Introduction

Neoplasm of the ovary presents an increasing challenge to the physician. They are the cause of more deaths than any other female genital tract tumours. Approximately (4-24%) of adnexal masses in premenopausal women and (39-68%) in postmenopausal women are malignant ***(Hata et al., 2003).***

Most women with ovarian masses (cancer) have no symptoms for long periods of time. In early stage disease, the patient may experience irregular menses if she is premenopausal. If a pelvic mass is compressing the bladder or rectum, she may report urinary frequency or constipation. Occasionally, she may perceive lower abdominal distension, pressure or pain such as dyspareunia, acute symptoms such as pain secondary to rupture or torsion are unusual and some have symptoms related to the presence of ascites, omental metastases or bowel metastases ***(Olson et al., 2001).***

Because the patient usually complains of abdominal symptoms she may not have pelvic examination and a tumour may be missed - a variety of benign conditions of the reproductive tract such as pelvic inflammatory disease, endometriosis and pedunculated uterine leiomyoma can simulate ovarian cancer ***(Berek and Hacker, 2000).***

A careful history taking and pelvic examination is an important step for the diagnosis; however, the diagnostic accuracy of

pelvic examination varied in different series between 50% and 90%. It is affected by several variables including the experience of the gynecologist, the type of the patient and the characteristics of the mass. Several factors may hinder the diagnosis, even for an experienced gynecologist such as virginity, obesity, associated pregnancy, ascites and pelvic tenderness ***(Roman et al., 1997).***

The ultrasound describes the characteristics of ovarian and adnexal masses and predict the ovarian cancer based on these characteristics and clinical parameters. Ultrasound characteristics can be used to diagnose the classic-appearing non-neoplastic, benign neoplasms and malignancies. In cases in which the appearance of an ovarian mass is not classic, assignment of relative risk of malignancy using a multi-parameteric model is appropriate and beneficial for patient management ***(Twickler and Moschos, 2010).***

Interval of ovarian cancer screening using transvaginal ultrasonography (TVS) and selection of populations with a high risk of this disease are an important issue in detecting early stage-disease. We report two cases of ovarian cancer patients incidentally detected at FIGO stage I using TVS in the obligatory staff health check. They had undergone other ovarian cancer screening by TVS six months before and received a carefull result at the time. One patient had risk factors (RFs) for ovarian cancer such as obesity and a familial history of ovarian cancer in a first degree relative, and the other had RFs such as obesity and endometrial malignancy.

Although cost-effective screening may be important, we recommend that while normal and asymptomatic populations are screened annually, women with any high RFs for ovarian cancer should be screened every six months ***(Fukuyama et al., 2009).***

The observations made in the late 1980s indicated that the transvaginal color Doppler ultrasonography can be used in the detection of ovarian cancer and has generated a stream of clinical trials. However, the conflicting results of numerous publications have led to major controversy. Transvaginal color Doppler ultrasonography saves times and increases the accuracy of measurements, though masses over 10 cm in size are bets evaluated using conventional transabdominal sonography ***(Miyazaki, 2003).***

A quantitative systematic review was performed to estimate the accuracy ultrasonography with color Doppler in the diagnosis of ovarian tumors. Studies that compared color Doppler ultrasonography with paraffin-embedded sections parameters for the diagnosis of ovarian tumors concluded that ultrasonography with color Doppler is a useful preoperative test for predicting the diagnosis of pelvic masses ***(Medeiros et al., 2009).***

CA-125 is a tumour-associated antigen to an antibody expressed by about 80% of patients with epithelial ovarian cancer. It can be increased by non-gynecological malignancies with involvement of the pleural or peritoneum and by benign conditions that result in ascites. Because of the many medical diagnosis that gives false-positive CA-125 results, CA-125 can

not be used for general population screening for ovarian cancer in either premenopausal or postmenopausal women. However, in menopausal women who present with a pelvic mass, CA-125 can help differentiate benign from malignant masses ***(Schutter et al, 2002).***

