Braunagel, in 1947, reported sigmoid volvulus to be more common in the East European countries, accounting for 30% to 50% of all cases of intestinal obstruction. Henry in 1940 reported the incidence of volvulus in America as 7%. In U.S.A., the incidence is approximately 10% of all cases of acute intestinal obstruction. Shalinski (Russia) found 35 cases of volvulus out of 110 cases of acute intestinal obstruction. Arapanas and Stewart (1961) reported 46 cases in which 115 episodes of volvulus were treated from 1945 to 1959. Wilson and Dunavant (1965) discussed about 62 patients seen at Johns Hopkins Hospital, which accounts for approximately 4% of all the patients with intestinal obstruction and for 16% of all colonic obstruction. Abrams (1963) reported 27 incidences in 23 patients. The most impressive incidence of the volvulus reported by Scott (1965) is that, in Northern Iran, sigmoid volvulus accounts for 95% of all cases of colonic obstruction. Jean and Murray (1952) reported it to be a common cause of intestinal obstruction (25%) in a state
mental hospital, 21 cases were admitted during five years. Stupper, Ottomann and Stahlgren (1966) reported 39 patients with 63 episodes of sigmoid volvulus. Zertmann (quoted by Bacon) reported 215 cases from Russia in which more than 50% were due to volvulus. Braun and Mertmann (quoted by Bacon) reported 102 cases from Berlin and 23% were due to this condition. Buxton (1956) reported 37 patients of volvulus of the colon out of which 29 were of sigmoid colon. In Germany it is 30% of all the cases of intestinal obstruction.

In India volvulus is common in certain states e.g. North Bihar (Sanarji 1943), South India (Sankaran 1962), Penn et al. (1964), Western Uttar Pradesh (Mc Walters 1945), Rajasthan (Ojha 1950) and Madhya Pradesh (Jain and Seth 1966). Fatosley in 1972 studied 93 incidences from January 1964 to December 1966 out of 348 cases of obstruction. Jain and Seth reported 98 cases in 1968, the incidence being 71%. Sankaran in 1962 reported a series of 24 cases of volvulus of sigmoid colon out of 225 cases of intestinal obstruction. Tahaliani (1972) has given a series of 3 cases of sigmoid volvulus in which sigmoidolopaxy was performed.
SMALL INTESTINE

Ripstein and Miller (1950) from Canada have reported a series of 23 cases of small bowel volvulus. Re Walters in 1945 reported a series of 138 cases of volvulus, out of which 36 cases were of small intestine (26%). Cockins (1936) refers to Vick's 176 cases of volvulus collected from 21 British hospitals for a five year period; there in the volvulus of small intestine forms 48%. In Kerr and Kirkaldy-Willis (1946) series there were 7 cases out of a total of 25 cases of acute intestinal obstruction. Morson and Norton (U.S.A.) 1950 have reported 36 cases of small intestine volvulus out of 261924 cases of intestinal obstruction. On the other hand, Jular and Mc Lenathu (U.S.A. 1963) have shown the incidence of small gut volvulus as high as 6% i.e., 23 out of 176 cases of intestinal obstruction. O`Sears (1954) had reported a case of small bowel volvulus who had five times operation of volvulus.

In India the incidence of small bowel volvulus is significantly higher. Banerji (1950) reported 209 cases of volvulus out of 603 cases of acute intestinal obstruction. Out of these, small bowel volvulus was 79.1%. The incidence of volvulus of small intestine as reported by various authors is as follows:-
OFHA (1950) 16%, ANDERSON (1954) 7.5%, KOCHAR RAI AND SINGH (1966) 12%, BHANSALI AND SOTHNA (1970), 7.5%,
RAH (1954) 20%, TANEJA (1962) 7.7%.

