DISCUSSION

Gynaecography means the X-ray visualisation of female pelvic viscera after introduction of gaseous medium into peritoneal cavity. Many times, it is difficult to comment on the size and shape of internal genital organs even after a skillful bimanual vaginal, speculum and rectal examination aided with all the sophisticated laboratory investigations. One can make only a provisional diagnosis. But for confirmation, gynaecologist requires the help of pelvic pneumo-gynaecography or other surgical procedures like culdoscopy, endoscopy, laparoscopy or laparotomy.

Pelvic pneumography is a suitable and reliable method, provides a permanent record and is done on an outpatient basis.

Various routes are available for introduction of gaseous medium into the peritoneal cavity, like trans-abdominal, trans-uterine and trans-vaginal. We have used the trans-abdominal route as it is simple, quick to perform and does not require the assistance of the busy gynaecologist.

We divided our patients into seven groups depending upon their provisional clinical diagnosis.
**Technical failure-rate.**

Abram (1965) reported technical failure in 9 out of 161 patients. Causes of failure were injection of gas extraperitoneally in 3 cases and improper insertion of needle in abdomen due to extensive previous abdominal surgery in 5 cases.

Daves (1964) reported failure of technique in 79 (13%) out of 579 cases. Causes of failure were poor needle placement resulting in the introduction of gas into the abdominal wall or retroperitoneal space in 54 cases, huge masses of frozen pelvis in 13, exposure factors or projection in 8 and full bladder or rectum in 4 cases.

Punia (1960) did not get satisfactory pneumogram of one case out of 30 studied due to technical fault.

In present study, we have failure rate of 11.29% (7 out of 62 cases). Causes of failure are poor needle placement resulting in the introduction of gas into abdominal wall or bowel lumen in 2 cases, huge mass of frozen pelvis in one, poor exposure factors in two cases, improper positioning of the patient in one case and full bladder in one case.

Failure-rate, in present study, is similar to Daves. This high rate is due to our being inexperienced of the technique.
NORMAL GROUP:

(a) Ovarian index: Stein and Leventhal (1935) mentioned that normal ovary is about 1/4th of the size of uterus.

<table>
<thead>
<tr>
<th>Author's name</th>
<th>Range of O.I. (in sq. cms.)</th>
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<tbody>
<tr>
<td>Gershon-Cohen &amp; Hermel (1952)</td>
<td>3 to 12 sq. cms.</td>
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<tr>
<td>Edwards &amp; Evans (1963)</td>
<td>3.0 to 10.0 sq. cm²</td>
</tr>
<tr>
<td>Daves et al (1964)</td>
<td>5.3 to 22.4 sq. cms.</td>
</tr>
<tr>
<td>Haigten &amp; Stevens (1967)</td>
<td>3.7 to 14.6 cm² (Mean 9.0 cm²)</td>
</tr>
<tr>
<td>Bhargava &amp; Malhotra (1969)</td>
<td>6 to 15 sq. cms.</td>
</tr>
<tr>
<td>Present study</td>
<td>6.6 to 10.2 sq. cms (Mean 8.38 sq. cm²)</td>
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</tbody>
</table>

It is clear that the lower limit of ovarian index in present study is higher than that of other authors except Bhargava (1969) while upper limit is approx. similar to that of Gershon-Cohen (1952). Daves (1964) reported much higher values. All ovaries which measured 22.4 sq. cm² were clinically palpable in present study. So this would differ from Daves.

(b) Shape of ovaries: In the present study, all the normal patients have oval ovaries. This is similar to the findings of other authors.

(c) Uterine index: In present study, uterine index ranges from 11.00 to 30.00 sq. cms. with a mean of 21.68 sq. cms.
Gershon-Cohen (1952) reported the range of uterine index from 13 sq. cms. to 35 sq. cms. in normal group. Nei does (1967) reported the range of uterine index from 15 to 55 sq. cms. with a mean of 37.4 sq. cms. Bhargava (1969) reported uterine index 30 sq. cms. in normal group.

Uterine index in present study is similar to that of Gershon-Cohen (1952) while it is less than that of Nei does (1967) and Bhargava (1969). It might be due to the fact that the normal cases, selected in this study, had less numbers of pregnancies and relatively less age of the cases. Furthermore, this is due to the difference in end points taken. We have measured the index for the body of the uterus which projects through the fundus whereas other authors have measured the index of the fundus itself. Hence strict comparison of the results can not be made. It was considered that the magnification of the body of the uterus is less than that of fundus as most uterus are antverted, the fundus becomes more magnified, therefore the body was measured.

(d) Ovarian/Utterine Ratio - O/U ratio, as measured by formula ovarian index divided by uterine index, is 0.26 to 0.64 with a mean of 0.42 in present study.

