchen cupboard and drawers, ready for use by the patients when required. Sterile cotton wool swabs, which were rubbed over the surfaces of these articles, were employed.

On receipt of the swabs and broth tubes in the laboratory, subcultures were inoculated on to 2 blood agar plates and 1 McConkey plate. One blood agar plate was incubated anaerobically at 37°C, while the other and the McConkey plate were incubated aerobically at 37°C. All colonies developing after 24, 48 and 72 hours' incubation were identified.

Blood agar plates were exposed to the air around the patient's bed to assess the bacterial contamination of the air. The developing colonies were counted and fully identified.

RESULTS

Results of cultures from ward utensils (Table I) and some of the foods tested (Table II), whether cooked or uncooked, demonstrated a range of bacteria, most of which were commensals and saprophytes. No fungi of any description were isolated. The bacterial content of the air around the patient's bed as tested resulted in a moderate growth of *Staphylococcus epidermidis.*

TABLE I. ANALYSIS OF UTENSILS TESTED

Utensils	Micro-organisms
Cup	*Staphylococcus epidermidis*
Knife	*Serratia marcescens*
Plate	*Serratia marcescens*
Fork	*Staphylococcus epidermidis*
	Bacillus subtilis
Spoon	*Staphylococcus epidermidis*
	Bacillus subtilis

TABLE II. ANALYSIS OF FOODS TESTED

Food	Micro-organisms
Cooked	
Meat	*Bacillus subtilis*
Chicken	*Bacillus subtilis*
Potato	**No growth**
Carrots	*Staphylococcus epidermidis*
Custard	*Bacillus subtilis*
Jelly	**No growth**
Dairy products	
Milk	*Escherichia coli*
Butter	*Escherichia coli*
Uncooked	
Grape	
Pear	
Orange	*Bacillus subtilis*
Banana	*Staphylococcus epidermidis*
Apple	
Confectionery	
Cold-drink (freshly opened)	**No growth**
Cold-drink (open for 1 hour)	**No growth**
Yoghurt	**No growth**

A different picture was obtained, however, when soil-grown vegetables were cultured in the uncooked state. A profuse growth of highly pathogenic bacteria (Table III) was obtained, which included *Pseudomonas aeruginosa, Escherichia coli,* the *Enterobacter* species and *Staphylococcus pyogenes.* It is noteworthy that potentially pathogenic bacteria like *Staphylococcus epidermidis* and *Serratia marcescens* were isolated not only from some of the foods tested, but from the ward utensils used by patients, as well as from the air.

TABLE III. MICRO-ORGANISMS CULTURED FROM SOIL-GROWN VEGETABLES

Lettuce	*Pseudomonas aeruginosa*
	Enterobacter cloacae
	Escherichia coli
Radish	*Enterobacter cloacae*
	Pseudomonas aeruginosa
	Hafnia **sp.**
Cucumber	*Proteus* **sp.**
	Staphylococcus pyogenes

DISCUSSION

Therapy of acute leukaemia has undergone radical changes during the past decade. Most noteworthy of these is the introduction of combination chemotherapy in preference to single drug administration. When a patient is rendered pancytopenic, death often ensues before the agents have had time to exert their desired effect. The cause of death in these patients is primarily either infection or haemorrhage. The conditions predisposing to infection are a combination of factors, namely a decreased number of granulocytes, impaired cellular immunity and environmental contamination with opportunistic pathogens.

The bowel, harbouring bacteria such as *E. coli, Klebsiella, Enterobacter, Proteus* and *Pseudomonas,* may be a major source of infection in patients rendered neutropenic by chemotherapeutic agents. Mice are able to tolerate higher doses of antitumour agents[7] and radiation[8] once their bowels have been rendered coliform-free by oral non-absorbable antibiotics. It has therefore been suggested that a diet restricted to cooked food, with oral non-absorbable antibiotics, would decrease the oral intake of pathogenic micro-organisms.[6] Bowel sterilisation, however, has been disappointing in decreasing the incidence of infection in human leukaemia, in the absence of isolator units.[9]

The common micro-organisms causing infections in leukaemic patients are listed in Table IV.[1] By far the most common micro-organisms causing infection in these patients belong to the *Pseudomonas* species. These bacteria are highly prevalent in the environment, especially in moisture and soil, and may colonise the large intestine. Common sources for these bacteria include vegetables, as shown in this study, particularly if these are consumed uncooked. A recent report has incriminated flowers as a source of infection, and has stressed the advisability of not keeping vases and flowers near the patient's bed.[10]

TABLE IV. ORGANISMS CAUSING INFECTION IN LEUKAEMIC PATIENTS

Bacteria	*Pseudomonas aeruginosa*
	Klebsiella
	Serratia marcescens
	Staphylococcus aureus
	Staphylococcus epidermidis
Fungal	*Candidiasis*
	Aspergillosis
	Mucomycosis
	Cryptococcus
	Histoplasmosis
Viral	*Varicella-Zoster*
	Herpes simplex

Two important facts emerge from our investigation. Firstly, air in the ward and ward utensils are as contaminated by micro-organisms as are the majority of foods tested, whether cooked or uncooked, with the exception of vegetables grown in soil. The micro-organisms cultured are, in the main, species belonging to the Gram-positive varieties like *Bacillus subtilis* and *Staphylococcus*

epidermidis. These are well-known saprophytes and commensals, seldom if ever responsible for infections in leukaemic patients.

Secondly, as has been suggested by other investigators, vegetables grown in soil are apparently contaminated with Gram-negative micro-organisms, originating in the gastro-intestinal tract of man and animal, and known to be pathogenic under certain circumstances.[11]

CONCLUSION

The spectrum of bacteria isolated in our study shows that, with the important exception of those isolated from soil-grown vegetables, the micro-organisms isolated are not the same as those incriminated in the pathogenesis of septicaemia in leukaemic patients.

We concede that isolator units may be advantageous in preventing severe infections,[8] but in the absence of such units general dietary restriction on its own is of little value in reducing the incidence of infection. However, it is essential that uncooked vegetables grown in soil should be avoided in the diet of leukaemic patients.

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