CAECUM AND ASCENDING COLON-

The first case of volvulus of caecum was reported
by Rokitansky in 1841. Following that, no thorough
consideration of the condition appeared until the work
of Monteggia, who reported 24 cases in 1890. FAilit in
1902, reported 79 cases including those above
mentioned. By 1913, Senischah was able to collect some
116 cases and in 1942, Wolfer, Weston and Anson
collected an additional 193 cases making a total of
304. Of these 193 cases 60 occurred in North America.
Its incidence as recorded in literature is less than
1% of all acute intestinal obstruction. But there is a
definite rise in the incidence during pregnancy. The
earliest recorded case of volvulus of caecum associated
with pregnancy was described by crown in 1885. Rai and
Kochar (1970) reported 4 cases of volvulus of caecum
out of 238 cases of intestinal obstruction (1.3%).
MINSHAW AND CARTER (1950) reported 14 cases of volvulus
of caecum in a period of 16 years. Lambert's excellent
and very complete report in 1931 consisted of sixty one
cases of volvulus complicating pregnancy i.e. 29 of
sigmoid colon, 16 of cecum and 16 of small intestine. Kohn and Bride (1944) presented 18 cases of volvulus complicating pregnancy e.g. 12 of sigmoid colon, 3 cases of cecum and 3 of small intestine.

AGE AND SEX INCIDENCE:

Sigmoid Volvulus:

It has been reported by many authors that the disease is 3-4 times more common in men and has its maximum incidence in middle and advanced years (Ingalls, Lynch and Schilling 1964, Abrams 1963, Wilson and Dunavant 1965, Parthenie and Ralph Bewere 1962, Pool and Dunavant 1951, O'Muircheartaigh and Saxe 1967).

Arapenees and Stewart (1951) reported twice as many male patients (27 male and 13 females) and that 88% were of 55 years or older, varying from 1½ years to 94 years of age. Scott (1955) reported that 63% of his patients were less than 50 years of age. Botsford et al (1967) reported that 13 out of 18 patients were above the age of 60 years. The youngest was 18 years and oldest was 92 years. Buxton (1959) reported 29 cases of volvulus of sigmoid colon with a ratio of male and female, 60:40. Dean and Murray (1952) reported 21 cases of volvulus of sigmoid, in which the ratio between males and females was 2:1.
In India, according to Jain and Seth (1966) volvulus of the sigmoid colon is rarely seen in an individual under 30 years of age and it is commoner in men than in women. Fataley (1972) reported 33 cases, out of which 26 were males and 7 were females. The age ranged between 32 to 65 years. Tambah (1970) reported 22 cases of sigmoid volvulus of which 21 were males and 1 was female, the average age was 35-45 years.

**SMALL INTESTINE:**

Penn and Kuruvilla (1966) reported 31 cases of small bowel volvulus of which 29 were males and 2 were females and the peak incidence was in the age group 20-40 years (20 cases out of 31 cases). Anderson (1957) reported that average age for small bowel volvulus was 30 years and sex ratio between males and females was 12:2. Banerjee (1950) reported 309 cases of small bowel volvulus of which 295 were males and 14 were females and the maximum incidence was seen between 21-30 years of age. Ojha (1950) reported 18 cases of small bowel volvulus, of which 11 cases were between 20-40 years but all were females. Moretz and Morton (1950) reported 36 cases of small bowel volvulus ranging between age groups of 2 days to 60 years but the maximum incidence was encountered between 20-40 years (50%). In the series of Sabcock (1946) 66% patients were males and the
disease was more common in adults under 40 years of age or in children.

CARCINOMA

In Wilson's series (1955) 11 out of 20 patients were females. While in the series of Kocjar and Nai (1970) all the 6 patients were males. In Minshew and Carter's (1959) series the ratio between male and female was equal (seven males and seven females) and the average age was 55 years ranging from 15 to 84 years. Saini (1959) has reported that this disease is found between the ages of 20-40 years and is equally common in both the sexes.

In the series reported by Faltin (1951) 45% were between the ages of 17 and 30 years. The youngest patient reported was an infant 10 months old and the oldest patient was a man of 59 years. In McGraw, Krasna and Aigler (1948) series all the 4 patients were above 50 years of age and all were males. According to the above authors volvulus of cecum is more common in males than in females in the ratio of 2:1. Dixon and Meyer (1948) reported 12 cases of which 3 were of recurrent type. In Jordan and Seahra (1953) series, of the 6 cases of cecum and ascending colon volvulus 5 were men, whereas the condition is said to occur more in male. 70% of the patients who had cecal volvulus
were less than 40 years of age whereas four of these six patients were more than 50 years of age.

