REVIEW OF LITERATURE
REVIEW OF LITERATURE

It wasPesquera (1929) who for the first time recommended the use of duodenal tube in the radiological examination of small bowel. He made a mixture of barium, acacia and water and allowed it to flow down in a small intestine under gravity through a tube after duodenal intubation and examined the small bowel under fluoroscopy.

Cannan Cohen and Shay (1938) followed the technique of Pesquera and investigated the small bowel. They documented their results and were impressed by the findings obtained. They viewed the barium radiologically into jejunum, by passing the stomach, moved forward quickly. The competency of pylorus maintained and there was no reflux of barium into stomach instead of the complete filling of duodenal cap. The reflux occurred only when the pressure of the barium column injected into the duodenum was quite high. They used water suspension of barium made up of 3 ounces of barium into 250 ml of water.
The quantity of suspension used was 800-1200 ml. The rate of progress of the head of this barium column was very rapid under gravity. The entire small bowel could be filled in short period. Barium contrast medium reached ileocaecal region within 5-15 minutes. They named this method as "Barium Electrolysis".

In 1943 Schatzki gave the name small bowel enema to this method. He found an analogy between the filling of small bowel, by duodenal intubation and colon by a rectal tube. In his opinion the real advantage of this method of small bowel filling was rapid continuous radiological visualization of active filling of the bowel just like the barium meal examination for stomach and barium enema examination of large bowel. Such direct visualization of the small bowel was not possible in conventional barium meal follow through examination due to obstruction caused by the pylorus in the continuous flow of barium. He brought into use simple barium suspension by suspending 6 parts of barium sulphate powder into 20 parts of water by volume in 500-3000 ml. of quantity. He obtained the continuous flow of opaque
medium down the small bowel under gravity by using a transfusion flask attached to the duodenal tube. The duodenal intubation done per orally with the use of a soft rubber tube having a metal olive tip (refuse tube). He studied and examined 75 cases with this method. Out of them 35 were normal cases. The average time taken by barium column reaching to cecum was 15 minutes. In pathological cases the time taken was more than the average time. It was 37 minutes in pathological cases.

Friedman (1957) used the long three lumen tube (Miller Abbott type) to investigate the pathology of small bowel lesion by double contrast method. He indicated the use of double contrast examination in various pathological conditions of small bowel including the obstructive pathology. According to him in obstructive lesions the diagnostic use of tube method was also an adjunct in the therapy as decompressive agent.

Luca (1951) used the technique and the tube in management of occlusion of intestine and investigated the cases of obstructive pathology of small intestine radiologically particularly the neoplastic conditions.
But the associated problems and time consumed in passing
the Miller Abbott tube upto the lesion forced him to
disapprove the technique in subsequent cases to be exa-
mined radiologically. Though he strongly recommended
the intubation method by short tubes. The direct visual-
ization of small bowel by this method helped him to find
out between an extrinsic and intrinsic growth of small
bowel.

It was Scott Harden (1860) who first analy-
sed the causes of failure of accuracy of radiological
diagnosis by barium meal follow through examination and
concluded "The filling is controlled by pylorus which
is unpredictable and tends to produce irregularity and
any irritability of bowel further complicates the
picture by producing fragmentation and flocculation
opaque loops of overlapping coils obscure small
lesions. The real limitation of this method is to
test the elasticity of small bowel wall. The barium
column in followthrough series is propelled forwards
by peristaltic activity and at the same time the
maximum diameter of lumen is controlled by the tone
prevailing at the moment. Even the partial gastrectomy where pyloric control is removed the intestinal passage of the barium remains under the influence of peristaltic activity and the role of the tone remains dominant.

Obviously an early lesion causing minimal obstruction will not be visible if the constriction has not yet reduced the lumen below that permitted by the tone prevailing. Structural lesions like blind loops, diverticulum and fistulae fail to show due to maintenance of tone and peristaltic activity which prevent entry of barium into them."

He draw inference with this study that if this was the correct interpretation of the injected opaque meal then the success must depend upon the technique which would be independent of peristaltic activity and prevailing tone. At the same time the obscured view of bowel segments caused by the overlapping must be avoided. If possible a double contrast technique must be developed and sought in view to get finer details of mucosal pattern. Later on he emphasized on the use of double contrast technique.
He also pointed out and raised doubts on the universal acceptance of the Shinohara (1943) technique for the radiological examination of small bowel by introduction of small bowel enema on following points.

1. The difficulty and uncertainty experienced in effecting the duodenal intubation.

2. The disadvantage of obscuring the individual coil of the small bowel by the complete filling of tract with barium solution thus missing a small lesion.

