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A variety of infections and infestations of the gastrointestinal tract pose a diagnostic challenge for pathologists and gastroenterologists in the tropics. The interpretation of intestinal mucosal biopsies is complicated by the effect of the tropical, usually contaminated, environment and widespread malnutrition, which may influence gut mucosal morphology in even apparently healthy individuals. This chapter will concentrate on mucosal biopsy alterations that are widely prevalent in the healthy population in the small and large intestine and also on the specific bacterial and parasitic infections that can be diagnosed by gastrointestinal mucosal biopsy. It must be emphasised that the gastrointestinal pathologist working in the tropics should be fully familiar with the biopsy diagnosis of neoplastic conditions. This is particularly important since regional differences in the prevalence of malignancies are now becoming apparent (Ramakrishna et al. 1988).

A particularly important concern is the response of the gastrointestinal mucosa as an immunological organ (Parrot 1976). In many tropical countries the lumen of the gastrointestinal tract, including the small intestine, is colonised by a variety of microbes, both anaerobes and aerobes (Bhat et al. 1972). An autochthonous flora, predominantly anaerobic, has also been shown to be present in the small intestine (Bhat et al. 1980). In addition a variety of bacterial enteric pathogens also colonise the gut lumen without apparent ill effect, as they can be recovered from faecal samples from healthy individuals (Mathan and Rajan 1986). The prevalence of enterovirus and adenovirus infections and enteric parasites is also high in this population (Patel et al. 1983). The response of the gut-associated immune system to this antigenic challenge in the tropics has not been fully understood. Increases in small intestinal mucosal epithelial lymphocytes and total immunoglobulin fractions in the serum have been documented in such populations (Ross and Mathan 1981). The response of the gut mucosa to this challenge may be of considerable importance. For example, it has been documented that in the population of southern India the response to oral polio vaccine in children is not as appropriate as it is in the temperate climate, and these children may require up to nine doses before being adequately immunised (John 1976). These findings suggest that a detailed study of the responses of the gut as an immunological organ in the tropics is likely to contribute significantly to public health measures to control enteric infection.
2 Stomach

2.1 Gastritis

A higher prevalence of gastritis and gastric atrophy has been documented in tropical populations (VAISH et al. 1967; DESAI et al. 1977). The reasons for this are not known, but the recent documentation of Campylobacter pylori in gastric biopsies (NAIR et al. 1986) (see page 1) and the high prevalence of other enteric Campylobacter species in tropical populations (RAJAN and MATHAN 1981), suggests that this organism, which has been implicated in the pathogenesis of gastritis and duodenal ulcer (MARSHALL and WARREN 1984), may be important in tropical countries. The presence of C. pylori is easily demonstrated in endoscopic biopsies (Fig. 1), especially if silver stains are used. Prospective epidemiological studies backed up by culture and histological examination of endoscopic gastric biopsies are needed to define the role of this organism in tropical regions.

2.2 Tuberculosis

Tuberculosis of the stomach is a rare entity (PALMER 1950). At gastroscopy the lesion may present as an ulcer in the antrum or lesser curvature of the stomach. These ulcers have characteristic undermined edges, serpiginous outline and pale nodules in the adjacent mucosa, and must be differentiated from malignant lesions. Occasionally tuberculosis of the stomach may present as an infiltrative and hypertrophic lesion which may closely mimic neoplastic growths. Biopsies, particularly if they are taken repeatedly at the same spot to obtain submucosal tissue or at the edge of

Fig. 1. Surface cells of gastric mucosa with many spiral organisms adherent to the luminal border and in the surface mucus. × 900
the ulcers, can be diagnostic with characteristic granulomatous inflammation, cascation and giant cells. Acid-fast organisms may be demonstrable in appropriately stained tissues.