**DIETARY HABITS:**

The diet of coarse indigestible food (Jwar or bajara bread, Upar, Makka, Millet, green vegetables, potatoes) produces excessive loading of the bowel and in those taking large meals at irregular intervals or after short or long periods of fasting, the importance of this factor is magnified elongation of mesentery due to traction of the mesentery by the heavily loaded bowel containing coarse indigestible meals imperfectly baked or cooked. Kerr and Kirkaldy (1946) have emphasized over the diet in African people. They take two pints of maize gruel meal in the morning and this meal is again repeated in the day but no solid meal is taken till evening. Sudden dilatation of small intestine by thick liquid causes overloading of one or more loops which during exertion may become displaced and start the formation of volvulus. The resultant spasmotic peristalsis may complete the process.

**ETIOLOGICAL FACTORS:**

**SIGMOID VOLVULUS:**

V. Sankarar (1962) divided the causes into:

1. **Dietetic.**
2. Congenital or acquired long pelvic mesocolon.

3. Congenital or inflammatory narrow base of pelvic mesocolon.

1. **DIETETIC**:

   Significance of large amount of vegetable diet have been reported by various workers as the contributing factor for the high frequency of volvulus of sigmoid flexure.

   The residue of such a heavy meal will tend to accumulate in the pelvic colon and weigh down a congenitally long colon and may well, over a period of years, elongate it further and so pull on the mesentery tend to shorten the base of mesocolon attachment. The weight of the solid excreta in the pelvic colon acts as reservoir which might exert this pull.

2. **CONGENITAL OR ACQUIRED LONG PELVIC MESOCOLON**:

   The congenital longer sigmoid flexure are more common in men than in women. This may account for the larger number of cases observed in men. The greater incidence in certain areas of Europe is usually attributed to elongation of the sigmoid mesocolon secondarily to a diet high in vegetables and other foods which have a large residue and produce bulky stools. Constipation may also be a contributing factor.
to this mechanism as the redundancy may be progressive. A second feature leading to volvulus is that an afferent and an efferent loop lie in close approximation to each other and its mesocolon is both long as well as freely mobile with its narrow base at the site of attachment. Chronic constipation is one of the factors responsible for elongating the pelvic colon. The distal colon gets distended with faeces, and develops a thickening of its wall. Constipation and fermentation of gas and the consequent distension lifts the sigmoid loop up into abdominal cavity and as the proximal sigmoid loop dilates, it becomes more tense because of its fixed attachment with the descending colon, meanwhile the lower portion of the sigmoid and upper part of rectum, which are less fixed, rise and as the least resistance is to the left, the distended lower portion of the sigmoid and rectum move in that direction. The upper portion of the sigmoid moves down to the right and the volvulus is produced.

3. MARGINAL ATTACHMENT OF PELVIC MESOCOLON -

Is regarded as congenital or following inflammation at the base of the mesentary.
High incidence of sigmoid volvulus in neuropsychiatric patients from mental hospital has been reported by various authors viz; Dean and Murray (1952), 74%, Buxton (1964) 43%, Drapanas and Stewart in (1961) 80%, Gabriel and Campbell and Musselmann, Schults, Nyhan and Marks (1953) 50% to 70%.

**Small Intestine:**

Some authors (vide infra) have divided the small bowel volvulus into two groups, primary and secondary. By secondary they mean volvulus occurring after any abdominal operation (McKenna Priestly 1935, McRae and Horton 1956, Anderson 1954, Penn and Parquivo 1964).

The exact cause of primary volvulus is unknown but certain predisposing factors have been given by Ogba (1950).

1. **Volvulus of Isolated Loop or Loops of Small Intestine due to:**
   (a) Bands - Post operative or post inflammatory or congenital.
   (b) Adhesions - Tubercular, non-specific or post operative.
   (c) Tumours, mesenteric cysts or other cysts (Neurilemmoma).
(d) Foreign body and worms.
(e) Strictures.
(f) Pregnancy.
(g) Constipation.
(h) Meckel's diverticulum and other diverticulum.