To overcome these technical difficulties he recommended a method which allowed immediate duodenal intubation even as an out patient procedure and a double contrast enema with quick filling of small bowel. He used a double lumen tube through which a flexible duodenal tube slide within a gastric sheath. Radio opaque poly-thene tubes were used to minimise the friction and the sliding surfaces were lubricated with silicone. This allowed the accurate control of duodenal tube at the critical level of pylorus. He used only 20-30 ml. of
non-flocculating barium suspension diluted with 20-30 ml of water in order to get a view of a small segment of lumen in progression of barium without obscuring the field by total barium filling. The barium was propelled forwards by flushing with 1.5 pints of tap water containing little magnesium sulphate, to prevent water absorption in bowel. The barium column reached to caecum easily leaving behind a varying length of small bowel outlined by mucosal adhesions with double contrast. Proximally the barium was washed away from mucosa leaving a clear field thus allowing a clear vision, and field of the segment clearly visualised under examination at any time. The examination completed within 10 minutes of injection of contrast medium.

Trickey (1963) was of the opinion, though the Scott haden technique gave excellent results in duodenum, jejunum and proximal ileum, but frequently failed to obtain a good result in terminal ileum due to dilution of non-flocculating barium sulphate suspension (Micropaque) by ensuing the water flush
He used a flushing fluid which was not readily mixed with micropaque to overcome this problem. It distended the small bowel and remained radiolucent. He used prepacol 75% solution for this. Prepacol was a mixture of water retaining gel material (Hydroxy ethylcellulose) and a wetting agent (dioctyl sodium sulphosuccinate). A solution of prepacol stronger than 75% w/v could not be injected normally. He studied 120 cases and used 50 ml. of 5% micropaque and two pints of flushing agent. He could detect 16 pathological cases which were missed routine barium meal follow through examination.

Nilsson et al. (1967) improved the duodenal tube with a flexible guide wire made from volkswagen speedometer cable, from which the outer winding was removed. The nasogastric tube was also home made from insulation stripped from a 47″ piece of balden strain gauge cable No. 8434. This duodenal tube made the procedure simplified, and easy, and all subsequent workers used this tube in performing hypotonic duodenography and small bowel enema.
James (1962) used 20 mg of metoclopramide given intravenously prior to barium filling to enhance the gastric emptying time of barium suspension. He examined 47 patients by giving 20 mg metoclopramide i/v, out of them 12 showed complete gastric emptying within one hour, and in 32 cases barium reached the caecum in one hour. While in 40 control cases only one showed complete gastric emptying in one hour.

Bowen et al. (1969) also carried out barium meal examination with metoclopramide and evaluated the effect of metoclopramide on gastric motility and in barium meal progress. They studied 125 hospital patients, out of them 50 received 20 mg. metoclopramide i/v, 25 were given injection of saline and 50 received nothing. Barium meal with metoclopramide proved superior to any method used as detailed examination was finished at the end of one hour in 80% of cases. The saving of time to both patient and examiner was highlight of this study.

Pajewski (1970) first described a technique to obtain a double contrast view of small bowel without doing duodenal intubation. He assumed that film of the
opaque material coating the intestinal luminal surface, should not disintegrate when subjected to the pressure by the distending gas. In his opinion the tonus and the peristaltic activity would probably interfere with the adhesion of opaque material layer to the intestinal mucosal surface, and with the distribution of introduced gas. Therefore the intestinal motility must be depressed by pharmacological means at some stage of examination.

In his study for a single examination, he used 120 gm of barium sulphate, suspended in 100 ml. of water. After stirring 10 gm of sorbitol, 1 gm of trisodium citrate was added to it, and again stirred until a homogenous non-sedimentary suspension was obtained. The transit time of this suspension was found to be constant, and a scout roentgenogram after 40 minutes of injection of this suspension was taken. The roentgenogram disclosed that the opaque medium was distributed throughout the whole small bowel. At this stage 60 mg procaine or 1.5 mg paragon was given intramuscularly, and a flexible tube was passed into stomach. With the help of a air balloon pump considerable distension of the stomach was obtained.
The ingoing gas distributed itself evenly throughout small intestine and the intestinal motor activity ceased off gradually under the drug effect. The small bowel appeared distended and easily displacable translucent coils outlined a thin rim of opaque material. He claimed to obtain excellent results of mucosal visualization in 15 out of 20 unselected cases. But the results showed that only duodenum and proximal jejunum were shown adequately by this method, not the terminal ileum. The failure was due to the variation in individual susceptibility to the pharmacological action of anti-cholinergic drugs, since premature intestinal atony prevented progress of opaque material and gas. An additional limiting factor was the use of large doses of anti-cholinergic drugs, inflicting an adverse effect on intestinal motility.

Later on Rajowski (1975) replaced the anti-cholinergic drugs with atropine. He found duodenal intubation necessary for the visualization of the entire small intestine. He achieved better results by introducing air and barium meal through the duodenal
intubation and parenteral administration of metoclopramide. In 32 out of 40 unselected cases, but in his opinion the double contrast technique was not a substitute for conventional examination but complementary to the same, and should be reserved for rare cases in which the routine study was found to be inconclusive against strong clinical evidence.