Comparing our results with other authors is as follows -
Stein (1949) - 0.25 to 0.50
Gershon-Cohen (1952) - 0.25 to 0.33
Schulz & Rosen (1961) - 0.40 to 0.50
Present study - 0.28 to 0.64

Thus the lower limit of O/U ratio reported by Stein (1949) and Gershon-Cohen (1952) is the same as observed in our study while upper limit of O/U ratio in the present study is on higher side in comparison to other workers. The reason being that they have calculated ovary/uterine fundus ratio whereas we calculated ovary/body of uterus ratio. The body of the uterus has less area than that of the fundus giving rise to high O/U ratio.

Our radiological findings could not be confirmed as surgery was not done in these cases.

PATIENTS WITH CLINICAL DIAGNOSIS OF STEIN-LEVENTHAL SYNDROME

(a) Ovarian index - Stein applied gynaecography in 108 patients of Stein-Leventhal Syndrome which were proved by laparotomy. They could diagnose 80% of the total cases by gynaecography. It revealed a striking picture of small or normal sized uterus with bilaterally symmetrical enlarged ovaries which were often ½ to ⅓rd size of the uterine shadow. Stein (1939) has reported normal ovarian area ⅙th of the size of uterus. Unfortunately in their study, they have described absolute measurements, so comparison is not possible.
Edwards (1963) reported the range of ovarian index from 15 to 25 sq. cms. in enlarged ovary group of 18 patients. They confirmed their findings on laparotomy and histopathology.

Daves (1964) observed two criteria for diagnosing Stein-Leventhal Syndrome based on 5 proved cases. The first was an absolute increase in ovarian size and the second is a decrease to one or less in the ratio of the size of uterine fundus to the size of the ovaries. Ovarian index ranged from 9.9 sq. cms to 20.4 sq. cms. with a mean of 17.5 sq. cms.

Range of ovarian index observed in the present study of 6 cases is from 9 sq. cms. with a mean of 16.25 sq. cms. If the normal upper limit of ovarian index is taken 11.9 sq. cms, then only one ovary has normal index in the polycystic ovary group which may be incidental.

Comparison of ovarian index in polycystic ovarian disease of different workers reveal the following:

<table>
<thead>
<tr>
<th>Author's name</th>
<th>Range of ovarian index (in sq. cms.)</th>
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<tbody>
<tr>
<td>Edwards &amp; Evans (1963)</td>
<td>12.00 to 25.00</td>
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<tr>
<td>Daves et al (1964)</td>
<td>15.10 to 22.60</td>
</tr>
<tr>
<td>Ferriman &amp; Purdie (1965)</td>
<td>17.00 to 40.00</td>
</tr>
<tr>
<td>Weigen &amp; Stevens (1967)</td>
<td>6.00 to 38.00</td>
</tr>
<tr>
<td>Present study</td>
<td>8.00 to 45.00</td>
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</table>
The lowest ovarian index found by Weigen and Stevens (1967) was 6.00 sq. cms, whereas in the present study it was 8.00 sq. cms, which is almost identical. The upper limit of ovarian index reported by Ferriman & Purdie (1965) is almost the same as compared to present study. While other authors reported upper limit on the lower side as compared to present study. The reason for higher upper limit of ovarian index in our study can be explained by the fact that our patients came late for investigation and allowed the ovaries to attain these big sizes.

(b) Shape of ovaries - In present study, there were 44.71% round ovaries, 33.33% oval ovaries and 25% elongated ovaries. No ovary of lobulated shape was reported. Compared to normal group, the number of rounded and elongated ovaries is considerably higher in this group, as these shapes are unusual. Weigen (1967) reported that the rounded configuration is common in polycystic ovarian disease and was symmetrically present in 14 (40%) out of 35 cases. They concluded that the elongated shape was more specific as it was an unusual shape and it is not mimicked by any other condition. Their results revealed 11 (31%) out of 35 cases as elongated shape while they have not mentioned any shape of the ovaries in the remaining patients.
(c) **Uterine index** - It is a well accepted fact that the uterus is smaller in the polycystic ovarian group as compared to normal group. The range of uterine index in the present study is 12.00 to 25.00 sq. cms.

Comparison of our results with other authors is as follows -

<table>
<thead>
<tr>
<th>Author's name</th>
<th>Uterine index in sq. cms.</th>
</tr>
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<tbody>
<tr>
<td>Davees (1964)</td>
<td>13.5 to 21.0 sq. cms.</td>
</tr>
<tr>
<td>Weigen &amp; Stevens (1967)</td>
<td>10 to 50 cm² (mean 24.4 cm²)</td>
</tr>
<tr>
<td>Bhargava &amp; Malhotra (1969)</td>
<td>20 sq. cms. (Mean)</td>
</tr>
<tr>
<td>Present study</td>
<td>12 to 25 cm² (mean 16.70 sq. cm.)</td>
</tr>
</tbody>
</table>

The lower limit of uterine index in our study is similar to that of Davees (1964) and Weigen (1967) while mean of uterine index in our study is less than that of Weigen (1967) and Bhargava (1969) which can be explained from the fact that we measured the index of body of uterus.

