refraction occurs and this depends on the relative velocities of the two media. The greater the difference in velocities the greater the angle through which the wave bends.

Absorption:
As the waves travel through any medium some are absorbed, resulting in a reduction in intensity and heat being produced.

The amount of absorption that is likely to take place is a function of the tissue characterised by this absorption coefficient. Tissues with high collagen content absorb more strongly. Most soft tissues have similar absorption coefficients (0.5 dB cm\(^{-1}\) MHz\(^{-1}\)) but muscle has a higher coefficient (1.5 dB cm\(^{-1}\) MHz\(^{-1}\)) and lung and skull bone have high absorption coefficients (20 dB cm\(^{-1}\) MHz\(^{-1}\)).

The beam is reduced to half its intensity in a certain distance i.e. the half value distance and this depends on the nature of the medium and the frequency of the waves. In general, attenuation increases with rising frequency, thus, a 3 MHz beam will travel less than a 1 MHz beam. For example the half value distance for 1 MHz in air is 2.5mm, in water 1.5 m and in skin 40 mm.

Ultra-sound is rapidly attenuated in air, and only 0.1% of the incident energy is transmitted across the air/tissue interface. Thus ultra-sound is always applied via a coupling medium. This coupling agent must not absorb much ultrasonic and must provide a good acoustic match with the tissues so that reflection at the skin surface is minimised.

Scatter:
Most tissues contain numerous acoustic inhomogeneities. The incident ultrasonic beam thus suffers multiple reflections while being transmitted through the tissue. Some of these reflections carry energy out of the main beam. Thus the effect of scatter would be to diffuse the heating effect of the main beam.

Intensity:
This is the energy crossing a unit area in a unit time (watts per centimetre squared W/cm\(^2\)).

Ultrasonic Field:
This can be thought of as being composed of two distinct regions. The near field and the far field. Close to the transducer, in the near field or Fresnel zone, the beam is mainly confined to a cylinder having the diameter as the transducer. The intensity within this zone varies considerably both along and across the beam and it is not until the far field or Fraunhofer zone that the intensity becomes regular with marked changes in intensity. The near field extends a distance 1/4 from the transducer face, where r is the transducer radius and is the ultrasonic wavelength in that medium. In the far field the ultrasonic beam diameter increases, consequently the use of a smaller transducer or ultrasonic with a longer wavelength will lead to a less directional beam and inaccurate treatment. In therapeutic use the transducer is typically 15mm in radius, therefore the extent of the near field in water with a 1 MHz transducer will be 150mm.

As has been discussed above the intensity in the near field can be very peaked, and although the spatial average of intensity may be high, the peak intensity can be considerably higher. This is one reason why the treatment head must be kept moving during treatment (Hall, 1970). (See graph at the end of the article).

Mode:
The ultrasonic beam can be continuous or pulsed. For example (1) the Fresnel regions in the Mediterranean as a major area, because of the presence of certain creatures in the Mediterranean. These are therefore selected for treatment. Towards this end a WHO Mediterranean Meeting was convened in Rome in April 1980; besides Malta, eight other Mediterranean countries participated in the meeting, and these were Algeria, Greece, Italy, Morocco, Spain, Tunisia, Turkey and Jugoslavia. The rendezvous was the Istituto Superiore di Sanita in Rome. Malta was represented by Dr. P. Cuscheri and Dr. A. Mifsud.

The main purpose of the meeting was to submit specific recommendations relating to the following:
1. Epidemiological surveillance and exchange of information between National Health authorities and WHO.
2. The diagnosis and laboratory identification of Campylobacter and Yersinia.
3. Oral rehydration therapy.
4. Support for water and sanitation and related health education programmes.

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The thirty-first World Health Assembly of 1978 urged its member states through its resolution (WH 31.44) to identify diarrhoeal diseases in the Mediterranean as a major area for necessary action. Towards this end a WHO Mediterranean Meeting was convened in Rome in April 1980; besides Malta, eight other Mediterranean countries participated in the meeting, and these were Algeria, Greece, Italy, Morocco, Spain, Tunisia, Turkey and Jugoslavia. The rendezvous was the Istituto Superiore di Sanita in Rome. Malta was represented by Dr. P. Cuscheri and Dr. A. Mifsud.

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The countries bordering on the Mediterranean basin are an attraction to tourists from the North mainly because of beach availability and warm climate; the latter, however, encourages microbial multiplication in food and beverages, and this in its turn favours food poisoning. On the other hand, quite a few of the countries have coasts which are Mediterranean regions on their holiday round, and spread of infection from country to country is thereby facilitated. Although appearing to be a remote country, on the same sea, the various holiday resorts vary in quite a few aspects, particularly in socio-economic development, cultural and educational patterns, food habits, standards of hygiene, sanitation and health services. In the larger countries, differences also exist between one region and another.