3 Small Intestine

3.1 Tropical Enteropathy

Long, slender finger- or tongue-shaped villus structures are seldom present in jejunal mucosal biopsies from residents in many tropical countries (Baker et al. 1962; Lindenbaum et al. 1966; Baker and Mathan 1972; Baker 1973). Broader leaf-shaped villi and ridges, which on occasion may be in a convoluted pattern, are found in the majority, changes which are termed tropical enteropathy. These architectural abnormalities are reflected on examination of histological sections by an increase in the thickness of the crypts and increased cellularity of the lamina propria and the epithelial layer (Fig. 2). The foetal intestine in tropical southern India is not different from that in temperate climates, but changes begin shortly after birth (Chacko et al. 1968). It has been shown in experimental animals that exposure to the luminal contents is necessary for the changes to occur and that when the mucosa is isolated from gut continuity, in Thiry-Vella fistulae, the changes revert to normal or their progression is pro-

![Fig. 2. Jejunal mucosa from a healthy control subject with changes of tropical enteropathy: increase in crypt thickness, shortening of villi and increased cellularity of lamina propria. × 100](image-url)
vented (CHACKO et al. 1969). The morphological abnormalities are associated with functional alterations (BAKER and MATHAN 1972) and there is preliminary evidence to suggest that impaired intestinal absorption as a result of tropical enteropathy may lead to the loss of 5%–8% of ingested food energy in populations which can scarcely afford such a loss (CHACKO et al. 1984). Tropical enteropathy appears to be an adaptive response to a variety of environmental factors. There is increased turnover of enterocytes probably as a response to enterocyte loss from the villus compartment secondary to minimal damage (MATHAN et al. 1982). In addition to its possible contribution to malnutrition in tropical areas, tropical enteropathy makes it essential that the pathologist defines the range of "normality" in each region, especially when the subtle changes in the small intestinal epithelium associated with some of the malabsorption syndromes have to be interpreted.

3.2 Malnutrition

The elegant studies of DEO and RAMALINGASWAMY (1965) showed that it was possible to produce a gastrointestinal lesion in severely protein-depleted monkeys. However, whether a lesion results from protein or other malnutrition in humans is not yet established. Studies on children with protein energy malnutrition have shown that in marasmic children the morphology of the gut is apparently normal while in children who were clinically diagnosed as suffering from kwashiorkor there was a gut lesion with shortening of villi, hypertrophy of the crypt and marked infiltration of the lamina propria (BRUNSER et al. 1968). Whether this lesion was secondary to malnutrition or consequent upon infections of the gastrointestinal tract due to altered immunity in malnourished children is not yet clear.

3.3 Bacterial Infections

3.3.1 Cholera

Infection by Vibrio cholerae is the classical prototype of toxigenic diarrhoeas. Jejunal mucosal biopsies in patients studied in temperate countries showed an intact epithelium with degenerative lesions and subjacent mononuclear infiltrate (FRESH et al. 1964; SHEEHY et al. 1966; PASTORE et al. 1976). However, in several studies from tropical countries the abnormalities noted (GANGLAROSA et al. 1960; SPRINZ et al. 1962; ASAKURA et al. 1974) are probably not specific to cholera but reflect the wide prevalence of tropical enteropathy.
3.3.2 Tuberculosis

Intestinal tuberculosis primarily affects the distal small intestine and is unlikely to be a common diagnosis in peroral mucosal biopsies of the small intestine. Duodenal tuberculosis is a rare entity and the characteristic features of tuberculosis may be occasionally seen with submucosal caseating tubercles (CHUTTANI 1970).

3.4 Parasitic Diseases

3.4.1 Hook Worm Infestation

Hook worm infestation due to *Ankylostoma duodenale* or *Necator americanus* is common in many warm moist parts of the world. The infective stage of the parasite develops in facially contaminated soil, penetrates exposed skin surfaces and ultimately resides in the upper small intestine. The primary pathology resulting from hook worm infestation is iron deficiency anaemia due to blood loss caused by the parasite (MAHAMOOD 1966). There is some controversy as to whether there is an upper small intestinal mucosal lesion due to hook worm infestation. Experimental studies showed that in dogs a severe inflammatory lesion may develop in

![Image](image_url)

*Fig. 3. Jejunal mucosa with many Strongyloides larvae, eggs and part of an adult female worm in the crypt region. × 100*
the jejunum with marked surface ulceration and infiltration of the epithelium with neutrophils (Kalkofen 1974). In contrast, several reports of jejunal biopsies from different tropical countries (Banwell et al. 1967; Chiljean et al. 1967; Tandon et al. 1969) have suggested that there are no major histopathological changes in the upper small intestinal mucosa associated with hook worm infestation in the human.

