

# USE OF COMPACT DIGITAL CERVICOGRAPHY: AN ADJUVANT SCREENING TOOL FOR PRECANCEROUS CERVICAL LESIONS

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## SUMMARY

**Objective:** In an attempt to develop a new model to screen for cervical cancer, we set up a digital camera mounted with a macro lens for cervicography. This digitalized compact form of cervicography with the Reid colposcopic index (RCI) can be applied as an adjuvant tool to screen for abnormal Papanicolaou (Pap) smears.

**Materials and Methods:** Among 21,532 cases screened with a Pap smear, we enrolled 125 cases with precancerous smears for this prospective study. An 8-megapixel Canon digital camera with a macro lens and a light source comprised the compact digital cervicographic system. The results of compact digital cervicography were reported using the RCI scoring system. Cases with high-grade squamous intraepithelial lesion or atypical glandular cells of undetermined significance were transferred to medical centers for further confirmation and management. In total, 119 cases underwent compact digital cervicography. The data were analyzed with the McNemar test.

**Results:** With the digitized results of compact digital cervicography, we were able to show patients with precancerous Pap smears their cervix and help them understand its status. For patients with an abnormal Pap smear, the results of performing compact digital cervicography combined with the RCI scoring system were statistically significant ( $p < 0.05$ ).

**Conclusion:** The use of compact digital cervicography with the RCI scoring system is a significant device for screening abnormal Pap cases. It helps to improve patient care. Further research is required to understand the discrepancies among diagnostic results of Pap smears (the Bethesda system), cervicography with RCI, and histopathology. [*Taiwan J Obstet Gynecol* 2008;47(2):187–191]

**Key Words:** Bethesda system, compact digital cervicography, Papanicolaou smear, Reid colposcopic index

## Introduction

The incidence of cervical cancer mortality dramatically dropped with the introduction of Papanicolaou (Pap) smears [1]. Pap smears, colposcopy, cervicography, and ThinPrep liquid-based smears are well-known tools for screening for cervical cancers. The 2001 Bethesda system terminology is currently used for reporting Pap smears [2]. False-negative error rates of Pap smears are reported

to vary from 20.0% to 44.9% [3]. Colposcopy with a targeted biopsy is an end point or can confirm the histologic diagnosis of cervical cancer screening. The inter-observer agreement of pathologists examining cervical histologic tissue was only fair (with a kappa value of 0.358) [4]. An accurate colposcopic impression provided by a structural analysis is very important [4].

Stafl developed cervicography in 1981. Kim et al [5] mentioned that cervicography might be applied for mass screening, although it was not a replacement for colposcopy. Obtaining a quality cervicographic picture is very easy and can be done by doctors, nurses, and technicians. Evaluating cervicographic slides, however, must be done by experts in colposcopy, and it is time-consuming. Critics frequently ask why clinicians do not simply apply acetic acid and look at the acetowhite area with the



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naked eye [5]. Digital cervicography with the ability for online transmission and digital processing was recently developed. It is a modern modification for mass screening and texture analysis [1]. Using a model of compact digital cervicography with the Reid colposcopic index (RCI) scoring system, we examined the correlation between abnormal Pap smears (with the Bethesda system) and histopathology results.

At the Maternal and Child Health Center, Taiwan Area (MCHT), Taipei, Taiwan, we set up a prospective study with compact digital cervicography as a tool for cervical cancer screening. The instrument comprised a digital single lens reflex camera, a macro lens, a light source, and a personal computer. These are conveniently and commercially available and are more economical than the usual colposcope.

Gynecologic physicians often have to face extremely anxious patients who have received an abnormal Pap report indicating precancerous lesions or cancer. A psychologic analysis reported that women receiving a colposcopic diagnosis experience a high level of anxiety. The introduction of visual information in the form of an explanatory video prior to attendance significantly reduced anxiety [6]. We try to help such patients by displaying digital images of the cervix with an explanation. The results may help patients with precancerous Pap smears (especially atypical squamous cells of undetermined significance [ASCUS] cases) to follow the procedures for cancer screening.

## Materials and Methods

From June 2005 to October 2006, 21,532 Pap smears were performed at MCHT. We found 597 cases with precancerous lesions. Table 1 presents the percentage

distribution of precancerous lesions at MCHT and in Taiwan as reported by the Bureau of Health Promotion, Department of Health, Taiwan [7]. We used a Chi-squared test to test the homogeneity of the proportions, and they were similar ( $p=0.997$ ,  $p>0.05$ ) (Table 1).