(d) **Ovarian/Uterine ratio** - The range of O/U ratio in our study is 0.41 to 1.80. Only in one case the O/U ratio is below 0.50 which is due to the normal size of the ovary.

Comparison of our results with other authors is as follows -
<table>
<thead>
<tr>
<th>Author's name</th>
<th>Range of O/U ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stein (1949)</td>
<td>0.5 ≤ 0.75</td>
</tr>
<tr>
<td>Weigen &amp; Stevens (1967)</td>
<td>0.5 or more</td>
</tr>
<tr>
<td>Present study</td>
<td>0.41 to 1.29</td>
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</table>

The lower limits of our findings is similar to as reported by Stein (1949) & Weigen (1967). The upper limit is much higher than that of any other authors due to the differences in end points taken i.e. ovary/body of uterus ratio while other authors calculated ovary/uterine fundus ratio. The body of uterus has a smaller area giving rise to a high O/U ratio.

(a) Clinical, surgical & radiological correlation - Definite correlation between clinical, radiological and surgical findings was observed in 83.33% cases. In remaining 16.66% cases only one ovary was recorded as enlarged while gynaecography revealed enlargement of both the ovaries which was proved on surgery. Stein (1949) had accuracy rate of 80% in polycystic ovarian disease. Abrams & Hughes (1953) 66%, Weigen (1967) 100% and present study 100%. This high figure of accuracy rate is accounted for by the late stages in which most of our patients come, making it difficult to go wrong.
In present study, gynaecography revealed one case of Mullerian duct failure, 2 cases of absent uterus with normal ovaries, while 5 cases of normal or hypoplastic uterus with gonadal dysgenesis. Surgery aided with histopathological examination confirmed the gynaecographic findings in all these cases while clinically no certain diagnosis was possible. We also found out one case of true hermaphrodite and another of pseudohermaphrodite. So the accuracy rate was 100% in present study.

Kunstadtter et al (1953) reported 16 cases of various conditions such as ovarian agenesis, primary hypopituitarism, hypo-ovarianism, sexual precocity and pseudohermaphroditism.

Hensel (1960) also reported 21 cases of various anomalies such as ovarian agenesis, hypoplastic ovaries, unilateral development of uterus and congenital absence of uterus.

Thomas (1966) had successful gynaecographic diagnosis in 7 out of 9 cases of primary amenorrhoea.

Lippe et al (1975) also had successful gynaecographic diagnosis in primary amenorrhoea group.

From the above description, it is clear that we had more success than other authors. But it is to be
stressed that we do not have the facilities of hormone estimation which could lead to a better clinical diagnosis.

Patients with clinical diagnosis of sterility (primary / secondary):

In 10 patients of primary sterility of unclear cause, complete gynaecography revealed 4 cases of hypoplastic uterus with normal or small ovaries, 2 cases of septate uterus, 3 cases of tubal occlusion and one case of normal uterus with both small ovaries, while in 6 patients of secondary sterility, complete gynaecography revealed 3 cases of tubal occlusion, 1 case each of submucous fibroid uterus, ovarian tumour and normal uterus with both enlarged ovaries. Our radiological findings were confirmed at surgery in 4 of these cases.

Hensl (1960) also reported cases of septate and bicornuate uterus by gynaecography.

Dias-Brusual (1965) performed simple and complete gynaecography in 33 cases. Out of these, there were 21 cases of ovarian or uterine tumour as a cause of sterility. They reported success rate of 53%.

Ansari & Arronet (1965) performed pneumo-hysterosalpingography in 42 and pneumography in 10 cases. Gynaecography revealed normal radiological findings in
19 patients and abnormal in 33. The common
abnormalities detected were uterine hypoplasia, uterine
myomata, intra-uterine defect, tubal occlusion, ovarian
tumours and Stein-Leventhal syndrome.

Semin & Becker (1966) studied 9 cases of
sterility for tubal patency and ovarian morphology.

Stevens (1967) had reasonable explanation of
infertility in one-third out of 102 cases studied.

So comparing with other workers, it is evident
that we were able to find out the cause of sterility in
all the cases. The explanation for it may be that the
extra-uterine causes were already ruled out by thorough
clinical examination aided with other investigations.