2. VOLVULUS OF ALMOST THE WHOLE OF SMALL INTESTINE:

Due to dietetic habits of eating coarse millets
and corn or similar heavy vegetable diet with or without
period of fasting, associated with:

(a) Abnormality of base of mesentery due to
tuberculous glands or non-tuberculous glands.
(b) Shortening of the base of mesentery.
(c) Lengthening of the mesentery.
(d) Sclerosis of mesentery and its fibrous
shrinkage.
(e) Any of the remaining conditions under (b).
(f) Visceroptosis.

3. Volvulus of small intestine along with that of cecum
and ascending colon.

NOTE:

Elongation of mesentery occurs due to traction
of the mesentery by the heavily loaded bowel containing
coarse indigestible imperfectly baked or cooked and due
to spasmoid peristalsis of the bowel to get rid of the excessive roughage (Ojha 1950). As a compensatory phenomenon to elongation of mesentery, shortening of the root of mesentery can take place. Fixation, thickening and shortening of base of this mesentery by enlarged chronically inflamed glands at the root due to tubercular or non-tubercular infections, aggravates the condition by providing a point of suspension for the serpentine pendulum of small intestine, suspended now with an abnormally long fan shaped rope, with an already narrower end, further narrowed down and fixed inelastic (due to sclerosis, contractions and adhesions) base, so that, it would be rather surprising if the volvulus should not take place in the presence of all these predisposing factors. The normal mesentery is pliable and elastic and thus allows easy and safe play of the intestinal movements.

Ripstein and Miller (1953), Dhanasri and Sethna (1970), have also contributed the same factors for the causation of volvulus of small intestine.

**VOLVULUS OF CAECUM AND ASCENDING COLON:**

Normally the attachment of the caecum to the posterior abdominal wall prevents the occurrence of volvulus. Faltin (quoted by Wagensteen 1942), has reported that volvulus of caecum is only possible in the
absence of fixation of cecum, or in the presence of a mesocecum or mesocolon sufficiently mobile to permit the torsion; in such cases the cecum usually exhibits a continuation of mesentery possessed by the terminal ileum. Many cases present, in addition, failure of complete rotation of the right colon. Minford Harvey (quoted from Wennsten 1943) noted un-natural free motion of the cecum and ascending colon in 12.5% of the examination performed upon 103 infants at necropsy. Chalfant (quoted from Wennsten 1943) stated that unusual mobility of the cecum and ascending colon were present in about 20% of persons of all ages.

Saint (1950) has reported that characteristically such a cecum is large, flabby, thin walled and atonic and because of the elongated mesentery, often lies prolapsed in lesser pelvic. The axis of the twist is usually around the ileocolic artery. Other predisposing factors have been reported by Hocher and Rai (1970) such as pregnancy, over eating, previous operations, diarrhoea, violent coughing. The same precipitating factors have been enumerated by Minshaw and Carter (1959).

PATHOLOGY:

Minshaw and Richard Carter (1957) reported that torsion of 180° to 360° is usual but in cecal torsion
and volvulus of small intestine twists of 520° to 720° may be seen. With broad mesenteric attachment, a twist of more than 180° is unusual. It is the tightness of the twist rather than the number of twist which determines the pathological changes of tissue necrosis. In incomplete obstruction or those in which the torsion develops gradually, both gas and fluid may be found in different quantities within the strangulated segment. When complete occlusion of the bowel is established by torsion, the fluid within the loop will usually exceed the amount of gas present. The direction of twist in torsion of small intestine is usually clockwise though counter clockwise twists are observed. Torsion of cecum is usually anticlockwise. Clockwise twist is more common in sigmoid but both varieties occur also in sigmoid volvulus.