Patients in all cases with an abnormal Pap smear were informed by both telephone and mail, but 472 of them did not return to our specialty clinic. We ultimately enrolled 125 cases in this prospective study. There were 95 cases graded as ASCUS, three cases graded as atypical glandular cells of undetermined significance (AGCUS), 20 cases graded as low-grade squamous intraepithelial lesion (LSIL), and seven cases graded as high-grade squamous intraepithelial lesion (HSIL) (Table 1). The patients were aged between 29 and 71 years.

Among the 125 cases, patients in six cases did not accede to the study. The reasons included that three patients with ASCUS grade refused to undergo compact digital cervicography and another three patients with AGCUS grade were directly transferred to medical centers. In total, 119 patients with cervical precancerous lesions participated in this study.

In the clinic, the following procedures were completed in all 119 cases: (1) interpreting the Pap smear report for the patient; (2) performing compact digital cervicography with the RCI scoring system and explaining the result; (3) performing a liquid-based smear; and (4) preparing a referral sheet for the HSIL case to a medical center, after completing the previous three procedures.

For compact digital cervicography, we created an instrument comprising a Canon 350D digital camera with a Canon EFS 60-mm macro lens and a circular-shaped continuous light source. The digital camera had 8-megapixel facility. The macro lens can produce a 1:1 actual-sized picture (Figure 1). The camera was fixed on a tripod. The compact form of the digital cervicoscope is shown in Figure 2. A personal computer with a display screen can help the doctor explain the digital images of the cervix to the patient. During the digital cervicographic examination, the cervix was cleansed with 3% acetic acid for visual inspection of acetowhite. Lugol's solution was then applied for the Schiller test.

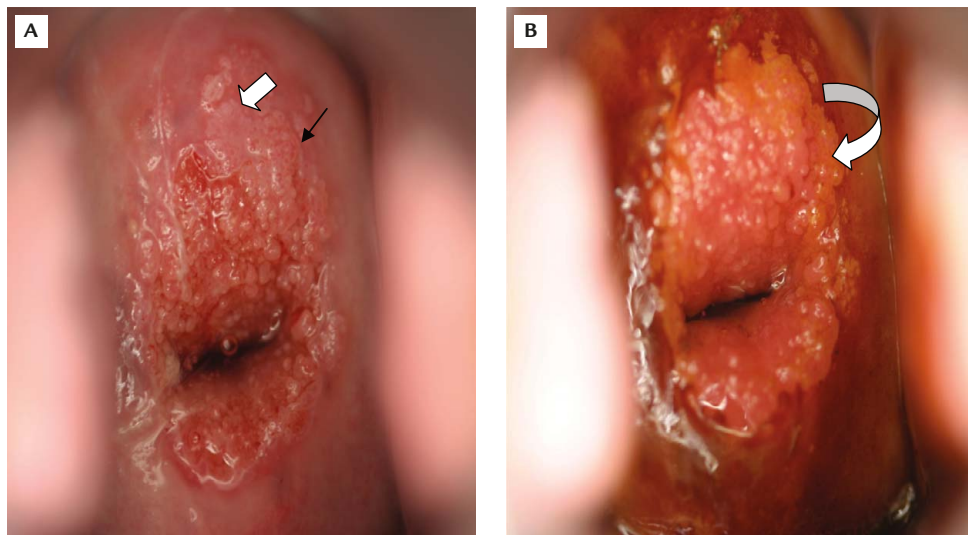
As mentioned by Ferris et al [8], the RCI can predict the histologic grade of cervical disease. The purpose of this prospective study was to examine the correlation between the Pap smear (Bethesda system) and histopathology results with the aid of compact digital cervicography and the RCI scoring system. All changes from Bethesda grades by the Pap smear to RCI scores by compact digital cervicography were recorded.