3.4.2 Strongyloidiasis

Asymptomatic infestation of the small intestine by the nematode Strongyloides stercoralis is prevalent in many tropical countries. The parasite is found in about 8% of jejunal luminal fluid samples at Vellore. It lives mainly in the lumina of crypts and can give rise to chronic diarrhoea and malabsorption. In immuno-compromised individuals a fatal hyperinfection may occur (Marcial-Rojas 1975; Igra-Siegman 1981). The adult female worm penetrates the epithelium and many segmented eggs or larvae may be found in the crypt epithelium and lamina propria in duodenal and jejunal biopsies (Fig. 3). Eosinophils and mononuclear cells constitute the cellular reaction around such worms.

3.4.3 Capillariasis

Infestation of the intestine by the nematode, Capillaria philippinensis has been reported primarily from the Philippines and Thailand. This infestation can also occur in an epidemic form with high mortality. The patients develop diarrhoea and malabsorption with protein losing enteropathy. Jejunal biopsies (Whalen et al. 1969) show worms penetrating the mucosa but there is no diffuse lesion significantly different from the background tropical enteropathy. In patients who had died, autopsy showed atrophy of the jejunal mucosa with flattened villi, denudation of the epithelium and infiltration of the lamina propria with plasma cells, lymphocytes, macrophages, eosinophils and neutrophil polymorphs (Cross and Bhadelia 1983). Although these lesions were maximal in the jejunum it is difficult to know whether they represent primary damage caused by the worm or changes consequent upon events of the terminal illness.

3.4.4 Cryptosporidium

A monoxenous coccidian parasite of warm-blooded vertebrates, Cryptosporidium, is a zoonotic agent found in temperate zones primarily as an opportunistic infection in immuno-incompetent individuals, particularly patients suffering from acquired immune deficiency syndrome (AIDS) (Angus 1983; Tzipori 1983; Current 1984). This parasite has a wide prevalence, both in asymptomatic individuals and in people with acute diarr-
rhoea, in several tropical countries (MATHAN et al. 1985). Cryptosporidium has been found throughout the gastrointestinal tract from the pharynx to the rectum. In severely infested patients at post-mortem the jejunum was most affected. In jejunal biopsies, the histological changes
are non-specific but the characteristic spherical basophilic structures attached to the microvillus border of the enterocytes are easily recognised (Fig. 4). Electron microscopic examination of jejunal biopsies shows all stages of schizogony and gametogony. The organism is enclosed in a modified epithelial surface membrane and is thus located intracellularly but extracytoplasmically. Adaptive and degenerative changes may be present in the enterocytes (LEFKOWITCH et al. 1984). There may be mild to moderate shortening of villi with increased crypt height and mononuclear infiltration of the lamina propria (CASEMORE et al. 1985).

3.4.5 Microsporidia

The Microsporidia are primitive coccidian parasites, primarily of invertebrates and fish, but are now being recognised in mammals. There are a large number of species of this parasite and one species, *Enterocytozoon bieneusi*, has now been reported from AIDS patients (CANNING and HOLLISTER 1987). It is an obligatory intracellular parasite and structures morphologically resembling these may occasionally be found within enterocytes in jejunal biopsies in the tropics (Fig. 5).