Preoperative discrimination of benign and malignant ovarian tumors using color Doppler sonography and its correlation with histopathology. A total of forty clinically diagnosed ovarian tumours were studied over a period of one year. The study aimed at evaluating the efficacy of transvaginal color Doppler sonography (TV-CDS) in preoperative discrimination of benign and malignant ovarian tumours and to correlate the imaging findings with postoperative histopathological findings. The pulsatility index (PI) and resistive index (RI) were studied as primary efficacy variables of TV-CDS. Using TV-CDS, 72.5% of the ovarian tumours were found benign and 22.8% were malignant which were significantly correlated with postoperative histopathological findings. The average PI for benign and malignant tumours were 0.62 and 0.41 respectively. The low PI and RI values in malignant tumors as compared to benign ones were statistically highly significant ($P<0.001$). The validity tests for TV-CDS were found to be 90% sensitive, 100% specific and 97% accurate. The study concludes that TV-CDS is a useful imaging diagnostic modality in preoperative discrimination of benign and malignant ovarian tumours due to its excellent characterization of tumors neovascularization ***(Bangladesh Med Res Counc Bull, 2005).***

Aim of the Work

The aim of this study is to evaluate the efficacy of ultrasonography and color Doppler in discrimination of benign and malignant ovarian tumours and to correlate the imaging finding and tumour markers (CA 125 – CEA and Inhibin) with postoperative histopathological findings.

Embryology and Anatomy

Ovaries:

The ovaries are homologous with the testes and like these they develop from the genital ridges. Situated on each side of the uterus close to the lateral pelvic wall they are attached to the posterosuperior aspect of the broad ligament posteroinferior to the uterine tube ***(David et al., 2000).***

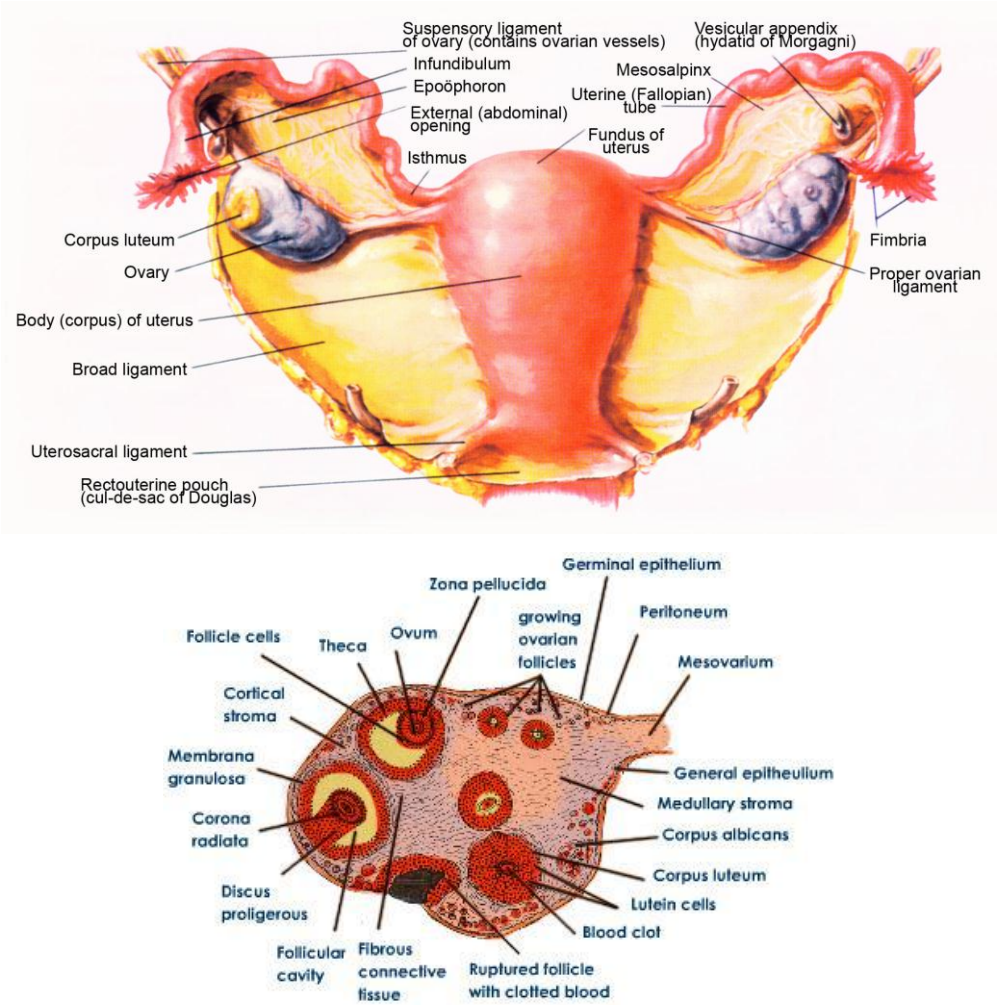
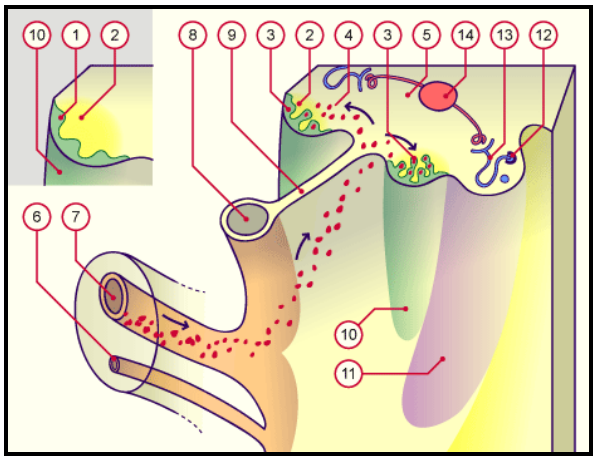
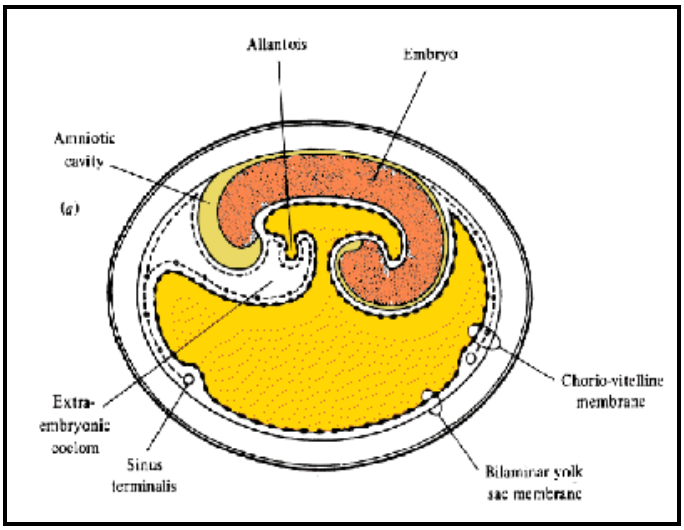