The total RCI score represents a weighted scoring system predictive of the severity of premalignant cervical

**Table 1.** Comparison of percentage distributions of precancerous lesions at the Maternal and Child Health Center, Taiwan Area (MCHT) and in Taiwan

Grade of Pap smears	At MCHT (%)	In Taiwan (%) <sup>*</sup>
ASCUS ( $n=95$ ) <sup>†</sup> / AGCUS ( $n=3$ ) <sup>‡</sup>	1.75	1.6
LSIL ( $n=20$ )	0.26	0.7
HSIL ( $n=7$ )	0.17	0.5

Chi-squared test:  $p=0.997$ ,  $p>0.05$ . <sup>\*</sup>According to the document issued by Bureau of Health Promotion, Department of Health, Taiwan [7]; <sup>†</sup>three cases of atypical squamous cells of undetermined significance (ASCUS) did not undergo compact digital cervicography; <sup>‡</sup>three cases of atypical glandular cells of undetermined significance (AGCUS) were transferred to medical centers. LSIL = low-grade squamous intraepithelial lesion; HSIL = high-grade squamous intraepithelial lesion.



**Figure 1.** (A) Actual-sized digital cervicogram showing acetowhite (broad arrow) and mosaic (arrow) areas at the upper lip of the uterine cervix. (B) Lugol-unstained change (curved arrow) over the acetowhite area of (A) is noticed.



**Figure 2.** The compact digital "cervicocamera".

lesions. In general, the lower the RCI score, the less serious the disease. Total RCI scores of 0 to 2 are predictive of mild dysplasia (cervical intraepithelial neoplasia [CIN] 1) as reported by Ferris et al [8,9]. We know that CIN 1 lesions can regress or progress. CIN 1 may represent the state of cells progressing from ASCUS, LSIL, and RCI 0–2. To evaluate the correlations between the results of compact digital cervicography under the RCI system and Pap smears under the Bethesda system, all patients were classified into two groups. One group predictive of CIN 1 included patients with low-grade lesions such as ASCUS, LSIL, and RCI 0–2. The other group predictive of CIN 2 and 3 included patients with moderate to severe dysplasia such as HSIL and RCI

3–8. All changes in the classification after using compact digital cervicography with the RCI scoring system were recorded. We used the McNemar test to analyze the effect of performing compact digital cervicography combined with the RCI scoring system.

Finally, there were four HSIL cases transferred to medical centers to undergo histopathologic examinations. We analyzed the results of the Pap smear, compact digital cervicography with RCI, and the histopathologic diagnoses of these four cases.

## Results

In total, 119 cases of precancerous lesions underwent compact digital cervicography combined with the RCI scoring system. The case distributions of screening results by the Pap smear under the Bethesda system and compact digital cervicography with the RCI scoring system are shown in Table 2. There were 92 ASCUS cases, 20 LSIL cases, and seven HSIL cases from the results of the Pap smear. After performing compact digital cervicography, 93 cases had RCI scores of 0–2, and 26 cases had RCI scores of 3–8.

All patients were classified into two groups before and after performing compact digital cervicography with RCI (Table 3). One group predictive of CIN 1 included patients with low-grade lesions such as ASCUS, LSIL, and RCI 0–2. The other group predictive of CIN 2 and 3 included patients with moderate to severe dysplasia such as HSIL and RCI 3–8. There were 112 cases of ASCUS or LSIL (by the Pap smear) classified into the group predictive of CIN 1. After performing cervicography with RCI, 92 cases remained in the same

**Table 2.** Case distribution of screening results by Pap smear and digital cervicography with the Reid colposcopic index (RCI) scoring system

Grade of Pap smear	RCI score by compact digital cervicography								
	0	1	2	3	4	5	6	7	8
ASCUS ( <i>n</i> = 92)	60	10	8	8	3	0	0	3	0
LSIL ( <i>n</i> = 20)	6	4	4	3	0	2	0	0	1
HSIL ( <i>n</i> = 7)	1	0	0	2	1	1	1	1	0

ASCUS = atypical squamous cells of undetermined significance; LSIL = low-grade squamous intraepithelial lesion; HSIL = high-grade squamous intraepithelial lesion.

**Table 3.** McNemar test of changes after using compact digital cervicography with the Reid colposcopic index (RCI) scoring system

PAP smear (Bethesda)	Compact digital cervicography with RCI scoring system		
	Predictive of CIN 1	Predictive of CIN 2 and 3	Total
Predictive of CIN 1	92	20	112
Predictive of CIN 2 and 3	1	6	7
Total	93	26	119

McNemar test:  $\chi^2 = 15.429$ ;  $\chi^2_{95}(1) = 3.841$ ;  $\chi^2 > \chi^2_{95}(1)$ ;  $p < 0.05$ . CIN = cervical intraepithelial neoplasia.

