RADIOLOGICAL DIAGNOSIS OF MALABSORPTION SYNDROME

A THESIS

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In

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BY

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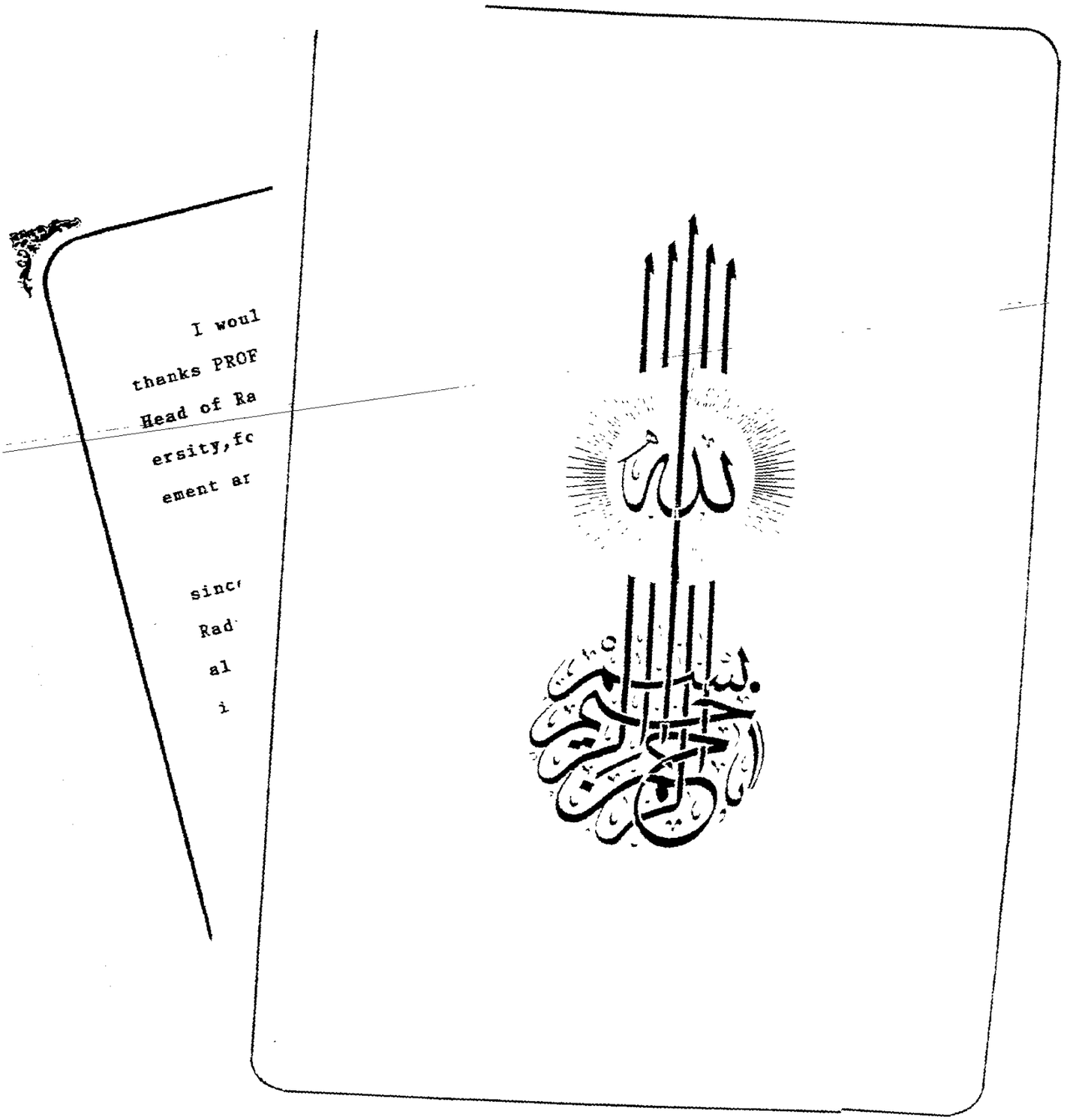