Although notification of disease is a pre-requisite to proper and adequate surveillance, it is difficult to ascertain to what extent these measures are adopted by member countries, in view of the detrimental effect this might have on the tourist industry, which always plays a major role in the national economic balance. Thus, a comparison of the bacteriological point of view, Dr. Cuscheri reviewed the enteric pathogens which are common in Malta. Cholera has not appeared since the early 1900’s and this has been supported and confirmed by routine and periodic bacteriological investigations on local sewage and by stool cultures on visitors from overseas who suffer from diarrhoeal disease.

Barbary dysesthesia has been on the decline since 1970; Shigella sonnei predominates with an occasional Shigella flexneri. Four cases of typhoid fever were reported in 1979, and the consumption of raw food, particularly shellfish, has been incriminated more often than not over the past few years; paratyphoid fever is rare.

The majority of Salmonella food poisonings were caused by S. typhimurium (55%), whilst S. anatum accounted for another 31%. Meat and chicken make-up dishes have been the more frequent culprits.

Enteroagopathic E. coli account for a minimal amount of diarrhoeal diseases in children. The development of more reliable techniques for detection of Campylobacter and Yersinia is still under way, and it is envisaged that facilities would soon be available for the diagnosis of these two Agents.

With regards to the situation in Malta from the paediatric point of view, quoting data gathered from hospital records and from the Department of Statistics it was apparent that the vast majority of enteric infections are treated by the general practitioner at home by a variety of proprietary anti-diarrhoeal agents and glucose-electrolyte mixture administered orally, to replace milk feeds; traditionally, to one litre of sterilised water a tablespoonful of sugar and a spoonful of salt is added. With the onset of dehydration, the child is then referred to hospital for fluid replacement, usually in the form of quarter saline in 5% dextrose, and this is more commonly administered through a peripheral vein. Very rarely a cut-down is required when shock has supervened, and blood volume replacement would then also require blood or plasma.

Two pre-graduate medical students surveyed all the admissions of children under the age of ten years medical during 1979 into the paediatric wards of Karin Grech Hospital; a summary of the statistics prepared from this study follows. With a population of 57,000 children under the age of ten years in the Maltese Islands during 1979, an average of 1.1% required admission into hospital for the control of a diarrhoeal disease. Of these, 50% were in the first year of life, and 25% in the first six months. The mean hospital stay was seven days, and intravenous fluid replacement was the rule for the first few days. Antibiotic therapy
was guided by stool cultures and sensitivities, but was more usually limited to the more severe enteric infections. The majority of the cases were admitted between June and August (46%), with a nadir between March and May (14%). The mortality rate was among the lowest recorded at the Meeting, and estimated at 1.5 per thousand admission into hospital for diarrhoeal disease.

It is interesting to compare notes with the other participating Mediterranean countries. In Morocco, diarrhoeal disease has a peak incidence in August and mainly affects children under the age of two years; Salmonella is responsible for 72% of stool cultures, and lack of adequate sanitary hygiene plays a major role in pathogenesis. Bacillary dysentery is a problem in Yugoslavia where it is reported to affect 211/100,000 population. Rotavirus is the main offending organism in Spain, accounting for 50-60% of all diarrhoea of infancy. In Tunisia, enteric infections are a major cause of referral to hospital; infants between the ages of one and eleven months are mainly affected, and the mortality rate is extremely high, amounting to 24% of all admissions for diarrhoea. (17% of all deaths in infancy are caused by upper respiratory tract infections). Salmonella is responsible for 60% of cases, Shigella 25%, E. coli 10% and Vibrio cholera 3%. The majority of the cases were admitted with pig and chicken handlers. 47% of diarrhoeal infections with these agents were due to secretory diarrhoea; 3. There is a constant increase of Salmonellosis in Europe.

Transmission of Ultra-sound This depends on the case and speed with which the media can be deflected and is indicated by the acoustic impedance of the material. Sound waves travel more easily through a medium with a high rather than a low characteristic impedance, for example sound waves travel more easily through steel than through water. Ultra-sound energy is propagated in soft tissue as longitudinal mechanical waves in a directional beam whose shape depends upon the diameter of the transducer relative to the wavelength of the ultrasound wave. Longitudinal waves will be converted to a transverse wave when something solid, like bone, lies in the path of the sound beam. For therapeutic purposes it is important to note that a transverse wave will not travel through fluids. When a sound wave encounters a different medium from that in which it is traveling, it is reflected, refracted and/or absorbed or scattered.