**Table 4.** Results of Pap smear, compact digital cervicography with the Reid colposcopic index (RCI), and histopathology of four cases

Case	Pap (Bethesda grade)	Digital cervicography with RCI	Histopathology
Case A	Dysplasia but cannot exclude HSIL (17)	RCI 0	Inflammatory changes
Case B	Severe dysplasia HSIL (9)	RCI 4	Koilocytosis, cervical erosion
Case C	Moderate dysplasia HSIL (8)	RCI 5	CIN 2 HSIL, CIN 1 koilocyte
Case D	Severe dysplasia HSIL (9)	RCI 6	CIN 3 CIS

HSIL = high-grade squamous intraepithelial lesion; CIN = cervical intraepithelial neoplasia; CIS = carcinoma in situ.

group and 20 cases were changed to the group predictive of CIN 2 and 3. There were seven cases of HSIL (by the Pap smear) classified into the group predictive of CIN 2 and 3. After performing cervicography with the RCI, six cases remained in the same group and one case was changed to the group predictive of CIN 1. A McNemar test was used to analyze changes in classification after performing compact digital cervicography with the RCI scoring system. The effect of applying compact digital cervicography was statistically significant ( $p < 0.05$ ; Table 3).

We found that the video explanation helped patients understand their cervical state and decrease anxiety about their illness [6]. We also noted that 60 cases of ASCUS grade fell into RCI 0. RCI 0 means that there were low-grade lesions under the definition of RCI scoring. These represent potentially benign changes of a human papillomavirus infection or mild dysplasia and are not usually equal to normal [9], yet it helped relieve

the state of extreme anxiety experienced by our patients. The use of this modern version of compact digital cervicography with RCI resulted in good patient care.

Table 4 shows some pathologic evidence of the four HSIL cases. For cases C and D, the results among the Pap smear (Bethesda), histopathology, and compact digital cervicography with the RCI scoring system were coincident. For case A, the RCI score was 0, and the histologic report was “inflammatory change, no evidence of dysplasia”, although the original Pap smear indicated “dysplasia, but cannot exclude HSIL”. For case B, there were discrepancies among the results of the Pap smear, histopathology and compact digital cervicography. We got 75% coincidence and 25% discrepancy between the RCI scoring system and histopathology with the aid of compact digital cervicography for the four cases of precancerous lesions. Although there were only a few cases, the evidence confirming the coincidence between RCI and histopathology encouraged us

to apply compact digital cervicography as an adjuvant screening tool for cervical precancerous lesions.

## Discussion

A confirmatory diagnosis of cervical cancer must depend on a biopsy for histologic proof, but the pathology report requires much time. The accuracy of mass screening techniques is quite important for both doctors and patients. In Taiwan, the Pap smear is a standard method for mass screening. The false-negative error rates of Pap smears ranged from 20.0% to 44.9% [3]. In India, visual inspection acetowhite (VIA) screening combined with a colposcopic examination for VIA-positive cases has been reported to have almost 100% sensitivity [10]. In Iran, the sensitivity of VIA is about 74% [11]. The VIA method is also approved by the World Health Organization as an alternative to cytology to determine patients at risk for cervical cancer [10,12].

In recent studies, the RCI scoring system can predict histologic grades of cervical disease with low-grade precancerous lesions [8]. The use of compact digital cervicography with the RCI scoring system was shown to be a significant method in this study. This encouraged us to apply compact digital cervicography as an adjuvant screening tool for cervical precancerous lesions.

The use of compact digital cervicography with the RCI scoring system can also help patients realize the state of the cervix. As compact digital cervicography can present a visual explanation to patients, it can decrease the anxiety and help patients follow the guidelines for cancer screening.

Compact digital cervicography can easily be processed digitally and transmitted over the Internet. It can also be used for remote learning and for texture analysis or computer-aided diagnosis for classification of cervical lesions in the future [1].

In our study, there were some discrepancies among the results of the Pap smear (Bethesda), cervicography

with RCI, and histopathologic diagnoses. Therefore, further research efforts are still required.

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