UTERINE MYOMATA GROUP:

In present study, there is complete, clinical,
radiological and surgical correlation in 6 (95.71%) cases,
while one case (14.3%) which was clinically diagnosed as
fibroid uterus; proved to be normal gynaecographically
and surgically. Uterus is enlarged and irregular in
3 cases while ovaries were also enlarged in three cases.
Filling defects were seen in two cases by hysterosalpingo-
graphy. So we have clinical accuracy rate of 85.71% while
gynaecographic accuracy rate is 100%.
Daves (1964) had ninety-six per cent success rate by gynaecography.

Ansari & Arronet (1966) also had success rate of 100% in 3 cases of fibroid uterus, out of which one was diagnosed clinically.

Semin & Secker (1966) also reported 11 cases of uterine myomata.

So from above description, it is clear that fibroid uterus can be diagnosed easily by pneumogynaecography by its abnormal enlargement, lobulated shape and filling defects of uterine cavity and tubes.

**OVARIAN TUMOUR GROUP**

In present study, clinical, radiological and surgical findings are similar in 71.43% cases. While in 28.6% cases which were suspected to be a ovarian tumour clinically, proved to be normal radiologically. So the clinical accuracy rate was 83.33% and gynaecographic accuracy rate 100%.

Daves (1964) had gynaecographic accuracy rate of 76% compared to clinical accuracy rate of 55%.

Our results are slightly better as compared to that of Daves (1964).
CERVICAL-CANCER GROUP:

In present study, overstaging of the Ca-cervix was done by gynaecography as compared to clinical staging in all the four cases studied. So we had no clinical radiological correlation in any case. We could not confirm our findings as surgery could not be done in any of these cases.

Daves (1964) reported pneumographic, clinical correlation in 15 of the 28 patients.

Sala, Keats, Kenneth, Dolon and Jose (1962) and Daves, Diner & Brenner (1964) also did overstaging by this method.

Punia et al (1980) reported consistent staging in 22 out of 29 cases, while 7 cases were understaged.

So, our study had approximately similar results as reported by other workers.

COMPLICATIONS OF GYNAECOGRAPHY:

In present study, we came across with the complications as follows –

Nausea (30.64%), vomiting (6.43%), shoulder pain (53.23%), abdominal pain (19.35%), surgical emphysema (11.29%) and bowel puncture in 1.61%.
Stauffer (1956) demonstrated that gas embolism did not occur even after injecting a large amount of gas angiographically.

Buice & Gould (1957) had no complications excepting slight shoulder pain in their study.

Schuls and Rosen (1961) reported bowel puncture surgical emphysema and abdominal discomfort.

Stevens (1964) pointed out the possibility of internal bleeding, bowel puncture, gas embolism and bilateral pleuroperitoneal pneumothorax.

Daves (1964) reported sufficient abdominal discomfort in every patient. Other complications encountered in their study were peritonitis, puncture of stomach, colon, mesentery and retroperitoneal space.

Ansari & Arronst (1970) noted mild to moderate abdominal discomfort, nausea, vomiting, vaginal spotting or mild bleeding in their study.

Lippe (1975) reported extra peritoneal insufflation of the gas and right shoulder pain.

So, it is clear that the complications encountered in our study also occurred in previous studies.
There are several situations in which the radiologist is not sure about the radiographic impression that internal organs would cast on the film and pelvic pneumogynaecography in relation to uterus and ovaries is no exception. Some common disputable situations are described below:

1. The state of the flexion of the uterus is so variable that end points measurements may not truly depict the size of the uterus.

2. The ovary does not lie parallel to the transverse diameter of the pelvis but at right angles to it, or in an "end on" position, thus the true ovarian enlargement can not be assessed in a postero-anterior projection. In the "end on" projection, the ovary may seem normal whereas it is actually considerably enlarged. In these cases, the oblique projection usually gives the correct assessment.

3. Fluid filled coils of small bowel when seen "end on" may be mistaken for the ovary and the size wrongly assessed. The ovarian shadow invariably shows one or two small bumps around it, which are projections of the fimbriated ends of the fallopian tubes whereas the small bowel is usually sharply and evenly outlined.
4. Full bladder may interfere with the correct assessment of the size of the uterus and ovary owing to the displacement that it can offer to the said tissue giving rise to more magnification.

All these errors are controllable and when taken into account should increase the diagnostic accuracy of the gynaecogram.

**RADIATION SAFETY OF THE PROCEDURE**

Doubleday (1963) has mentioned about the amount of radiation which is delivered to patients undergoing pelvic pneumography. The exposure factors used in an average sized patients are 80 k.V., 70-90 MAS using 3 m.m. aluminium filter and a 40° focal film distance. The dosage delivered to the ovary calculated during a routine Barium enema examination is 1500 milli rads. Since radiation workers are permitted 5000 milli rads/year, the amount of radiation delivered in pelvic pneumography is considered to be negligible.