**Reflection:** When an ultrasonic wave is incident on an interface between two different types of tissues some reflection will occur. The amount of reflection will depend on the characteristic acoustic impedance (Z) of the tissues involved. (Z is the product of the density of the medium and the sound velocity in that medium). The reflected beam interacts with the incident beam and this may lead to the formation of standing waves. Standing waves may affect the flow of blood.

**Refraction:** Waves may continue to travel through the new medium; if it strikes the new medium at a right angle it will continue to travel in a straight line, otherwise...
may damage the intestinal mucosa and cause malabsorption. Tincture of opium, paregoric and atropine are dangerous in children and dysenteric patients because of delayed intestinal transit time. Steroids are expensive, useless and may cause adverse side-effects. Charcoal, kaolin, pectin and bismuth are of no value. Methylene blue is useless and may be dangerous, whilst Lomotil is particularly dangerous in infants (Euro Reports and Studies 44). Nothing much can be left in the therapeutic armamentarium at this stage.

Replacement of fluid and electrolyte losses suffices in most instances, and this can usually be effected through the oral route. Intravenous and extracellular fluid losses of water and electrolytes cause an isotonic hypovolaemia; aldosterone secretion increases and the GFR decreases in order to conserve sodium. There is diminished tissue perfusion and shock causing lactic acidosis. The associated bicarbonate loss in the stool causes a hyperchloremic metabolic acidosis, and the large potassium concentration in the diarrhoeal stool depletes the potassium stores. The serum K⁺ may be normal in acidosis at the expense of low intracellular K⁺; correction of the acidosis will cause K⁺ to enter the cells and cause a low serum K⁺.

Water losses and requirements vary with age and these variations must be taken into account when planning replacement and maintenance fluid programmes. Tables 1 and 2 illustrate the differences encountered between infancy and adulthood. It is to be remembered that neonates cannot concentrate their urine as well as older infants and children. After due allowance is made for losses and maintenance, the thirst mechanism can safely be relied upon to maintain homeostasis.

Enteral infection is the greatest killer among children, and it is estimated that 30% of deaths under 5 years are due to diarrhoeal diseases. There is a marked decrease in incidence in breast fed infants, and the trend noticeably increases on the institution of mixed feeding. Weight loss is a problem, and if the disease is protracted there is also an arrest of height gain.

One official from the Italian Health Ministry remarked that a child with diarrhoea stood a better chance of survival without the treatment prescribed by the general practitioner. The same cannot be said for the local situation, and it will so remain so long as antibiotics and dangerous anti-diarrhoeals are not abused. Promotion of breast feeding is the best prophylactic, and simple water and electrolyte replacement by oral rehydrating solution (ORS) is calculated to save 70% of admissions for replacement by the intravenous route. Fasting causes disappearance of enzymes from the gastro-intestinal tract, with ORS, acidosis and hypokalaemia are gradually corrected and hunger is re-acquired permitting weight gain and a speedier approach to convalescence. Lactose is particularly very lable, and is one of the last enzymes to be restored to function after enteric infection - hence the importance of avoiding milk and milk substitutes until well into convalescence.

References

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<th>Reference</th>
<th>Title</th>
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Acknowledgement: I would like to thank Mr. A. Zomait MD FA Claire for his help in the preparation of this manuscript.
Diagnosis

Few problems are usually encountered in the diagnosis of external fistulae as the skin breach
spontaneously closes. In such conditions, the site is clearly visible. In the occasional problematic case, oral
markers such as carmine dye will definitely prove helpful. As in every clinical condition a thorough
history and examination are essential paying particular attention to any predisposing abdominal
pathology and/or previous operation. Internal fistulae often prove somewhat more difficult to diagnose as
they tend to present with non-specific symptoms such as abdominal pain, diarrhoea etc, but the one
universal complaint is weight loss. Investigations are essential adjuncts in diagnosis. Radiological studies in
particular whether plain or using contrast are very useful to show:

- origin of fistula
- complexity and size of fistula track
- condition of G.I.T. from where fistula commences
- presence of distal obstruction.

Fistulography using contrast media may also be utilised. Ultrasound, CT scan, bacteriological
examination or biopsy procedures may also prove useful. Laparoscopy or laparotomy may ultimately
be resorted to in order to obtain the full diagnosis.

Management

The currently adopted rationale of therapy is summarised in Table 2. Resuscitation should not be
carried out using blood unless the fistula is connected to a blood vessel (e.g. aorto-duodenal) or the patient is
severely anaemic. Neither is the use of plasma popular. The best way seems to be the administration
of 500-1000 ml of Dextrose 70 followed by Normal Saline.