3.4.6 Kala Azar

Visceral leishmaniasis is widely prevalent in South America, the Mediterranean basin and large parts of Asia and Africa. Endemic for many years in India, kala azar has now assumed epidemic proportions in the Gangetic plain. The illness usually presents with prolonged pyrexia and marked splenomegaly and is primarily an infection of the reticulo-endothelial system. Leishman-Donovan (LD) bodies (the leishmanial form of the parasite) may be present in lamina propria histiocytes in gastric and jejunal
biopsies (Fig. 6). The LD bodies are 2–4.5 μm by 1–2.5 μm, oval or round structures with oval nuclei applied to the more convex ventral border. In severe cases diarrhoea may be present and enlarged villi with focal ulceration are scattered in the mucosa (EDDINGTON and GILLES 1969).
3.4.7 Coccidiosis

Gastrointestinal infection with two species of coccidia, *Isospora belli* and *I. hominis*, primarily parasites of the small intestinal epithelium in humans, is a cause of chronic diarrhoea and malabsorption in tropical and temperate climates. The parasite is present within or just below the villous epithelium and can be better identified with overstained Giemsa or haematoxylin-eosin-alcian blue stains (Brandborg et al. 1979). All stages of schizogony and gametogony (Fig. 7), including trophozoites, schizonts, merozoites, micro- and macrogametes and unsporulated oocysts, may be recognised in biopsies (Titler et al. 1974) and oocysts in duodenal luminal fluid.

3.4.8 Sarcosporidiosis

Human intestinal sarcosporidiosis has been reported from Thailand, particularly among people who eat undercooked beef (Bunyaratvei et al. 1982). The patients usually present with fever and acute abdominal pain as well as leucocytosis. Severe cases are characterised by necrotising enteritis of the jejunum and ileum with heavy eosinophilic infiltration. The sexual forms of Sarcosporidia are found in the epithelium (Fig. 8).
3.4.9 Giardiasis

The protozoan parasite *Giardia lamblia* is worldwide in its distribution and it has been suggested that it may be the most frequent intestinal pathogen associated with diarrhoea in industrialised countries (Smith and Wolfe 1980). In many tropical areas it is widely prevalent (30%–40%) in asymptomatic individuals (Gilman et al. 1985). Giemsa-stained smears of the intestinal luminal fluid or the mucus associated with jejunal biopsies are particularly useful for detecting these parasites, which are pear shaped with the broad rounded anterior end containing two nuclei. Phosphotungs-tic acid or Giemsa stains demonstrate the organisms in the interstitial space in sections better than do haematoxylin and eosin stains. The jejunal mu-
cosa of asymptomatic individuals harbouring the parasite may not show any significant abnormality although damage to microvilli, felt to be caused by the suction disc of the parasite, has been documented (Tandon et al. 1974) (Fig. 9). The most consistent abnormality in symptomatic indi-
viduals is an increase in epithelial lymphocytes (Wright and Tomkins 1977; Rosekrans et al. 1981). *G. lamblia* is frequently associated with im-
munoglobulin deficiency and nodular lymphoid hyperplasia in the upper small intestine. Jejunal biopsies from such individuals show marked abnor-
malities which are probably related to the underlying disease (Ross and Mathan 1987).

3.5 Tropical Sprue

Tropical sprue is a primary malabsorption syndrome which affects resi-
dents of and visitors to several tropical regions (Mathan 1988). While it has not yet been fully documented from sub-Saharan Africa it is widely pre-
valent in India and Southeast Asia as well as in many of the Caribbean
Fig. 9. a Jejunal mucosa with many giardial trophozoites in the intervillous space. × 150. Insert shows giardia with characteristic pear shape and two prominent nuclei in its anterior end. × 500.
b Electron micrograph of giardial trophozoites adherent to each other and anchored on the microvilli by their suction discs. × 7000.
islands. As early as 1914 it was suggested, by examination of autopsy material, that the primary lesion in tropical sprue involved the small intestinal mucosa. Subsequent to the availability of peroral intestinal biopsy instruments, the morphological alterations in the jejunal mucosa in tropical sprue have been described extensively (SCHENK et al. 1965; SWANSON and THOMASSEN 1965). However, even now tropical sprue is a diagnosis of exclusion in a patient with malabsorption syndrome, where the many conditions which give rise to secondary malabsorption have been ruled out (MATHAN 1988).

