INTRODUCTION

Induction of labour is defined as an intervention designed to artificially initiate uterine contractions leading to progressive dilatation and effacement of the cervix and birth of the baby ***(RCOG, 2001).***

Induction of labour is primarily employed when the benefits of delivery outweigh the risks of continuing the pregnancy. However, this intervention can have a significant impact on the birth experiences of women, such as an increased risk of emergency caesarean delivery ***(Rogers et al., 2011).***

The commonly cited indications for induction of labor are premature rupture of the membranes before onset of labor, diseases as diabetes mellitus or hypertension with pregnancy, maternal request, or pregnancy passing 41 weeks, which is the most common indication ***(Bennett et al., 2004).***

Induction of labor is indicated in about 20% of term pregnancies and is associated with a caesarean delivery rate of about 20% ***(Government statistical service, 2005).*** The successful induction is reported to be related to cervical characteristics, or 'ripeness' ***(Groenevelda et al., 2010)***.

Elective induction is not convenient when routine delays at the hospital postpone the starting time of the induction. It is not convenient when an induction does not work and the pregnant woman is sent home to try another day. And it certainly is not convenient when induction leads to a cesarean surgery. After a cesarean surgery, a new mother has to recover from major abdominal surgery and is at increased risk for complications ***(Liu et al., 2007).***

Assessment of the cervix has been used as a predictor of the probability of vaginal delivery. The traditional method of predicting whether an induced labour will result in a successful vaginal delivery is based on the digital examination of the cervix. The most widely accepted and used is the scoring system described by Bishop in 1964 ***(Bishop, 1964)***.

Although cervical ripeness can be established with the Bishop score, this frequently used method shows a high inter- and intra-observer variability ***(Laencina et al., 2007).*** Alternatively, transvaginal ultrasonographic measurement of cervical length may be a more objective method for assessing cervical status ***(Pandis et al., 2001)***.

Transvaginal ultrasonographic measurement could represent more accurate assessment of the cervix than digital examination because the supra-vaginal portion of the cervix usually comprises about 50% of cervical length, but this is highly variable among individuals. This portion is difficult to assess digitally. In addition, effacement is subjective and can vary considerably among examiners. Moreover, effacement is difficult to determine in the closed cervix. In contrast, trans-vaginal ultrasonographic cervical measurement is quantitative and easily reproducible. Cervical shortening, as seen on sonograms, has been proposed as representative of the process of cervical effacement ***(Ware and Raynor, 2000).***

The Bishop score appears to be a better predictor of the time interval from induction to delivery and to vaginal delivery than cervical length after induction of labour for medical reasons ***(Rozenberg et al., 2005).***

In comparison with the Bishop score, the use of sonographic cervical length for assessing the cervix prior to induction of labor can reduce the need for prostaglandin administration by approximately 50% without adversely affecting the outcome of induction in nulliparae at term if the cut-off values used are a Bishop score of = 4 and a cervical length of = 28 mm ***(Park et al., 2011).***

AIM OF THE WORK

To compare cervical length- measured by transvaginal ultrasonography- and Bishop score as a predictor of successful induction of labor in nulliparous women.

Research question:

In women undergoing induction of labor, does transvaginal ultrasonography measurement of cervical length is more predictor of successful induction of labor than Bishop score.

Outcome:

The primary outcome: vaginal delivery in 24 h.

The secondary outcome: fetal distress, CS delivery, puerperal sepsis, neonatal sepsis.

Research hypothesis:

Null hypothesis: there is no difference between cervical length- measured by transvaginal ultrasonography- and Bishop score as a predictor of successful induction of labor in nulliparous women.

Alternative hypothesis: there is difference between cervical length- measured by transvaginal ultrasonography- and Bishop score as a predictor of successful induction of labor in nulliparous women.

Clinical application:

If transvaginal ultrasonography measurement of cervical length is more predictor of successful induction of labor than Bishop score, it will be used clinically more than Bishop score.

