Epidermodysplasia verruciformis (EDV) is a rare inherited or acquired dermatosis associated with an increased risk of squamous cell carcinoma (SCC). We describe, for the first time to our knowledge, its frozen section pathologic characteristics and specific benefits of the use of Mohs micrographic surgery (MMS) in its setting.

EDV is characterized by an abnormal susceptibility to β-genotype human papillomavirus (HPV) infections causing persistent flat warts or pityriasis versicolor-like lesions with a tendency to be widespread over the body. Approximately 75% of EDV patients have a homozygous inactivating mutation in TMC6 (EVER1) and TMC8 (EVER2), creating susceptibility to HPV, notably the oncogenic subtypes HPV-5 and HPV-8, which increase the risks of keratinocyte atypia and SCC. Tumors arising from EDV lesions are numerous and evolve progressively starting in childhood or early adolescence, eventually leading to the formation of nonmelanoma skin cancer, predominantly SCC, in 30% to 70% of patients in the fourth or fifth decade of life. “Acquired EDV” is a term used to describe an EDV-like phenotype in immunocompromised hosts with defective cell-mediated immunity.

Relevant publications indexed in electronic databases (PubMed, Embase, Web of Science, and Cochrane Library) between inception of the database and June 19, 2021, were searched using permutations of the terms “EDV,” “epidermodysplasia verruciformis,” “Mohs,” “micrographic,” and “frozen.” The search revealed that EDV characteristics in MMS frozen sections have not been previously documented. We discuss 2 cases of EDV and EDV-like histopathologic findings identified in MMS frozen sections. In addition to describing the frozen section pathologic characteristics of EDV compared with those found in permanent sections, we indicate the differential diagnoses of similar clear cell changes in frozen section pathology to avoid diagnostic pitfalls.

CASE 1

A 52-year-old Caucasian man with a history of HIV-associated EDV that began 15 years previously and a significant history of EDV-associated SCCs presented for MMS of an SCC on the dorsal surface of the hand. In addition to the SCC, his intraoperative MMS frozen sections included classic histopathologic findings for EDV: acanthosis, gentle undulation, a thick granular layer with pronounced basophilic keratinohyaline granules, and large keratinocytes with correspondingly large nuclei in the granular and spinous layers with abundant blue-gray cytoplasm (Fig 1). Also noted were foci of parakeratosis isolated to the areas above the abnormal keratinocytes.

CASE 2

An 84-year-old Caucasian immunocompetent man without known EDV risk factors and a history
of multiple nonmelanoma skin cancers presented for MMS of an SCC on the forehead. His intraoperative MMS frozen sections revealed atypical keratinocytes and keratin pearls consistent with SCC, but also various foci of vacuolated cells in the epidermis with subtle blue-gray cytoplasm with large, deep purple, chunky granules and enlarged nuclei (Fig 2). Permanent sections submitted confirmed the frozen section findings of EDV-like changes (Fig 3).

**DISCUSSION**

Compared with permanent paraffin-embedded section histology (Fig 3), EDV and EDV-like changes observed in our laboratory on frozen section histology (Figs 1 and 2) appear to have a more subtle blue-gray cytoplasm. These findings may be even more challenging to interpret with other clear cell changes frequently observed in frozen sections. The differential diagnoses for the histologic changes found in EDV include other viral changes, Paget's disease, keratinocytic neoplasms with clear cell change, pagetoid spread SCC in situ, intraepithelial sebaceous neoplasms, and freeze artefact (Fig 4). A distinguishing characteristic is that the atypically enlarged clear cells in EDV are usually more present in the granular and spinous layers with enlarged, hyperchromatic, or centrally pyknotic nuclei. In comparison with case 1, the granules are more “dirty-appearing” and of different sizes; this could be related to differences in the granular layers themselves (ie, related to anatomic site) and/or HPV type.

It is also important to remember that incidental EDV-like changes, like those found in case 2, can be found in patients without a known history of inherited or acquired EDV. This finding has been
termed “EDV acanthoma” by dermatopathologists. Our description of the frozen section histology of EDV in case 2 raises the possibility that subtle EDV-like changes in frozen sections may be commonly overlooked and compels consideration of the clinical relevance of these findings. A case series of incidental EDV found in benign biopsy specimens showed that 3 of 5 cases were positive for HPV-5, which could suggest that the patients were at increased risk of developing SCC; however, the investigators were not able to obtain the clinical history of skin cancers in these patients. Nevertheless, EDV-HPV subtypes found in normal skin and eyebrow hairs have been linked to an increase in SCCs.

There is no satisfactory treatment for congenital or acquired EDV to date. Topical and systemic retinoids, high-dose oral cimetidine, intralesional interferon, and cidofovir generally lead to recrudescent EDV warts. Electrodessication, cryotherapy, imiquimod, 5-fluorouracil, and podophyllotoxin, which are effective treatment options for common verrucae, have been applied to EDV lesions with inconsistent success.

Although there is no reliable treatment for widespread EDV warts, we propose that MMS is a helpful modality in the setting of EDV. In addition to its inherent benefits of histologic confirmation of clearance while minimizing tissue loss and maximizing outcomes, MMS offers specific advantages in its context to EDV and EDV-like changes. First, it provides the advantage of recognizing the baseline EDV in constituent skin of patients with known EDV histories in order to differentiate cancer from baseline EDV. For example, the patient in case 1 had diffuse EDV in his intraoperative MMS frozen sections, which could make it challenging to differentiate clear cell keratinocyte carcinomas (eg, SCC in situ); however, MMS offered the advantage of seeing the baseline EDV in constituent skin. Additionally, when EDV-like changes are unexpectedly encountered, the Mohs micrographic surgeon can interpret the findings in the context of the patient and the histologic differential diagnoses we have described. We remind Mohs micrographic surgeons of EDV-like changes and encourage them to document them, even if small foci, as “EDV-like change” or “EDV acanthoma,” as this may aid in studying these lesions in the future for any further implications.

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Conflicts of interest
None disclosed.

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