Free peritoneal fluid, hemorrhage, into bowel and infarction of its wall, gangrene and perforation of the twisted segment with associated peritonitis are natural sequelae of the occurrence. Submucous vascular planes is particularly vulnerable to the flattening force exerted by pressure within the lumen. It has been shown by Gatch and Culbertson (1953) that the bowel is made practically bloodless when intraluminal pressure equals or exceeds the diastolic blood pressure. At this level it stops all absorption by way of mesentery.
Ordinarily, veins are occluded first by the strangulating force, the bowel then becomes bluish black in colour and, occasionally, it can be outlined as a tympanic, semirigid mass, (Nahl's sign). This venous occlusion produces hemorrhagic infarction of the segment with loss of blood sufficient to produce shock, particularly in the case where a long loop is involved in volvulus. Toxins, bacteria and blood pass through the bowel wall permeating the peritoneal fluid. This forms the basis for peritoneal irritation as seen clinically.

In the clinical management of the patient, suffering from advanced obstruction, it seems desirable to deflate the bowel gradually before the operative relief of the obstruction is undertaken, otherwise barriers against absorptions of toxins by way of the peritoneum and against their rapid absorption by way of mucousery, may be broken down.

**CLINICAL FEATURES**

**SIGMOID VOLVULUS**

Hinshaw and Carter (1957) reported 55 cases and classified the clinical features into two main groups:-
1. Acute fulminating type: Characterized by unusual occurrence in younger age group, sudden onset and rapid course, diffuse abdominal pain and tenderness, early development of peritonitis and frequently stimulating a perforated viscus or some other abdominal catastrophe.

2. Subacute progressive type: Which is more common, usually occurs in older patients, has a more gradual onset, runs a more benign course and develops non-viability of bowel more slowly.

Various authors have reported various clinical features, but the majority of the patients complain of abdominal pain, exhibit marked abdominal tenderness and give a history of chronic constipation; vomiting is not a prominent feature. (Draper & Stewart 1961, Wilson and Dunyavan 1968, Gruenberger 1947, Betsford Healey & Veith 1967). Ingalls, Lynch and Schilling (1964) have described some clinical features as those described by Hinchman and Carter and also by Abrams (1963). The common findings were abdominal distension (75%), pain (50%) and nausea and vomiting (25%).

Boon and Murray (1952) described that chronic sigmoid volvulus was characterized by recurrent exacerbation of painless abdominal distension, massive visible peristalsis and obstipation.
Moresets and Morton (1950) have reported that majority of the patients had severe cramplike upper abdominal or periumbilical pain. Nausea and vomiting are usually prominent features in the clinical history. Only two patients out of 36 had neither of these symptoms. Vomitus was 'fecal' or very foul smelling in most of the cases. Constipation was present in 14 cases. The most common finding on examination was tenderness and abdominal distension. There was localization of tenderness which varied according to the loop of bowel involved. In more advanced cases generalised tenderness was present. Distension was present in 25 cases and absent in 6 cases. Peristalsis was present in more than 50% of cases. Fluid within the abdominal cavity was noted in 7 of these patients (20%). An abdominal mass was palpated in 6 patients.

In the Mckechnie and Priestley series (1936), 7 cases, including two of those with acute volvulus, had no significant abdominal findings on local examination. Physical examination commonly reveals' distension, tenderness and rigidity'. Pain was present in 85.7%, nausea and vomiting in 74%, constipation in 51.4% and distension in only 11.4%. The pain was colic like in 49.7% and steady in 37.2%.
In the series reported by Leonard and Darow (1938) abdominal pain and vomiting were present in 100%. Constipation was present only in 30% and distension was present in 37%. Abdominal tenderness and rigidity were found rarely in their series.

Gill and Eggleston (1964) reported in their series that patients with volvulus of small bowel were admitted as acute surgical emergencies with vomiting, constipation, abdominal colic and progressive, abdominal distension of central type. According to Banarjee (1950), vomiting is not a marked feature though there are always a few vomiting at the onset. Distension is of central type, visible peristalsis as ladder patterns and peristaltic roars are present in all cases except in late ones.

Hinchew and Carter (1959) suggested a clinical classification into two major types. First, the acute fulminating type is characterized by a sudden onset of symptoms, rapid clinical course, severe abdominal pain and signs of peritoneal irritation. The second clinical variety of volvulus of cecum is the acute obstructive type. It's chief feature is low, small intestinal obstruction, with intermittent cramping abdominal pain associated with peristaltic rushes, obstipation and vomiting. There are usually no significant findings to
suggest peritoneal irritation and scout film of abdomen show a distended small bowel.