Figure (1): Anatomy of adnexae ***(David et al., 2000).***



1 Coelomic epithelium
2 Local mesenchyma (in proliferation)
3 Gonadal cord
4 Primordial germ cells (PGC)
5 Mesenchyma
6 Allantois
7 Omphalomesenteric duct
8 Intestine
9 Dorsal mesentery
10 Genital ridge
11 Nephrogenic cord
12 Mesonephric duct (Wolff)
13 Mesonephric tubule
14 Aorta



The germ cells which will eventually inhabit the gonads originate from the primitive hind gut. They appear around the 25th day.

By 30 days the gut complete with mesentery is formed. The germ cells now migrate from the gut to the root of the mesentery. About 1 to 2 million remain at birth and about 300,000 at puberty, of the original 6 or 7 million. A smaller number may be a factor in leading to premature menopause.

At the same time the coelomic epithelium proliferates and forms thickenings, the genital ridges, together with the underlying mesenchyme on either side of the mesenteric root near the developing kidney.

Figure (2a): Embryology of the human ovary ***(David et al., 2000).***

At this stage the primitive gonad (genital ridge) consists of mesoderm (coelomic epithelium plus mesenchyme) covered by coelomic epithelium. The germ cells now migrate from the root of the mesentery to the genital ridge.

The coelomic epithelium growing into the genital ridge forms so-called sex cords which enclose each germ cell.

Up to this time, around the 7th week, the gonad is of indifferent type, male being indistinguishable from female.

The germ cells and most of the sex cord cells remain in the superficial part, the future cortex of the ovary. The cords lose contact with the surface epithelium and form small groups of cells each with its germ cell, a primitive follicle. Some of the sex cord cells grow into the medulla. These tend to regress and form rudimentary tubules, the rete.

As the ovary grows, it projects increasingly into the peritoneal (coelomic) cavity, thus forming a mesentery.