Kellner (1970) collected extensive literature on radiological examination of small bowel. He came to the conclusion after doing extensive trials that contrast medium should not be swallowed but should be directly introduced into the duodenum. He examined more than 1500 cases in a period of 3 years. He used Bilnno dotter tube for duodenal intubation and stainless steel guide-wire. He could intubate the duodenum within 5-6 minutes with practice, with total fluoroscopic exposure not exceeding 15-20 seconds. He used 400 ml. of micropaque of 1.25 specific gravity and taking 5-6 minutes for contrast infusion under gravity. The cecum was reached by the end of infusion in 37% of cases, or several minutes later after a supplementary dose of
300-400 ml. of medium in further 33% of cases. The rapid administration of this large amount of contrast medium always enabled the loops of small intestine to be examined, in a well defined state. A significant advantage of this method was that small irregularities of the mucosa were less likely to be missed, when same loops were slightly contracted. He found that a large amount of fluid (1200 ml.) was necessary in paralytic-ileus, ileus caused by obstruction, scleroderma and similar conditions. Double contrast appearance was obtained by a following enema of 600-1200 ml. of plain tap water. This propelled the barium inside the lumen of small intestine, into the colon. The barium left adhered to the mucosa gave a double contrast effect against water filled lumen. This was further enhanced in certain cases by pumping air into the duodenal tube.

Sanders (1976) employing the Fellink technique, investigated 150 cases of small bowel disease, and showed the comparative results of conventional barium seal followthrough examination and double contrast method. He pointed out the advantages of double contrast small bowel enema over the conventional barium seal followthrough
examination. A certain number of cases found to be of
Crohn's disease by conventional barium meal followthrough
examination, found to be normal by double contrast techni-
que. He opined that small bowel obstruction was not
contraindication to this technique but rather a good
indication particularly where it occurred early in the
course or when it was clinically doubtful. With the
infusion method permitting simultaneous demonstration of
the small intestine, not only loops were fully distended
but the normal motor activity was temporarily suspended
or decreased shortly after infusion. This was likely
the effect of fluid overload. These two effects allowed
early recognition of lesions particularly the obstructive
type in addition it could clarify indeterminate findings,
shown by conventional study. The comparison was very
similar to that between hypotonic duodenography and
routine barium upper gastrointestinal examination. The
water used for infusion produced a double contrast effect
in small bowel. This allowed the loops to be "seen -
through" even when there was overlapping and helped in
early detection of filling defects.
Pyet (1970) using the same technique as Sellink used, investigated a total 233 cases by double contrast small bowel enema. According to him, the air contrast technique for visualizing the small bowel proved to be best, and the technique offered good visualization of all portion of small bowel, free from overlap, and with sufficient distension of the bowel to show mucosal pathology.

He employing the duodenal intubation, injected 400-600 ml. of barium suspension made from 2 parts of barium suspended in 3 parts of water. During the injection the head of barium column was seen by intermittent screening. This allowed the whole of small bowel to be visualized clearly.

At the end of barium injection, he injected 500-1000 ml. of air down the small bowel to get the double contrast effect. No false negative or false positive results were obtained.

Noakes (1976) documented his experiences with Trickey's method. He used 100-160 ml. of undiluted micropaque followed by upto 2000 ml. of 1/2% propcol, in order to propel micropaque down the cæcum. He obtained distension of small bowel with double contrast in micropaque quoted success.
He found large difference in density and diameter of lumen when air was employed as double contrast medium.

Herlinger (1972) described his experience with small bowel double contrast enema using the Trickey's technique. He found small bowel enema more informative and excellent in showing the full extent of lesions and their demarcation from normal gut. He experienced in follow-through examination, that the aliquots of barium gradually exiting from the stomach and passing slowly through the small intestine were soon flocculated by the exposure to even mildly abnormal fluid contents. With transgastric intubation using the Miller-Abbott type tube, a bolus injection of barium could be made to pass rapidly through jejunum and ileum reducing the incidence of flocculation considerably.

Instead of water or air as double contrast agents, he used methyl-cellulose 5% aqueous suspension as double contrast agent and found significant advantages over water or air. First it showed low degree of diffusivity into barium suspension and thus preserved the mucosal surface coating of barium well beyond the duration of examination.
Secondly it propelled unbroken and virtually undiluted barium column towards caecum. Thirdly once the injection of methyl-cellulose through the tube was stopped, it seemed to lack any locally stimulating action and moderately distended small bowel loops remained inactive and outlined by double contrast. He prepared the aqueous suspension of methyl-cellulose by adding 10 gm of methyl-cellulose powder (viscosity 450) to about 200 ml. of hot water, stirring vigorously while one continued to stir, ice water was added to a total of 7-1 litres. A total of 1-2 litres of this suspension was injected through a 50 ml. glass syringe at rate of 100 ml. per minute. 

Unutra et al (1981) carried out a study of small intestine diseases in 45 patients and 5 control subjects by small bowel enema and conventional barium meal followthrough examination. They compared the efficacy of small bowel enema over conventional barium meal followthrough examination. The workers found small bowel enema more informative and superior to the conventional barium meal followthrough study. They classified the patients on the basis of barium meal followthrough examination results into 3 groups.
1. Patients with definite lesions.
2. Patients with suspicious findings.
3. Patients with normal findings.

It was found that small bowel series was definitely superior to conventional barium meal follow-through examination in all the 3 groups of patients, as it brought out the definite radiological features of the underlying pathology.