Precancerous Lesions of the Cervix, Vulva and Vagina According to the 2014 WHO Classification of Tumors of the Female Genital Tract

Systematik der präinvasiven Läsionen von Zervix, Vulva und Vagina nach der WHO-Klassifikation 2014 „Tumours of the Female Genital Tract“

The field of medicine is subject to a continuous process of development with constant updates, meaning that classifications need to be continually re-evaluated and adapted to the current level of knowledge. Important scientific findings in recent years have led to a new WHO terminology for precancerous lesions of the cervix, vulva and vagina which are discussed below.

1 Precancerous lesions (dysplasias) of the cervix

1.1 Historical terminology

Based on studies carried out by Schauenstein, Schottländer and Kernauer in the early decades of the 20th century, the term “carcinoma in situ” (CIS) was introduced into general medical terminology by Broders in 1932 to describe precancerous lesions of the squamous epithelium. This was a revolutionary step, as most of the medical community at the time doubted the existence of a preinvasive stage for invasive carcinoma. The term “dysplasia” goes back to Reagan, who first used it in 1953 to describe all atypical and abnormal differentiations of the squamous epithelium which were less pronounced than those occurring in CIS. In 1963 Koss presented the theory, since disproved, that all cervical dysplasias, irrespective of their degree of severity (i.e., including even mild and moderate dysplasia), could progress to invasion, although the incidence of progression differed. The CIN terminology, which divides the lesions into 3 main groups and is still widely used today, was introduced by Richart in 1968. He used it to describe a continuous progression from mild (CIN 1) to moderate dysplasia (CIN 2) and finally to severe dysplasia or carcinoma in situ (CIN 3). At a workshop held in Bethesda (Maryland) in 1990, Richart transferred the already existing nomenclature used in cervical cytology which differentiated low-grade from high-grade lesions into 3 main groups and is still widely used today. Important scientific findings in recent years have led to a new WHO terminology for precancerous lesions of the cervix, vulva and vagina which are discussed below.

1.2 Current classification of WHO 2014

The current WHO classification of precancerous lesions of cervical squamous epithelium is based on new findings on HPV-related carcinogenesis; the key assumption in this context is that two early genes of HPV (E6 and E7) trigger neoplastic transformation of the squamous epithelium. This capacity to induce neoplastic transformation requires a specific expression pattern of E6 and E7, which only occurs in a small percentage of HPV infections. These types are referred to as transforming HPV infections [1].

Transforming infections are usually associated with HPV high-risk genotypes. After constant expression of E6 and E7 oncogenes the oncoproteins encoded by E6 and E7 bind to to cell cycle proteins, leading to loss of cell cycle control. Mutations gradually accumulate and cells become genetically unstable. Morphological findings are moderate or severe dysplasia of the cervical squamous epithelium (CIN 2 or CIN 3), which are summarized in the WHO classification as HSIL. At this stage disruption of the cell cycle led to an accumulation of tumor suppressor gene p16 which
can be demonstrated in an immunohistochemical examination with antibody to p16ink4a with overexpression of p16, when a continuous staining of all atypical epithelial cells including basal keratinocytes is observed. At colposcopy these lesions generally correspond to type 2 changes (major changes). HSIL have a significant risk of progression to invasive carcinoma [1–3]. In permissive (productive) HPV infections, expression of the viral genes E6 and E7 only occurs in basal cells in the squamous epithelium which are capable of regeneration and is therefore controlled. Permissive (productive) HPV infections can be caused by low-risk and/or high-risk HPVs. In low-risk HPV infections LSIL reveals a focal discontinuous staining with p16ink4a antibody (no overexpression, irrespective of the percentage of p16ink4a staining) as the binding affinity of low-risk HPV oncoproteins to the cell cycle proteins is significantly lower than the binding affinity of high-risk HPV oncogenes. Morphological findings are koilocytic changes and/or the development of condyloma or mild dysplasia (CIN 1). The WHO classifies these changes as LSIL. After several months T-cells generally begin to detect viral antigens, so that the majority of permissive (productive) HPV infections disappear again within one or two years. A minority of LSIL cases are caused by high-risk HPV. These lesions show overexpression of p16ink4a in the basal third of the epithelium. According to the current state of knowledge, the clinical procedure for p16ink4a reveals a focal discontinuous staining with p16ink4a antibody (no overexpression, irrespective of the percentage of p16ink4a staining) as the binding affinity of low-risk HPV oncoproteins to the cell cycle proteins is significantly lower than the binding affinity of high-risk HPV oncogenes. Morphological findings are koilocytic changes and/or the development of condyloma or mild dysplasia (CIN 1). The WHO classifies these changes as LSIL. After several months T-cells generally begin to detect viral antigens, so that the majority of permissive (productive) HPV infections disappear again within one or two years. A minority of LSIL cases are caused by high-risk HPV. These lesions show overexpression of p16ink4a in the basal third of the epithelium. According to the current state of knowledge, the clinical procedure for p16ink4a staining is significantly lower than the binding affinity of high-risk HPV oncogenes. Morphological findings are koilocytic changes and/or the development of condyloma or mild dysplasia (CIN 1). The WHO classifies these changes as LSIL. After several months T-cells generally begin to detect viral antigens, so that the majority of permissive (productive) HPV infections disappear again within one or two years. A minority of LSIL cases are caused by high-risk HPV. These lesions show overexpression of p16ink4a in the basal third of the epithelium. According to the current state of knowledge, the clinical procedure for p16ink4a staining is significantly lower than the binding affinity of high-risk HPV oncogenes. Morphological findings are koilocytic changes and/or the development of condyloma or mild dysplasia (CIN 1). The WHO classifies these changes as LSIL. After several months T-cells generally begin to detect viral antigens, so that the majority of permissive (productive) HPV infections disappear again within one or two years.