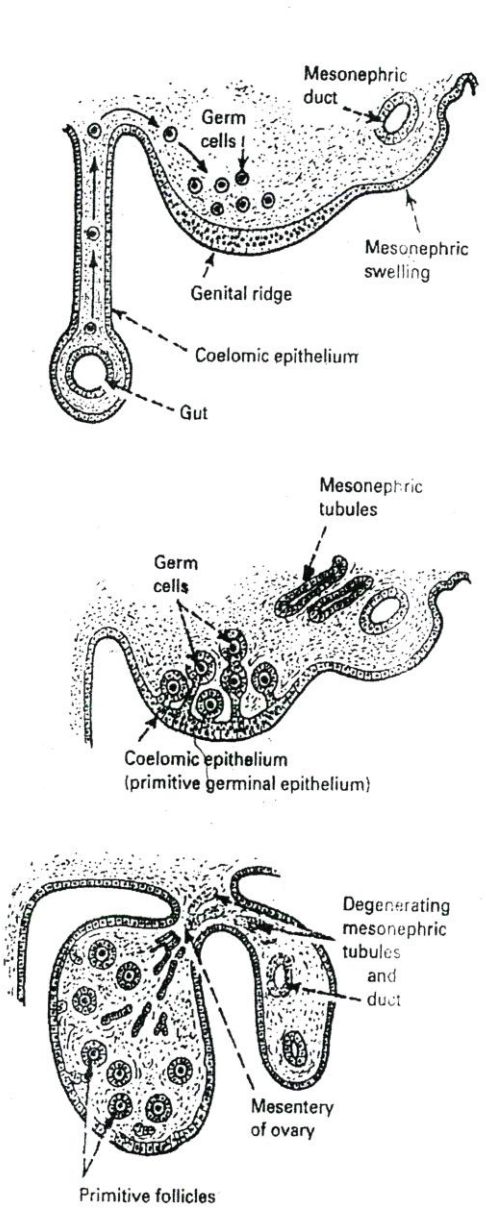


Figure (2b): Embryology of the human ovary ***(David et al., 2000).***

Ovaries:

The ovaries, two in number, they are situated one on each side of the uterus in relation to the lateral pelvic wall. Each ovary is almond-shaped and is about 3 cm long, 1.5 cm wide and about 1cm in thickness ***(Bannister and Dyson, 1995).***

The ovaries are of grayish-pink color and present a smooth surface before regular ovulation begins but there after the surface is creased and irregular due to cicatrisation, which follows degeneration of the successive corpora luteae ***(McMinn, 1994).***

The exact position of the ovary is subject to a wide range of variation in women who have born children, as it is displaced in the first pregnancy and probably never returns again to its original position ***(Lumley et al., 1995).***

Each ovary has a lateral and a medial surface, a tubal (or upper) and a uterine (or lower) extremity and a mesovarian and a free border ***(Slaby et al., 1994).***

The ovary lies in the ovarian fossa, a depression on the lateral wall of the lesser pelvis; this fossa is bounded in front by the obliterated umbilical artery and behind by the ureter and the internal iliac artery ***(Bannister and Dyson, 1995).***

a) <u>Tubal extremity</u>: is near the external iliac vein and to it are attached the ovarian fimbria of the uterine tube and a fold of peritoneum, the suspensory ligament of the ovary, which contains the ovarian vessels and nerves.

b) Uterine extremity: is usually narrower than the tubal extremity and is attached to the lateral angle of the uterus, immediately below and behind the uterine tube, by a rounded cord, the ligament of the ovary, which lies within the broad ligament ***(Hall-Craggs, 1995),***

c) Lateral surface: is in contact with the parietal peritoneum that lines the ovarian fossa and it separates the ovary from the extra peritoneal tissue and the obturator vessels and nerves.

d) Medial surface*:* is to a large extent covered by the uterine tube and the peritoneal recess between this aspect and the mesosalpinx is termed the ovarian fossa ***(Lumley et al., 1995).***

e) Mesovarian border*:* the ovary is attached to the back of the broad ligament by a short fold termed the mesovarium and between the two layers of this fold the blood vessels and nerves-pass to the hilum of the ovary.

f) Free border*:* is convex and is separated from the ureter by peritoneum ***(Slaby et al., 1994).***

The uterine tube arches over the ovary, running upwards in relation to its mesovarian border, curving over its tubal extremity and then passing downwards on its free border and medial surface ***(Chung, 2006).***

Structure of the ovaries:

The ovary consists of number of Graffian follicles imbedded in stroma and invested by a serous covering derived from the peritoneum ***(Chiting, 1995).***

Generally; the ovary consists of the following layers.

a) *Germinal epithelium* formed of single layer of columnar cells.

