ROLE OF THERMOGRAPHY IN CERVICAL PATHOLOGY

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Abstract

Cervical Cancer is the fourth-most common cause of cancer and also the fourth-most common cause of death from cancer in women. Diagnosis of the uterine cervical lesions remains a key element of the women's health care especially in the context of the cervical carcinoma prophylaxis. The Digital Infrared Thermal Imaging (DITI) constitutes a new generation biophysical potential diagnostic modality in the field of medicine. The purpose of this study is to analyze various thermographic patterns observed in both physiology and pathology of uterine cervix and to establish the standard thermographic pattern which helps in early diagnosis and consequently reducing the mortality and morbidity. The study population consisted of 130 women aged from 20 to 70 years collected by screening all females through mass campaign and also referred cases with cervical complaints from the Department of Obstetrics and Gynecology. The thermograms obtained were correlated with clinical, cytologic and colposcopic findings. In total, 130 thermo graphic patterns were analyzed. We found 52 normal thermograms, abnormal thermograms of cervical lesions such as cervicitis (40 patients), retention cyst (18 patients), endocervical polyp (8 patients) Ca cervix-pap smear positive (8 patients), invasive carcinoma (4 patients) were studied. Statistically significant differences were found in thermographic profiles of the portion between the normal cervix and cervical lesions such as cervicitis, carcinoma in-situ and invasive cancer. The advantages are early detection, radiation free, non-invasive, painless and cost effective modality.

Keywords: Thermal Imaging, Carcinoma cervix, Cervicitis, Thermograms.

Introduction: Human-being is a homeotherm, capable of maintaining a constant temperature of the body, which may be different from surrounding temperature [1]. The body of homeotherms can be divided into two parts, viz. the inner core and the outer periphery. The core temperature is preserved within a
narrow limit (approximately 42–33°C)\cite{2,3].

regulation of inner core temperature is essential for normal performance of human body.

Figure 1. Med 2000 IRIS Elite camera and its Output

Change of core temperature by a few degrees is considered as a clear indication of probable illness. "Therme" means HEAT & "Graphos," means writing or drawing technique for detecting & measuring variations in the heat emitted by various regions of the body & transforming them into visible signals that can be recorded photographically, diagnosing abnormal or diseased underlying conditions.

The Principle behind Thermography is that, it converts the infrared radiation emitted from skin into electrical impulses and feeds the information into a Computer. The Computer analyzes the temperature, vascular changes and produces high-resolution images known as Thermograms. The images can be displayed on a monitor for analysis, with areas of raised temperature appearing RED and areas of below normal temperature appearing BLUE. (Fig 1b).

Materials and Methods

This is a descriptive study conducted in the Department of Radiology (SLIMS, Pondicherry) using a non-contact thermographic camera MED2000 IRIS Elite for a period of two years from November 2013 to November 2015 to evaluate the role of Thermal Imaging as screening modality in early detection of inflammatory lesions and non-inflammatory cancerous conditions. The study population consisted of 130 women...
aged from 20 to 70 years by screening all females through mass campaign and also referred cases with cervical complaints from the department of obstetrics and gynecology. The thermograms obtained were correlated with clinical, cytological and colposcopic findings.

**Results and discussion:**

In total, 130 thermographic patterns were analyzed. We found 52 normal thermograms, abnormal thermograms of cervical lesions such as cervicitis (40 patients), retention cyst (18 patients), endocervical polyp (8 patients), Ca cervix in-situ pap smear positive (8 patients), invasive carcinoma (4 patients) were studied. The above mentioned results are demonstrated in Chart 1.

![Chart 1: Normal and Abnormal Cervical Thermogram](image-url)

**Figure 2a.** Shows normal thermographic pattern of cervix and endocervical canal with well-defined distinct margins: **Figure 2b.** Shows hyperthermic inflammatory changes of the cervix suggesting possibility of cervicitis: **Figure 2c.** Shows histologic picture of cervix infiltrated by mononuclear inflammatory cells.
Cervicitis is inflammation of the uterine cervix. Cervicitis in women has many features in common with urethritis in men and many cases are caused by sexually transmitted infections.[4,5] Non-infectious causes of cervicitis can include intrauterine devices, contraceptive diaphragms, and allergic reactions to spermicides or latex condom.

Cervicitis can be caused by any of a number of infections, of which the most common are Chlamydia and gonorrhea with Chlamydia accounting for approximately 40% of cases. In our study, we found forty abnormal thermographic patterns with normal contour of the cervix suggesting the possibility of cervicitis which was further confirmed by clinical and histopathological correlation.