Sections of jejunal biopsies show varying degrees of increase in the thickness of the crypts and shortening and distortion of villi (Fig. 10). Partial villous atrophy has been the term used to describe these changes but since the morphogenesis of the lesion occurs by primary damage to the
crypt it is better to avoid this term, which implies a primary lesion in villi (MATHAN et al. 1986).

Details of enterocyte damage are more apparent when 1-μm sections of plastic-embedded tissue are examined by light microscopy or thin sections are studied in the electron microscope. Damaged enterocytes, with altered brush border, dilated rough endoplasmic reticulum, loss of mitochondrial cristae and marked increase in lysosomes, are scattered throughout the epithelium of the crypt-villus unit. Extrusion of damaged enterocytes, some with poor staining characteristics and others condensed and with pyknotic nuclei, takes place all along the crypt-villus unit and not only at the zone of extrusion at the villus tips (MATHAN et al. 1975). Epithelial lymphocytes are clustered around these damaged cells. Epithelial lymphocytes are increased both in the villus and in the crypt (ROSS and MATHAN 1981). The initial enterocyte lesion in patients with short duration was not associated with an increase in epithelial lymphocytes, which occurred 3–4 weeks later. The increase in epithelial lymphocytes appears to be secondary to the loss of barrier function consequent to enterocyte damage (MARSH et al. 1983). The basement membrane is thick and fat droplets are present in enterocytes, the basement membrane and superficial layers of the lamina propria, even after a 10-h fast, indicating a defect of fat transport. The cellular infiltrate in the lamina propria, lymphocytes and plasma cells is also increased.

It has been possible to examine jejunal biopsies from patients with very short duration of diarrhoea, affected in epidemics of tropical sprue in
southern India (Mathan and Baker 1971). The first lesion, detectable within 48 h of onset of diarrhoea, was damage to crypt enterocytes (Fig. 11). At that time surface enterocytes were apparently morphologically intact although the patient had malabsorption. In vitro culture of jejunal biopsies, pulse labelled with \(^{3}\)H-thymidine, with follow-up of migration of the label up the villus for up to 48 h, suggested that increased stem cell turnover and more rapid migration of enterocytes to and loss from the functional compartment, the villus, were characteristic of the established lesion of tropical sprue (Mathan et al. 1986). These data suggest that the initial lesion, caused by an as yet unidentified agent, occurs in crypt enterocytes. The damaged crypt enterocytes (stem cells) give rise to damaged progeny which migrate and are extruded rapidly from the functional layer in the villi, leading to shortening of the villi. The balance between the extent of the enterocyte stem cell damage, damaged progeny enterocyte loss from the functional compartment, and compensatory increase in proliferation of the stem cells explains the short villi and hypertrophy of the crypts. It is not yet possible, based on published reports from other parts of the world, to say whether the crypt lesion which has been described in tropical sprue in southern India occurs elsewhere.

3.6 Immunoproliferative Small Intestinal Disease

Originally known as the Mediterranean type of lymphoma, and later alpha heavy chain disease, because of the abnormal monoclonal gammapathy which many of these patients develop, this disease is now recognised as an abnormality of the gut-associated lymphoid tissue (Isaacson 1985) (see also page 143). In addition to the Mediterranean region and the Middle East, immunoproliferative small intestinal disease (IPSID) has been reported from several other tropical regions. Histologically three stages in the evolution of the lymphoma have been described. Infiltration of the lamina propria by plasma cells without invasion of the crypts occurs in stage A. In stage B the appearance of a band-like or nodular lymphoid infiltrate composed of a mixture of lymphocytes, centrocytes and centroblasts in the lower part of the lamina propria is the characteristic finding. Cells from this lymphoid infiltrate may invade and destroy the jejunal crypts, forming typical lympho-epithelial lesions (Isaacson and Spencer 1987). Plasma cells are still the predominant cell in the lamina propria, although they are few in the infiltrating nodules, which may resemble lymphoid follicles. A malignant lymphomatous infiltrate involving the submucosa is characteristic of stage C and plasma cells at this stage are much less evident. The histological picture can be quite pleomorphic in these lymphomas, with a predominance of follicle centre-like cells. Since IPSID affects the upper small intestine diffusely, per oral jejunal biopsies may be diagnostic (Fig. 12). The demonstration of alpha heavy chains, without light chains, in tissue sections by immunocytochemistry helps to confirm
the diagnosis in stage A. This is particularly useful as long-term antibiotic therapy can arrest or revert the disease at this stage.