ANATOMY OF THE CERVIX

Gross Anatomy of the Cervix:

The **cervix** (or **neck of the uterus**) is the lower, narrow portion of the uterus where it joins with the top end of the vagina. It is cylindrical or conical in shape and protrudes through the upper anterior vaginal wall. Approximately half its length is visible with appropriate medical equipment; the remainder lies above the vagina beyond view. It is occasionally called "cervix uteri" Cervix means neck in latin ***(Weschler et al., 2002).***

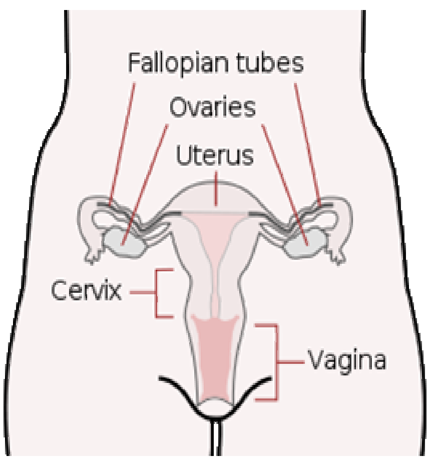

Figure (1): Schematic frontal view of female anatomy ***(Weschler et al., 2002).***

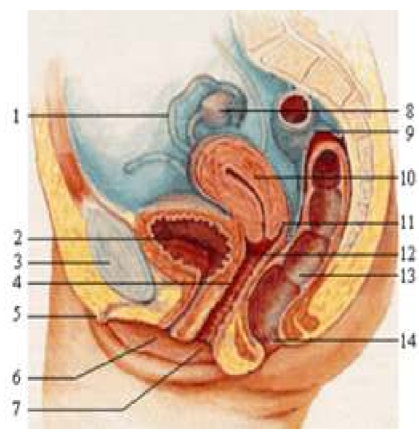

Figure (2): 1: fallopian tube, 2: bladder, 3: pubic bone, 4: g-spot, 5: clitoris, 6: urethra, 7: vagina, 8: ovary, 9: sigmoid colon, 10: uterus, 11: fornix, 12: cervix, 13: rectum, 14: anus.

Latin: cervix uteri

Gray's: subject #268 1259

Before childbirth, the external cervical os is small, regular, oval opening. After childbirth, the orifice is converted into a transverse slit that is divided such that there are the so-called anterior and posterior lips of cervix. If torn deeply during delivery, it might heal in such a manner that it appears to be irregular, nodular or stellate. These changes are sufficiently characteristic to permit an examiner to ascertain with some certainly whether a given woman has borne children by vaginal delivery. Anteriorly, the upper boundary of the cervix is internal os, which corresponds to the level at which the peritoneum is reflected upon the bladder. The supra vaginal segment is covered by peritoneum on its posterior surface. This segment is attached to the cardinal ligaments anteriorly, and it is separated from the overlying bladder by loose connective tissue ***(Cunningham et al., 2005).***

Relations of the cervix:

The external end of the cervix bulges into the anterior wall of the vagina, which divides it into supravaginal and vaginal regions. The supravaginal part of the cervix is separated in front from the bladder by cellular connective tissue, the parametrium, which also passes to the sides of the cervix and laterally between the two layers of the broad ligaments ***(Susan et al., 2005).***

The right uterine arteries flank the cervix in this tissue and the ureters descend forwards in it 2 cm from the cervix, curving under the arch formed by the uterine arteries. The relation of the arteries to the ureters is not always symmetrical ***(Susan et al., 2005).***

The supravaginal cervix is covered posteriorly by peritoneum, which continues caudally onto the posterior vaginal wall and is then reflected onto the rectum via the recto-uterine reces. Posteriorly, it is related to the rectum, from which it may be separated by a terminal ileal coli. The vaginal part of the cervix projects into the vaginal cavity forming grooves around its perimeter termed vaginal fornices ***(Susan et al., 2005).***

Cervical Ligaments:

The cervix is held in its position by its ligaments namely:

1- Cardinal ligaments:

Also called the transverse cervical ligaments or the Mackenrodt ligaments.It extend from the side of the cervix and lateral fornix of the vagina to attach extensively on the pelvic wall at the level of the cervix ***(Susan et al., 2005).***

At the lateral margin of each broad ligament, the peritoneum is reflected onto the side of the pelvis. The thick base of the broad ligament is continuous with the connective tissue of the pelvic floor, the denest portion is usually referred to as the cardinal ligament, and is composed of connective tissue that medially is united firmly to the supra-vaginal portion of the cervix ***(Cunningham et al., 2005).***

2- Pubocervical ligament:

Fibres of the pubocervical ligament pass forward from the anterior aspect of the supra-vaginal cervix to diverge around the urethra.This fibres attach to posterior aspect of the pubic bone ***(Cunningham et al., 2005).***

3- The uterosacral ligament:

Each uterosacral ligament extends from an attachment postero laterally to the supravaginal portion of the cervix to encircle the rectum and inserts into the fascia lata over the sacrum. The ligaments are composed of connective tissue and some smooth muscle and are coverd by peritoneum. They form the lateral boundaries of pouch of Douglas. These cervical ligaments stabilize the cervix in approximately the center of the pelvis in non pregnant woman, while during pregnancy, they are the "guy ropes" the uterus pulls upon to expel the baby in the second stage of labour ***(Danforth, 1983); (Cunningham et al., 2005).***

Histology of the Cervix

Types of epithelium in the cervix:

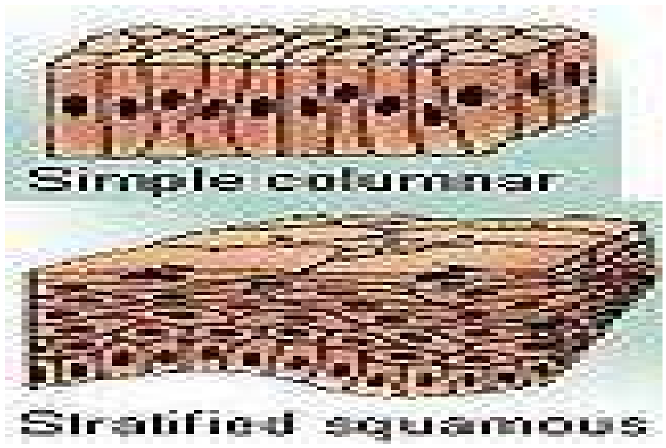

Figure (3): Simple columnar and stratifed squamous epithelium ***(Johanthan et al., 2002)***.

The epithelium of the cervix is varied. The ectocervix is composed of non keratinized stratified squamous epithelium, the endocervix is composed of simple columner epithelium. However, the intersection where these two epithelia meet (the squamocolumnar junction) is geographically variable and dependent on hormonal stimulation. It is the dynamic interface, the transformation zone that is most vulnerable to the development of squamous neoplasia ***(Johanthan et al., 2002).***

The mucosa of the cervical canal is composed of a single layer of very high ciliated columnar epithelium that rests on a thin basement membrane. Numerous cervical glands extend from the surface of the endocervical mucosa directly into the subjacent connective tissue. These glands furnish the thick cervical secretion ***(Cunningham et al., 2005).***

Cervical Connective Tissue:

The extracellular matrix is made up of collagen fibers and elastin separated by ground substance. The collagen gives the tissue tensile strength; the elastin gives the tissue elasticity.

1- The Cervical Stroma (Collagen):

The underlying cervical stroma is composed mainly of fibrous connective tissue, which is demonstrated by contrast stain to be almost entirely collagen. 50% of the total weight of the cervix is formed of collagen fibers. Collagen fibers of the cervix represent 82% of total cervical proteins ***(Danforth, 1983).***

During pregnancy, normally, the uterine cervix rearranges its collagen fibers. The non pregnant cervix contains collagen fibers that have a definite cable like structure and form fibril bundles. These fibrils appear wavy when viewed with a light microscope ***(Phyllis and Leppert, 1995).***

The basic molecule has a molecular weight of about 300.000 Dalton. It consists of three parallel individual polypeptide chain, wrapped around each other in "super- helix" much like the strands of rope ***(Uldbjerg et al., 1983a).***

2- Elastin:

Elastin has an important role in cervical physiology at the changes and control of elastin fiber concentration and distribution in physiological and pharmacological cervical ripening have been established. There is a reduction in cervical elastin during pregnancy and elastin may also be important in returning the cervix to a non pregnant shape following delivery ***(Leppert et al., 1987).***

Leppert and Yus (1992) demonstrated that the ratio of elastin to collagen is highest at the area of the internal os, meaning that there is more elastin fibers compared with collagen at the internal os, these elastin fibers are very thin compared with elastin fibers of other tissues.

Elastin fibers act as lubricant to allow the collagen fibers to slide by each other if stress is applied changes of the cervix during pregnancy cause a rearangment of collagen fibrils so that the tissues assumes the characteristic for soft easily distensible tissue ***(Phyllis and Leppret, 1995).***

3- Glycosaminoglycans:

Glycosaminoglycans (GAGs) are large unbranched polysaccharide chains composed of disaccharide repeating units that contain lexosamine (glycosamine or galactosamine) residue and usually an uronic acid (glucuronic acid or induronic acid) residue. Cervical GAGs constitute about 1% of the dry defatted tissue, which is similar to other connective tissues. The glycosaminoglycans dominate quantitatively, dermaton sulphates being the most common (52-73%) ***(Uldbjerg et al., 1983b).***