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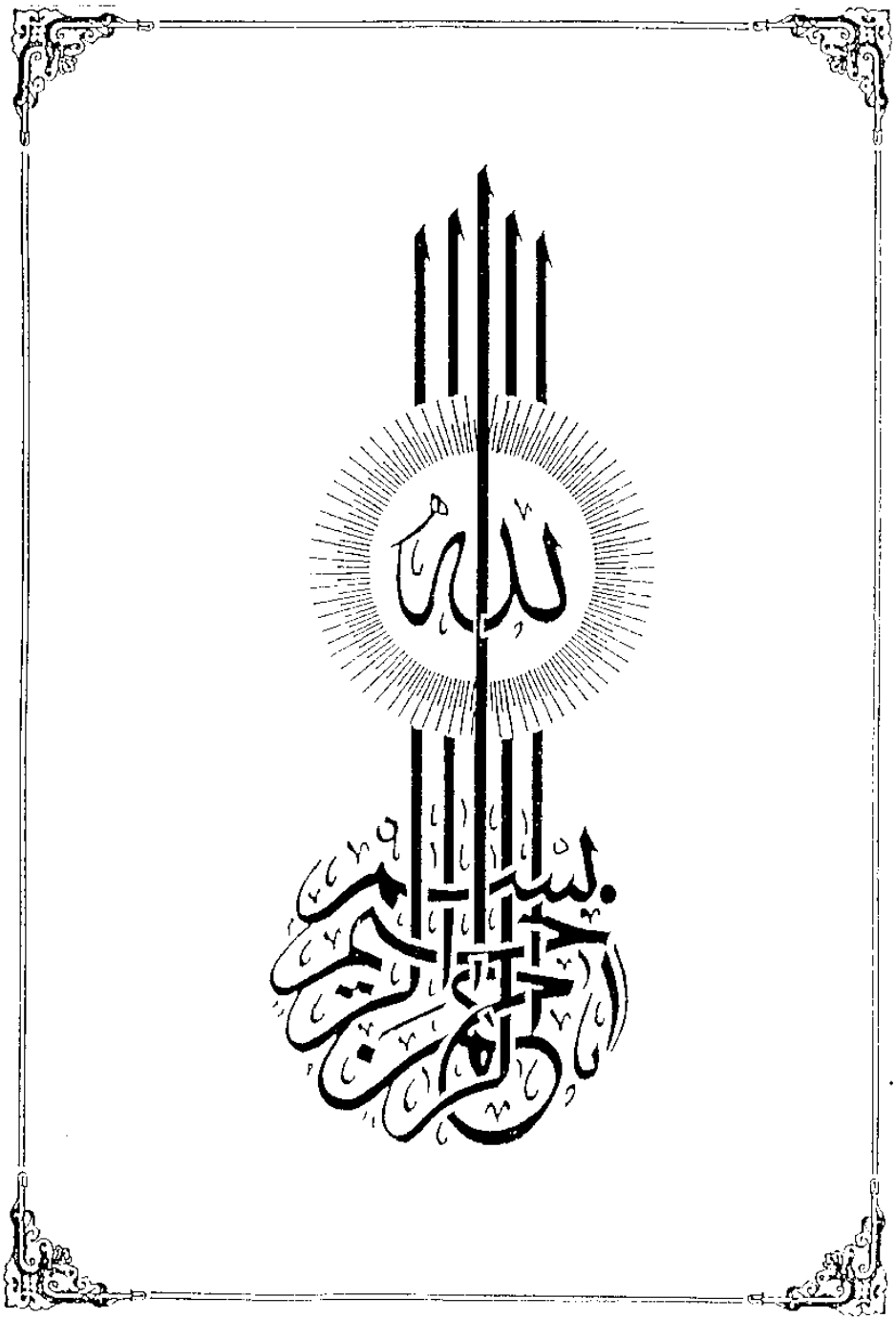

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INTRODUCTION
AND
AIM OF WORK

I. INTRODUCTION AND AIM OF WORK

The end result of food digestion in the upper Gastro-Intestinal Tract is its absorption through the small intestine . Nutrients absorbed will pass through systemic circulation to the different body organs and tissues. Disturbances in the absorption of nutrient element result from a pathological condition, leading to a group of symptoms collectively known as Malabsorption Syndrome .

Since the Gastro-Intestinal Tract renders itself relatively well to radiological examination; therefore, radiology plays an important role in the diagnosis of pathological conditions that lead to malabsorption.

The aim of this work is to present in a comprehensive concise manner the various relationships between the different pathological entities of malabsorption and their radiological manifestations. The various radiological investigations used for that purpose are also described.

RADIOLOGICAL ANATOMY OF THE SMALL INTESTINE

II. RADIOLOGICAL ANATOMY OF THE SMALL INTESTINE

1. EMBRYOLOGY OF THE SMALL INTESTINE :

1.1. The small intestine develops from the cranial limb of the midgut loop proximal to the caecum. The midgut is the part of the yolk sac between the anterior and posterior intestinal portals. The midgut is at first continuous with the yolk sac. The connection is reduced and becomes represented by the vitellointestinal duct [Mahran 1970] .

The midgut at this stage is in the form of a U loop suspended to the posterior abdominal wall by the dorsal mesentery which carries the vitelline arteries to the yolk sac. These arteries supply the midgut and then unite at their origin to form the superior mesenteric artery.

The U loop has a proximal [Cranial] limb and a distal [caudal] limb; the vitello-intestinal [vitelline] duct is situated at its apex .

1.2. ROTATION OF GUT :

The midgut loop rotates 90° anticlockwise, in a manner that the cranial limb lies now to the right while the caudal limb lies to the left. The axis around

which the rotation takes place is the superior mesenteric artery .

The cranial limb grows faster and becomes convoluted. At the 6th week, a small conical projection appears in the caudal limb of the loop near the apex. This projection will later form the caecum .

At this stage differentiation between large and small intestine could be recognised. The part of the loop proximal to the caecum develops into the small intestine while the distal part develops into the large intestine .

1.3. HERNIATION AND COILING :

During the period of development, the abdominal cavity is crowded by the growing liver and kidneys.