4 Large Intestine

4.1 Tropical Colonoopathy

Conventional histological examination of rectal mucosal biopsies from residents of tropical countries does not show striking changes similar to those of tropical enteropathy in the jejunum. However, a detailed study of the ultrastructural morphology of rectal biopsies at Vellore showed an increase in lysosomes, electron dense bodies and vesicles in both crypt and surface colonocytes (Fig. 15). In comparison with biopsies from volunteers in temperate climates the surface colonocytes were shorter, with short, irregularly grouped microvilli and poor plication of lateral cell membranes indicating immaturity. There were also alterations in goblet cell mucus granules, a reticulohistiocytic response in the subluminal lamina propria and evidence of vascular damage. These changes in biopsies from “normal” subjects in the tropics suggested a response to non-specific damage (Mathan and Mathan 1985 a).

Another striking finding was the wide prevalence of spiral organisms attached to the apical border of luminal colonocytes (spirochaetosis). In contrast to temperate zones (see page 249), where spiral organisms are found in about 2%–3% of biopsies from controls, similar bacteria were present in 66% of asymptomatic individuals in southern India.
4.2 Acute Infectious Diarrhoea

Intestinal mucosal biopsies are not part of the regular work-up of acute infectious diarrhoea. The majority of patients can be diagnosed on clinical grounds associated with appropriate microbiological investigation. Two recent developments, the recognition of acute self-limited colitis and the increasing frequency with which idiopathic inflammatory bowel disease (IBD) is being diagnosed in tropical countries, make it necessary to define clearly the rectal mucosal histopathological features of a variety of acute diarrhoeal diseases.
4.2.1 Watery Diarrhoea

Infection by enterotoxigenic bacteria [V. cholera, heat labile (LT) and heat stable (ST) toxin-producing coliforms, entero-adhesive E. coli etc.] is the classical example of infectious diarrhoea with large watery stools. The primary site of action of the enterotoxins is in the small intestine and the large volume of fluid secreted overwhelms the absorptive capacity of the colon, giving rise to diarrhoea. The architecture of colonocytes is preserved in these conditions although evidence of increased water absorption with oedema of the lamina propria may be present. A lamina propria vascular lesion (see below) may also occur (MATHAN and MATHAN 1985 b).

4.2.2 The Dysenteries

It is particularly important to differentiate IBD from the dysenteries, the result of invasive damage of the colonic mucosa by bacteria and parasites.

4.2.2.1 Bacterial Dysenteries

Histological examination of rectal mucosal biopsies from 37 patients from whom a pure culture of Shigella was obtained (ANAND et al. 1986) showed a mixed round cell and polymorphonuclear, or a predominantly round cell,