Preinvasive lesions of rare subtypes of adenocarcinoma of the cervix (e.g., clear cell, serous, endometrioid, mesonephric, gastric-type, and minimal deviation adenocarcinoma) are insufficiently characterized and are therefore not classified separately [3].

### 1.3 Current joint classification of HPV-associated squamous intraepithelial lesions of the cervix, vulva and vagina, WHO 2014 (Table 1)

As the pathogenesis of HPV-related cancers in the squamous epithelium of the cervix, vulva and vagina is comparable, the current WHO terminology uses the previously mentioned diagnostic categories LSIL and HSIL to classify HPV-associated lesions in all three organs [2, 5, 6]. (Table 1): LSIL therefore includes all lesions (koilocytic changes, flat condyloma, mild dysplasia) resulting from permissive (productive) HPV infection of the squamous epithelium of the cervix, vulva or vagina. Pointed condylomas are classified in the 2014 WHO classification among benign lesions of the squamous epithelium as variants of LSIL. HSIL includes moderate and severe HPV-associated dysplasias of the cervix, vulva and vagina (Table 1).

LSIL of the cervix, vulva and vagina have a high rate of spontaneous remission and only a low risk of progression to invasive carcinoma. HSIL of the cervix, vulva and vagina have a significant risk of progression to invasive carcinoma. The diagnostic categories CIN 1, VIN 1 (usual type) and VAIN I can also be continued to be used synonymously for LSIL, just as CIN 2, CIN 3, VIN 2 (usual type), VIN 3 (usual type), VAIN 2 and VAIN 3 can be used synonymously for HSIL. In clinical practice, adding the individual diagnostic criteria in brackets would be very useful (e.g., HSIL [CIN 2], LSIL [condyloma], etc.), and the authors would recommend doing so because of the differences in clinical course (i.e., different progression and regression rates of CIN 2 and CIN 3).

### 2 Preinvasive Lesions of the Vulva

#### 2.1 Historical terminology

In 1965 Kaufman and Gardner grouped premalignant changes of the vulva into three groups: erythroplasia of Queyrat, Bowen’s disease and carcinoma simplex, first described by Abell in 1965. Since 1976 the International Society for the Study of Vulvar Disease (ISVVD) uses the terms mild dysplasia (VIN 1), moderate...
dysplasia (VIN 2) and severe dysplasia (VIN 3). In 2004 the ISVVD introduced a two-part classification system, classifying lesions into HPV-positive usual-type VIN (formerly VIN 2/3) or HPV-negative differentiated VIN (dVIN)/simplex-type carcinoma in situ (CIS) [1].

2.2 Current 2014 WHO classification (Tables 1 and 3)
The WHO currently classifies vulvar lesions into two fundamentally different lesions of the squamous epithelium according to the different pathogenesis of the vulvar cancer (HPV-induced or HPV-negative): SIL and differentiated VIN (dVIN). SIL covers all HPV-associated intraepithelial lesions. In analogy to cervical and vaginal classifications, these vulvar lesions are differentiated into LSIL and HSIL. In contrast, dVIN refers to HPV-negative lesions which generally develop within the context of dermatoses (lichen sclerosus and lichen planus). In contrast to HPV-associated lesions (SIL), dVIN is not graded according to severity. Biologically dVIN corresponds to an in situ carcinoma, independently of histological differentiation. On immunohistochemical examination, dVIN typically does not overexpress p16INK4A. Around half of dVIN show a positive immunohistochemical reaction for p53 antibodies [5].

At colposcopy the changes found with HPV-induced precancerous vulvar lesions largely correspond to those found in the cervix and vagina. The signs of dVIN on colposcopy are still insufficiently described; most commonly they correspond to those reported for leukoplakia or, in rarer cases, erythroplakia [1]. While vulvar LSIL has a high rate of spontaneous remission, vulvar HSIL and dVIN have a significant risk of progression to invasive carcinoma (see also 1.3). Compared to HPV-induced precancerous lesions, dVIN tends to progress faster to invasive carcinoma, in some cases within less than 1 year [1, 5]. Genital Paget’s disease is another preinvasive epithelial vulvar lesion. Melanoma in situ is a non-epithelial preinvasive lesion [1, 5].

3 Current Classification of Preinvasive Vaginal Lesions, WHO 2014 (Table 1)
Preinvasive lesions of the vaginal squamous epithelium are generally associated with HPV and, as such, are currently differentiated by the WHO into LSIL and HSIL (see also 1.3). At colposcopy vaginal LSIL generally correspond to type 1 changes (minor changes), while HSIL usually present as type 2 changes (major changes). In rare cases, vaginal cancers develop independently of HPV, e.g. subsequent to lichen planus. The mechanism of HPV-independent cancers in the vaginal squamous epithelium is still insufficiently studied but is assumed to correspond to the development in the vulva. However, to date the WHO has not identified diagnostic criteria analogous to dVIN [1, 6].

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Conflict of Interest
None.

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