All the patients of caecal volvulus in Kochar and Rai series (1970) belonged to the acute obstructed type and there was no case of acute fulminating type or of chronic recurrent type.

**DIAGNOSIS**

**SIGMOID COLON**

The diagnosis of the volvulus is suggested by the history and physical findings and confirmed by X-ray and sigmoidoscopic examination. A flat film of abdomen shows markedly dilated sigmoid, assumes the shape of a 'beet inner tube' or a 'large house shoe'. Barium enema may reveal twisting at the site of obstruction giving rise to what is called as 'bird's beak' appearance (Ingalls, Lynch and Schilling 1966).

In a supine scout film of the abdomen, a greatly distended loop of colon arising from pelvis and going to left or right upper abdomen is seen (Drananas & Steevert 1961 and Tanbaku 1970). Wilson and Davanent (1965) advocate that the twist in the sigmoid can be visualized in majority of cases by sigmoidoscopy. Pataley (1972) reported that in 65% of cases, the diagnosis was made by clinical examination.
Plain X-ray of abdomen is of immense help in confirmation of the diagnosis.

**SMALL INTESTINE**

According to Morita and Merton (1950), no pre-operative diagnosis was made in 6 cases out of 36 cases of small bowel volvulus. Of the remaining 28 cases, the diagnosis of small bowel obstruction was made in 17 instances (47.2%). The diagnosis of volvulus was made correctly in 7 cases. In patients seen relatively late, the diagnosis of intestinal obstruction was usually obvious, whereas the cause of obstruction was obscure. Among the wrong diagnosis were mesenteric thrombosis, large bowel obstruction, acute appendicitis, perforated duodenal ulcer, twisted ovarian cyst. In those cases seen shortly after the onset of initial pain, the problem was more that of a differential diagnosis of the acute abdomen, and clinical intestinal obstruction had not yet developed. However, the diagnosis could be made by the history, physical findings and plain skigram of the abdomen. Kocher, Rau and Singh (1966) have mentioned that it is not possible to make a specific diagnosis of the cause and type of obstruction, but radiating stripes of mucosal folds, though such a picture is uncommon, is highly suggestive of volvulus of the small bowel. Similarly, Penn and Kuruvilla (1966) have reported that X-ray examination is always successful in confirming the diagnosis of small intestinal obstruction but, made a
diagnosis of volvulus in only half of the cases.

Cecum and Ascending Colon:

Weiner (1956) reported 6 criteria where early diagnosis of cecal volvulus could be made by X-ray examination of the abdomen. The radiological findings were:

1. Great distension of cecum which is ectopically placed, located frequently in left upper quadrant.
2. Distended loops of small bowel located to the right of the cecum.
3. Visualization of ileo-cecal valve to the right of the cecum when the cecum is outlined by gas.
4. Mucosal folds at the point of obstruction may be outlined by gas and assume a spiral contour.
5. Evidence of obstruction of small intestine.

According to Shinshaw and Carter (1959) an understanding of the basic features of the two chief types is important in the early diagnosis of volvulus of cecum. The acute fulminating type must be considered in the diagnosis of any acute catastrophic abdominal
condition. But roentgenographic studies may be diagnostic. Roentgenographic studies are essential in the diagnosis of volvulus of cecum. In the acute fulminating type, the roentgenographic findings are largely confined to the distended loop of cecum and ascending colon with minimal small bowel distension. However, in acute obstructive variety, a well developed pattern of distended small bowel is usually seen in addition to the dilated cecum or right colon.

In 1937, Easton and Adams made a pre-operative diagnosis of volvulus of the cecum by means of a barium enema. They postulated that two conditions indicated the presence of a volvulus of the cecum. First was an obstruction to the passage of barium by enema at certain points in the ascending or transverse colon. The second was the simultaneous presence of a large collection of gas at the site of the cecum, either in the midline or slightly to the right of it.