2. Benign Conditions: Retention Cyst and Endocervical Polyp

A nabothian cyst or retention cyst is a mucus-filled cyst on the surface of the cervix. This tissue growth can block the cervical crypts, trapping cervical mucus inside the crypts. A cervical polyp is a common benign polyp or tumor on the surface of the cervical canal.[6] Symptoms if present include inter-menstrual bleeding, abnormally heavy menstrual bleeding (menorrhagia), vaginal bleeding in post-menopausal women, bleeding after sex and thick white vaginal or yellowish discharge (leucorrhoea). Cervical polyps can be seen during a pelvic examination as red or purple projections from the cervical canal. Diagnosis can be confirmed by a cervical biopsy which will reveal the nature of the cells present. 99% of cervical polyps will remain benign and 1% will at some point show neoplastic change [7] we found eighteen cases of retention cyst and eight cases of endocervical polyp showing abnormal thermographic patterns in our study.

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Period from (JUL–DEC: 2016)
3. Carcinoma In Situ

Figure 4a. Shows focal hyperthermic patch in anterior wall of cervix: Figure 4b: Biopsy Cervix Carcinoma in Situ- shows variation in size and shape of the nuclei, involving the full layer of the epithelium. The polarisation of the cells is lost.

Figure 5a. Altered contour of posterior lip of cervix showing Hyperthermic thermogram : Figure 5b. PAP SMEAR shows high grade Squamous Intraepithelial Lesion with large size of nucleus, irregular nuclear border and hyperchromasia. No features of invasion were noted

Cervical squamous intraepithelial lesion (SIL), previously called cervical intraepithelial neoplasia (CIN), is a form of dysplasia that can progress to cervical cancer. The term carcinoma in situ may be used interchangeably with high-grade SIL[8]. Carcinoma in situ is, by definition, a localized phenomenon, with no potential for metastasis unless it progresses into cancer. Therefore, its removal eliminates the risk of subsequent progression into a life-threatening condition. In our study, abnormal hyperthermic patches seen in eight patients subsequently turned out to be Carcinoma-in-situ in PAP smear and biopsy correlation.
4. Invasive Carcinoma

Figure 6a. Irregular Contour of cervix showing hyperthermic patch extending to adjacent Region Figure 6 b. Biopsy Cervix reveals Invasive Carcinoma –Large Cell Non Keratinizing The Lesion Shows Tumor Cell Invading Into Cervical Stroma

Invasive cervical carcinoma is thought to arise from the transformation of cervical intraepithelial neoplasia (CIN). Cervical squamous cell carcinoma arises from the squamocolumnar junction while adenocarcinomas arise from the endocervix. This is situated on the ectocervix in younger patients though regresses into the end cervical canal with age. Hence cervical tumors tend to be exophytic in younger patients and entophytic with advancing age. Our study shows abnormal hyperthermic cervical patterns seen extending to the adjacent parametrium and perineum which was subsequently proved as invasive carcinoma with clinical and histopathological correlation.

The main histological types are:

• squamous cell carcinoma of the cervix: accounts for the vast majority (80-90%) of cases and is associated with exposure to human papilloma virus (HPV)
• adenocarcinoma of the cervix: rarer (5-20%) and can have several sub types which include [9,10]
  o clear cell carcinoma of the cervix
  o endometroid carcinoma of the cervix: ~7% of adenocarcinomas [11]
  o mucinous carcinoma of the cervix
  o adenoma malignum: ~3% of adenocarcinomas
  o serous carcinoma of the cervix
  o mesonephric carcinoma of the cervix: ~3% of adenocarcinomas [12]
• neuroendocrine tumours of the cervix
  o Small cell carcinoma of the cervix: rare (0.5-6%) [13,14]
• adenosquamous cell carcinoma of the cervix: rare
Human papillomavirus (HPV) infection must be present for cervical cancer to occur. Complete evaluation starts with Papanicolaou (Pap) testing.

Screening recommendations

Current screening recommendations for specific age groups, based on guidelines from the American Cancer Society (ACS), the American Society for Colposcopy and Cervical Pathology (ASCCP), the American Society for Clinical Pathology (ASCP), the US Preventive Services Task Force (USPSTF), and the American College of Obstetricians and Gynecologists (ACOG), are as follows [15,16,17,18,19,20]:

- < 21 years: No screening recommended
- 21-29 years: Cytology (Pap smear) alone every 3 years
- 30-65 years: Human papillomavirus (HPV) and cytology contesting every 5 years (preferred) or cytology alone every 3 years (acceptable)
- > 65 years: No screening recommended if adequate prior screening
has been negative and high risk is not present

**Scope of the Study**

Thermal imaging is an absolutely harmless imaging methodology. Although the specificity of this modality is less but it can be compensated by correlation with clinical and histopathological examination which can enhance its ability as a screening tool.

**Conclusion**

The established thermo graphic mapping patterns of the normal cervix may form a basis for the future evaluation of the diagnostic application of computer thermograph in gynecology. Statistically significant differences were found in thermographic profiles of the portion between the normal cervix and cervical lesions such as cervicitis, carcinoma in-situ and invasive cancer. The advantages are early detection, radiation free, non-invasive, painless and cost effective modality.

**References**