Once resuscitation is complete full attention must be given to Fluid and Electrolyte management.
A strict fluid balance chart as well as daily
diuresis estimations should be kept. An initial daily regimen for the adult patient would be:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (immediate)</td>
<td>- Operate to eliminate sepsis if necessary.</td>
</tr>
<tr>
<td>2 (till day 2)</td>
<td>- Control fistula and protect skin</td>
</tr>
<tr>
<td>3 (day 3+)</td>
<td>- Start enteral feeding</td>
</tr>
<tr>
<td>4 (day 5+)</td>
<td>- Continue nutritional treatment until fistula closes or patient fit for surgery</td>
</tr>
</tbody>
</table>

Daily calorie needs border around 40-50 kcal/kg/day. A large part is supplied as fats up to a maximum of 2-3g/kg/day of 10% Intralipid. Any additional calories can be supplied by means of 10% Dextrose. Daily blood glucose estimations must be undertaken and any signs of hypoglycaemia treated with short-acting Insulin. Initially the total volume should be low (about 2L) and gradually increased. Vitamin supplements should also be provided with additional doses of folate as this is particularly low in this condition. Trace minerals must also be added particularly Zinc (120mg) of fluid lost and Chromate (20µg).

Once parenteral nutrition is safely established, the patient’s gastrointestinal function is reviewed with
a view to using it for the provision of nutrients. This is normally in the form of low residue elemental diets of
which several types are commercially available. However this may result in a number of problems
including gastric stasis, diarrhoea, and hyperosmolar dehydration all of which must be looked for and
corrected immediately. Should these prove troublesome the patient can be maintained solely on
parenteral nutrition.

As soon as the nutritional needs have been satisfied, it is essential to ensure correct protection of the skin (in external fistulae), as well as collection of all fluid discharge. This is carried out efficiently by the use of an adhesive STOMABAG. Besides protection

Table 2:

| Phase 1 (immediate) | - Restore blood volume |
| Phase 2 (till day 2) | - Correct fluid and electrolyte imbalances |
| Phase 3 (day 3+) | - Control fistula and protect skin |
| Phase 4 (day 5+) | - Drain abscesses with/out antibiotic therapy |

Subsequent administrations must then be tailored to the particular person in the light of the
electrolyte levels.

Nutrition of the patient with intestinal fistula is initially parenteral. A central venous catheter usually
inserted subclavian vein is set up. The basic idea is to provide calories, nitrogen compounds as well as
vitamins and trace elements. Various proprietary products are available. Nitrogen is provided by means of
amino-acid preparations. Initially 0.5g nitrogen/kg body wt./day may be started and subsequently long
term management involves the calculation of the daily urea excretion in the urine.

Gms. nitrogen/day - 24hr urea excretion x 100 = 28
80 60

Table 3:

Assessment of Dehydration and Fluid Deficit in Infants

<table>
<thead>
<tr>
<th>Degree of dehydration (% loss of body wt.)</th>
<th>Mild (4-5%)</th>
<th>Moderate (6-9%)</th>
<th>Severe (&gt;9%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Thirsty, alert, restless.</td>
<td>Thirsty, restless or drowsy</td>
<td>Drowsy, limp, cold, Sweaty and often cyanotic extremities</td>
</tr>
<tr>
<td>Skin elasticity</td>
<td>Normal</td>
<td>Decreased, mild to moderate</td>
<td>Marked decrease</td>
</tr>
<tr>
<td>Eyes</td>
<td>Normal</td>
<td>Sunken (detectable)</td>
<td>Grossly sunken</td>
</tr>
<tr>
<td>Tears</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Fontanelle</td>
<td>Normal</td>
<td>Depressed</td>
<td>Very dry</td>
</tr>
<tr>
<td>Mucousae</td>
<td>Moist</td>
<td>Dry</td>
<td>Very dry</td>
</tr>
<tr>
<td>Radial pulse</td>
<td>Normal</td>
<td>Rapid/weak</td>
<td>Rapid feeble or absent</td>
</tr>
<tr>
<td>Rectal temp</td>
<td>Nil</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>Urine flow</td>
<td>Normal</td>
<td>Scanty</td>
<td>Nil for &gt;8 hours</td>
</tr>
<tr>
<td>Respiration</td>
<td>Normal</td>
<td>Deep/rapid</td>
<td>Deep/rapid</td>
</tr>
<tr>
<td>Heart</td>
<td>normal</td>
<td>Tachycardia</td>
<td>Tachycardia/feeble</td>
</tr>
<tr>
<td>Estimated deficit</td>
<td>40-50 ml/kg</td>
<td>60-90ml/kg</td>
<td>100-120 ml/kg</td>
</tr>
</tbody>
</table>