![Fig. 14. Patient with acute colitis due to Shigella infection. There is marked mucus depletion and focal ulceration with a luminal inflammatory exudate. The lamina propria shows oedema, multiple focal haemorrhages and increased neutrophil polymorphs, plasma cells and lymphocytes. × 100](image-url)
Fig. 15. **a** Rectal mucosal biopsy from a patient with amoebic colitis. The superficial mucosa shows cell necrosis and is covered by an exudate with many neutrophils and trophozoites of *Entamoeba histolytica*. × 650. **b** Rectal mucosal biopsy from the edge of an undermined ulcer in amoebic colitis with edges covered by necrotic tissue and acute inflammatory exudate. A few scattered amoebae are present at the junction of necrotic tissue and mucosa. The adjacent mucosa shows marked mucus depletion. × 100
infiltrate extending into the muscularis mucosae and submucosa, oedema of the muscularis mucosa and submucosa, and mild disorganisation of the crypts. The mucosal abnormalities were maximal in patients from whom S. dysenteriae was isolated and milder in patients with non-bloody diarrhoea (Fig. 14). At colonoscopy the lesions mainly affect the distal colon (SPEELMAN et al. 1984). Ultrastructural studies (MATHAN and MATHAN 1986) showed colonic crypt damage and ulceration due to invasion by shigelloc, as well as a lamina propria vascular lesion (see below). Longer duration of symptoms was associated with features suggesting relative vascular insufficiency, lymphocyte activation, eosinophil and mast cell degranulation and the possibility of antibody-mediated colonic crypt damage.

Similar features are present in dysentery associated with Salmonella and Campylobacter infection, but to a lesser extent.

4.2.2.2 Parasitic Dysenteries

Amoebic dysentery is the prototype of the parasitic dysenteries and can produce lesions in the entire colon and terminal ileum, commonly in the caecum, rectosigmoid and hepatic flexure (HARRIES 1982). Several types of gross pathological changes have been described but the histological diagnosis is facilitated by the detection of Entamoeba histolytica (EH), which can be differentiated from other amoebae and macrophages by the characteristic erythrophagocytosis and the round nucleus with a central karyosome (GILMAN and PRATHAP 1977). In tissue sections PAS and iron stains help to distinguish EH from tissue macrophages. In early lesions, which appear as minute superficial ulcers at sigmoidoscopy, many EH may be present and small superficial ulcers with subjacent acute inflammation can be seen in tissue sections. The more established lesions are associated with flask-shaped ulcers with undermined edges and submucosal extension (Fig. 15). EH are fewer in such lesions (PRATHAP and GILMAN 1970). Amoebic granulomas may mimic carcinoma of the colon but can be distinguished in colonoscopic biopsies (KAUSHIK et al. 1973).

Other parasitic disorders that may give rise to dysenteries are associated with schistosomiasis and infection by Balantidium coli. Concentric fibrosis around degenerated schistosome eggs in the submucosa, with eosinophils, lymphocytes and macrophages, is diagnostic of S. mansoni and S. japonicum (Fig. 16) (GAMBESCA et al. 1976; NASH et al. 1982). B. coli dysentery is rare. Superficial ulcers covered by large saccular trophozoites, containing red blood cells and other ingested debris with large kidney-shaped nucleus and numerous cilia, is diagnostic (CASTRO et al. 1983).
4.2.3 Differentiation of Idiopathic Inflammatory Bowel Disease from Acute Self-limited Colitis

Acute self-limited colitis is a transient, presumably infectious, colonic inflammation presenting usually with the sudden onset of bloody diarrhoea and recovering in under 1 month. A proportion of patients with Salmonella and Shigella colitis in tropical countries have symptoms persistent for up to a month (MATHAN et al. 1984). In the last 10 years IBD has been diagnosed in over 150 patients in this centre and the frequency of detection of new patients is increasing.

Studies from temperate climates suggest that crypt atrophy, distorted crypt architecture, increased number of round cells and neutrophils in the lamina propria, a villus surface epithelium, basal lymphoid aggregations, granulomas and isolated giant cells are helpful in distinguishing IBD from infective self-limited colitis (DICKINSON et al. 1979; MANDAL et al. 1982; KUMAR et al. 1982; SURAWICZ and BELIC 1984). Plasmacytosis in the lamina propria extending to the mucosal base with distortion of the crypt architecture is also suggested as diagnostic of ulcerative colitis (NOSTRAND et al. 1987).