Therefore, the midgut loop which is also increasing in length is forced to herniate into the extra-embryonic coelom sac of the umbilical cord and outside the embryonic abdominal wall. This umbilical herniation normally occurs in every human embryo between the 6th week [Last, 1973] .

1.4. REDUCTION OF HERNIATION :

The herniated midgut returns to the abdominal cavity by the 10th week. This reduction may be attributed

approximately two-fifthes of the small bowel and the remaining three-fifthes is the ileum [Stuart et al,1975].

The mucous membrane of the small intestine is enormously increased in surface area by the formation of circular folds [valvulae conneventes], which are mounted by intestinal villi. The circular folds give a characteristic coiled-spring appearance to the inner aspect of the small intestine. These folds reach their maximum development in the distal half of the duodenum and proximal part of the jejunum, where they may be as 8 mm. in height and extend around two-thirds of the circumference of the bowel, branching in the course of their extension. Thereafter, these folds gradually become smaller and less numerous untill they virtually disappear in the lower ileum [Golden's, 1969].

2.2. MICROSCOPIC ANATOMY :

The wall of the small intestine is composed of four coats, from outer layer inwards, the serosa, muscularies propria, submucosa and mucosa .

The serosa is a thin outer layer and accounts for the smooth external surface. The muscularis propria lies next to the serosa and consists of an outer-longitudinal and an inner circular muscle layers. The submucosa is composed of

loose connective tissue which permits the mucosa to move freely over the muscularis . It contains blood vessels and lymphatics.

The mucosa is made up of muscularis mucosa, tunica propria and epithelium [Golden's, 1969]. The muscularis mucosa is composed of a thin layer of circular and longitudinal muscle fibres lying between the submucosa and the tunica propria. The fibres of muscularis mucosa extend into the villi. The tunica propria is a thin layer of connective tissue in the centre of the villus between the basement membrane and the muscularis mucosa containing terminal blood vessels, lymphatics, nerve fibres and several small lymph nodes [Golden's,1969]. These lymph nodes coalesce on the anti-mesentric side of the intestinal wall to from peyer's patches which vary from 1 cm to 10 cm in length. Their long axis parallels that of the intestine [Golden's, 1969].

These aggregates of lymphoid tissue are predominantly in ileum. Their number increases during childhood to an average two hundreds [200] at puberty, then decrease in number in adulthood [Crones, 1965]. They usually do not affect the barium shadow of the intestine in the adult, but may produce small filling defects in the barium shadow of the terminal ileum in children [Well's,1948].

2.4. BLOOD SUPPLY :

The superior mesenteric artery enters the root of the mesentery anterior to the body of the 2nd lumbar vertebra and divides into branches which supply the entire small intestine and the colon approximately to the splenic flexure.

In the terminal portion of mesentery, the branches form a series of arcades which anastomose with the arcades of the branches above and below, thus creating a free collateral circulation between the branches of the superior mesenteric artery.

Further potential collateral circulation is afforded by communicating arteries between the middle colic branch and the inferior mesenteric artery, also between the superior mesenteric artery and the superior pancreatic arteries [from the coeliac axis or the hepatic artery], and by communications with arteries of the posterior abdominal wall, [Golden's, 1969].

Venous return from small intestine is through the mesenteric venous system, which corresponds to the mesenteric arterial distribution. The mesenteric vein drains into the portal vein which enters the liver at the porta hepatis.

PATHOLOGY

III . P A T H O L O G Y

MALABSORPTION :

A wide variety of nutrients are absorbed from the small intestine among which are fats, carbohydrates, proteins, calcium, iron, folic acid, vitamins D, K, B_{12} and other B group vitamins .

The clinical picture of malabsorption is consequently a varied one. Steatorrhoea is the most prominent feature . Inadequate assimilation of protein leads to weight loss and osteoporosis; and in children to stunting of growth. Inadequate calcium absorption causes osteomalacia, tetany and secondary hyperparathyroidism. Lack of iron, folic acid or vitamin B_{12} causes anaemia. Lack of vitamin K leads to abnormal bleeding, stomatitis and glossitis. Dermatitis may develop as a result of B-vitamins deficiency.

ABSORPTIVE FUNCTION :

The absorption of the products of fat, carbohydrate and protein digestion takes place mainly in the upper small intestine, though this is also readily accomplished at more distal levels such as in the ileum after resection of the jejunum .

The water soluble vitamins including folic acid are absorbed in the upper small bowel beginning in duodenum.

Vitamin B_{12} and bile salts are absorbed at specific sites. VItamin B_{12} is first made soluble by intrinsic factor and is exclusively absorbed in the terminal ileum. Loss of this region of the gut leads to depletion of vitamin B_{12} unless it is given by injection. The bile salts of glycine and taurine, coupled with cholic acid, are also absorbed in the terminal ileum. They then pass to the liver where they are re-excreted into the gut in the enterohepatic circulation of bile salts.

If the terminal ileum is excised there are two consequences.

First, bile acids are progressively lost from the body with the inevitable development of steatorrhoea.