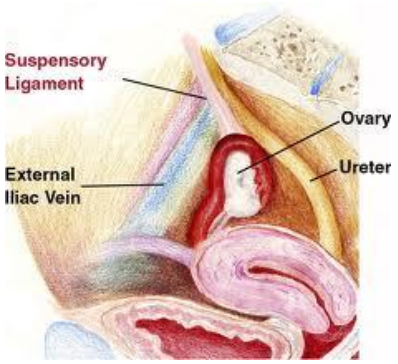
b) *Tunica albuginea:* which is a soft tissue abundantly supplied with blood vessels much more condensed on the surface of the ovary.

c) *Cortex:* containing large number of minute follicles and corpora lutea but below the superficial stratum more large and mature follicles are found.

d) *Medulla:* formed of highly vascular stroma forming the hilum of the ovary through that the blood vessels pass.

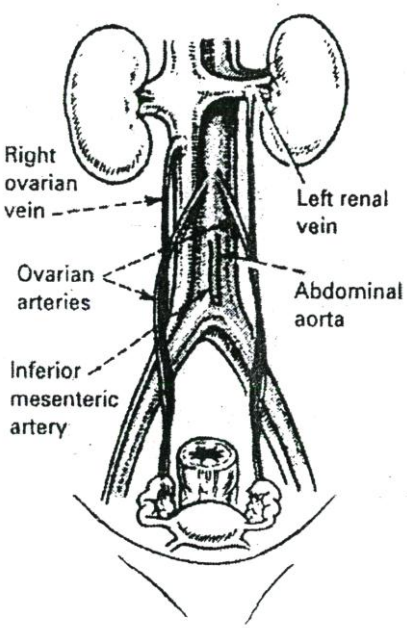
(Bannister and Dyson, 1995)

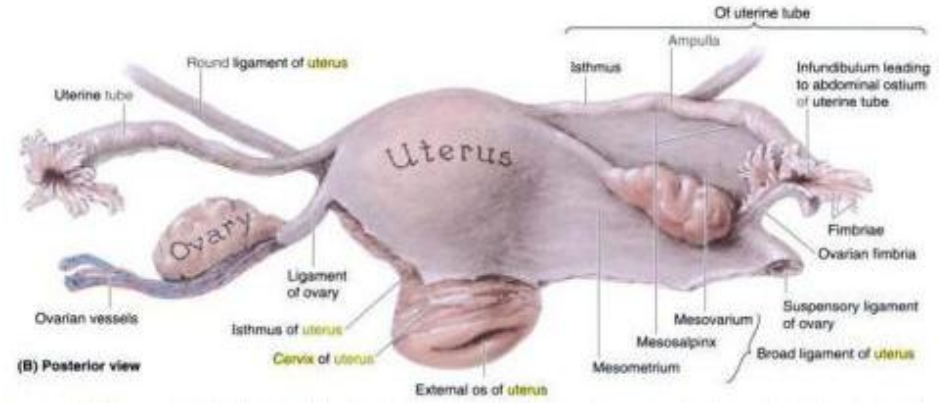
The ovary is about 3 cm long and 1.5 cm wide, roughly the size and shape of a date. It has its own mesentery, the mesovarium, from the posterior leaf of the broad ligament and is attached to the cornu of the uterus by the ovarian ligament which is continuous with the round ligament, the vestigial gubernaculum.



The ovary is developmentally an abdominal organ and its blood supply is from the abdominal aorta. The ovarian vessels lie in the infundibulopelvic ligaments.

Note: The left ovarian vein empties into the left renal vein.





The free surface of the ovary has no peritoneal covering, only a surface epithelium. The part attached to the mesovarium through which all vessels and nerves pass, is called the hilum.

Figure (3): Anatomy of human ovary ***(David et al., 2000).***

Blood supply of the ovaries:

The ovarian arteries arise from the abdominal aorta below the renal arteries and they enter the ovary through its hilum. An additional arterial supply is derived from the uterine artery ***(Chung, 1995).***

The veins form a plexus near the ovary termed the pampiniform plexus from which ovarian veins arise; with the right joining the inferior vena cava and the left drains in the left renal vein ***(Bannister and Dyson, 1995).***

Lymphatic drainage:

Lymph vessels drain primarily to the lumbo-aortic and pelvic lymph nodes, although it is reported that after the menopause the flow of lymph is reduced and it drains mainly to the aortolumbar nodes ***(Vanneuville et al., 1991).*** The lymphatic drainage occurs by utero ovarian and round ligament trunks and an external iliac accessory route in to the following regional nodes: External iliac, common iliac, hypogastric, lateral sacral and para-aortic nodes and, occasionally, to inguinal nodes.