In evaluating biopsies from tropical countries these features are useful but the presence of a mixed infiltrate in the lamina propria even in S. dysenteriae infections (ANAND et al. 1986) and the altered immune response in such populations, with many plasma cells in the lamina propria, has to be kept in mind (CHOU DARI et al. 1985). The extent and severity of
the changes associated with acute infective colitis depend on the duration of illness. Some of the features that help in the differentiation are the minimal amount of architectural distortion and disproportionately increased oedema and haemorrhage in the lamina propria compared to the extent of the inflammatory exudate. Epithelial cell regeneration is more rapid, with increased mitosis and signs of cellular immaturity, than in patients with ulcerative colitis.

4.2.4 Lamina Propria Vascular Lesion

Focal deep or pericytupal haemorrhage was a striking feature in rectal mucosal biopsies of an unselected group of adults with acute undifferentiated diarrhoea in southern India (CHoudari et al. 1985). The prevalence of these haemorrhages was unrelated to the pathogen isolated from the patient but was associated with a vascular lesion with endothelial damage (Fig. 17). Ultrastructural studies showed that a lesion resembling a local Shwartzman reaction was present in many of the lamina propria blood vessels (Mathan and Mathan 1985b). The prevalence of this lesion correlated well with the clinical severity of illness and not with any aetiological agent. These findings suggest that bacterial lipopolysaccharide (endotoxin) may also play a role in the pathogenesis of acute diarrhoea in tropical countries.
4.3 Tuberculosis

The facility with which mucosal samples of the colon, caecum and even the terminal ileum can be obtained by colonoscopy has made biopsies...
from ulcerocoonstrictive lesions of the colon and hypertrophic lesions of the colon and terminal ileum an important diagnostic aid. The colonoscopic biopsy diagnosis of a tuberculous lesion helps the early institution of appropriate therapy and avoids unnecessary laparotomies and resections. The majority of available literature on the pathlogy of colonic and ileocaecal tuberculosis is based on the study of resected specimens (CHAWLA et al. 1971; VAIIDYA and SODHI 1978; TANDON and PRAKASH 1972). Although there are isolated reports of cases of colonic tuberculosis diagnosed at colonoscopy (FRANKLIN et al. 1979; EHSANNULLAH et al. 1984), diagnosis is still often made after resection (KNUTSON and AROSENUS 1984).

In 11 proven cases of ileocaecal tuberculosis, colonoscopy showed deformed ileocaecal valves in all and a contracted caecal lumen in ten (BHARGAVA et al. 1985). Typical granulomas were found in biopsies from only three and *M. tuberculosis* was isolated on culture from a further four patients. However, a non-specific infiltration of the mucosa by inflammatory cells was found in all the patients. Biopsies from a total of 31 patients with colonic tuberculosis were studied at Vellore between 1980 and 1986. Nine of these had isolated colonic tuberculosis and 22 ileocaecal tuberculosis. The disease was confined to the ileocaecal region alone in only 8 of these 22 patients; in the others it extended to the ascending colon (9 patients) or was associated with segmental involvement in the transverse or sigmoid colon. Granulomas with or without Langhans type giant cells were present in biopsies from 21 of the 31 patients while the others had chronic inflammatory infiltrate without granulomas or caseation (Fig. 18). Colonoscopic biopsies are small and seldom obtain tissue deep within the submucosa. A higher yield can be expected if repeated biopsies are done at the same site to obtain deeper tissue. This technique enabled confirmation of the diagnosis in nearly two-thirds of suspected cases at Vellore.

5 Conclusion

The availability of peroral biopsy instruments for the small intestine and endoscopic biopsy of stomach, duodenum, colon, caecum and terminal ileum has made a variety of gastrointestinal mucosal samples available for histopathological examination. In the tropics interpretation of such biopsies has to be done in the light of the prevalence of tropical enteropathy and colonopathy. In addition to enabling the diagnosis of a variety of infective and parasitic conditions the examination of such biopsies by the electron microscope provides valuable clues to the pathogenesis of the diseases.

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References


Biopsies in the Tropics