4- Proteoglycans:

A proteoglycan is made up of one or several GAGs connected to a protein core. A cervical dermaton sulphate proteoglycan has been isolated ***(Uldbjerg et al., 1983c).***

The average molecular weight ranging from 73000 to 110500 dalton. The aminoacid composition is characterized by high contents of aspartic acid, glutamic acid and leucine. The GAGs are glycosaminoglycans with a copolymeric structures similar to cervical dermaton sulphate. The function of the dermaton sulphate proteoglycan is unknown, although histological observations suggest an interaction with collagen ***(Uldbjerg, 1989).***

5- Glycoproteins:

The protein cores of glycoproteins are combined with different amounts of oligosaccharides. Glycoproteins have been reported to be present in the uterine cervix ***(Uldbjerg et al., 1983b).*** It has been suggested that these glycoproteins originate from the mucus localized intra-cellularly and incrypts ***(Uldbjerg, 1989).***

Muscle:

The outer quarter or third of the wall is muscular like the inner and major part consist of cellular connective tissue, rich in collagen and containing some bundles of immature muscle fiber. The outer muscle layer is the extrinsic muscle of the cervix forming the bulk of cervix. It contains scattered muscle bundles. Which are referred to as intrinsic muscle of the cervix. The cervix consists of an outer narrow contractile layer and an inner broad from non contractile mass ***(Danforth, 1983).***

Cyclic changes in the cervix:

Although it is condiguous with the body of the uterus, the cervix of the uterus is different in a number of ways, the mucosa of the cervix does not undergo cyclic desquamation, but there are regular changes in the cervical mucous. Estrogen makes the mucus thinner and more alkaline, that promote the survival and transport of the sperm. Progesteron makes it thick, tenacious, and cellular. The mucus is thinnest at the time of ovulation, and its elasticity or spinnbarkeit, increases so by midcycle, a drop can be stretched into a long thin thread that may be 8-12 cm or more in length. In addition, it dries in an arborizing, fernlike pattern when a thin layer is spread on a slide. After ovulation and during pregnancy it becomes thick and fails to form the fern pattern ***(Alan and Decherney, 2007).***

Cervical Changes during Pregnancy:

During pregnancy, the length of the cervix remains relatively unchanged but it varies in width by about 1 to 2 cm. The external os usually remains firmly closed up to the 15th week of pregnancy. From the 15th to 20th week it dilates in 30% of primigravidas and in 39% of multigravidas. In the subsequent course of pregnancy, the external os dilates in a further number of women ***(Mclnnes et al., 1980).***

The process of connective tissue remodeling in the cervix during pregnancy occurs in four stages: softening, ripening, dilation, and repair. Although overlapping in time, each stage is uniquely regulated ***(Word et al., 2007).***

Although the cervix contains a small amount of smooth muscle, its major component is connective tissue. Rearrangement of this collagen- rich connective tissue is necessary to permit functions as diverse as maintenance of a pregnancy to term, dilatation to facilitate delivery, and repair following parturition so that a successful pregnancy can be repeated ***(Ludmir and Sehdev, 2000).***

The glands of the cervix undergo such marked proliferation that by the end of pregnancy they occupy approximately half of the entire cervical mass, rather than a small fraction as in the nonpregnant state. These normal pregnancy-induced changes represent an extension, or eversion, of the proliferating columnar endocervical glands. The endocervical mucosal cells produce copious amounts of a tenacious mucus that obstruct the cervical canal soon after conception. This mucous is rich in immunoglobulins and cytokines ***(Kuttch and Franklin, 2001).***

Remodeling is an anabolic process regulated by the hormonal milieu of pregnancy. During this phase, collagen, proteoglycans, and glycosaminoglycans are deposited into the extracellular matrix. An increased deposition of hyaluronate leads to an influx of water that is associated with cervical softening. The alterations in the proportion of collagen, proteoglycans, and glycosaminoglycans are believed to contribute to the progressive decline in cervical tensile strength, as is a gradual decrease in collagen fibril length ***(Albert and John, 2006).***

The cervix performs two opposite functions during pregnancy: it maintains the fetus in utero and then dilates with the onset of labor. Cervical biomechanics and biochemistry are less well understood than that of the myometrium, although greater attention has been paid to the cervix in the past decade, since the recognition that early cervical shortening often precedes the increased uterine activity associated with preterm delivery ***(Welsh & Nicolaides, 2002).***

Regulation of this process is poorly understood, although a number of pharmacologic and mechanical methods artificially