Nerve Supply:

The innervations derived from the ovarian plexuses consist of parasympathetic and autonomic nerves which accompany the ovarian vessels and come directly from preaortic plexuses. They are both motor and sensory. The segmental supply is T.10 &T. 11. Pain form the appendage is usually referred to the lower

abdominal wall on one or other side but can central. The ovary is insensitive except for squeezing on bimanual examination.

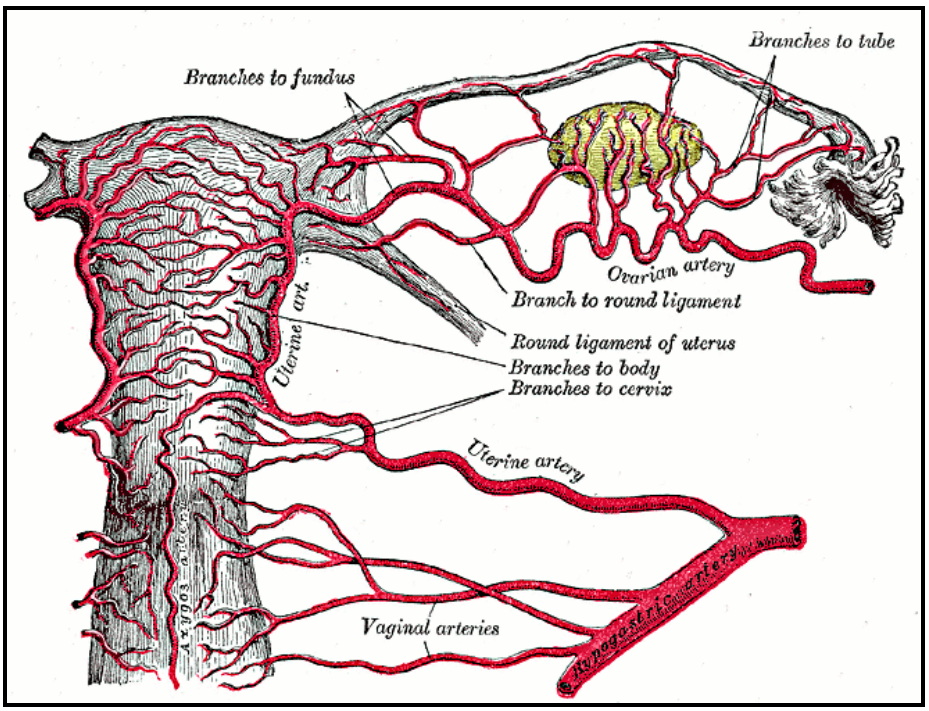


Figure (4): Blood supply of ovaries

Epidemiology and Risk Factors

One in 78 American women (1.3 percent) will develop ovarian cancer during her life time. In 2007,22,430 hew cases are estimated to develop in the United States. However, few patients are diagnosed early and subsequently cured. As a result, 15,280 deaths are expected, and ovarian cancer-remains the fifth leading cause of cancer-related death ***(Jemal et al., 2007).***

The highest rates are found in North Europe and white women hi North America tend to have lower rate o f developing ovarian cancer. Rates tends to be lower hi the most Asian countries but women of Japanese and Chinese descent in the United States have rates that are higher than in their countries of origin ***(Sasieni and Cuzick, 2001).***

Approximately 20% of ovarian neoplasms are borderline tumors. Invasive ovarian tumors are further classified by histologic subtype into serous histology which is the most frequently seen accounting for 56% of ovarian cancer hi a contemporary Canadian series. Mucinous tumors are the second most common at 18% followed by endometrioid at 10% and clear cell tumors 6%. Other unclassified and mixed epithelial tumors account for 3% of the total hi Canadian series ***(Karmer and Green, 2004).***

I- Reproductive risk factor:

Nulliparity is associated with long periods of repetitive ovulation, and has high risk of developing ovarian cancer ***(Purdie***