Introduction

Dermatologic ultrasound imaging has been rapidly growing in recent years because of the development of high-resolution multifrequency transducers and multichannel color Doppler machines [1]. The international working group, called DERMUS (Dermatologic Ultrasound) was formed and provided the guidelines for performing dermatologic ultrasound examinations [1] and proposed for an assessment training program [2]. The minimum frequency recommended for performing dermatologic examinations was 15 MHz [2]. Epidermal Cyst is a common slow-growing dermal or subcutaneous epithelial cyst, which contains keratin and is lined by the epidermis. Epidermal cyst is considered as level 1 content of the training program in dermatologic ultrasound by the international working group, called DERMUS (Dermatologic Ultrasound). I review the characteristic findings of epidermal cyst on high-resolution US including gray-scale, color Doppler and Real-Time Tissue Elastography (RTE). Epidermal cyst has been reported as a pseudotestis pattern and nonpseudotestis one on gray scale US. In relation to color Doppler US, unruptured type of epidermal cyst represented no substantial blood flow signals and ruptured type shows pericystic and peripheral vascularity. It is reported that superficial epidermoid tumor shows a softer nature than dose malignant tumor on RTE. It is also reported that RTE is able to detect differences in tissue elasticity between ruptured and unruptured epidermal cysts. The comprehensive procedure using high-resolution ultrasound is useful for the accurate diagnosis of epidermal cyst.

Keywords: Dermatologic Ultrasound; High-Resolution Ultrasonography; Real-Time Tissue Elastography; Color Doppler Ultrasonography; Comprehensive Procedure, Epidermal Cyst

Abbreviations: US: Ultrasound; RTE: Real Time Tissue Elastography; DERMUS: Dermatologic Ultrasound; SE: Strain Elastography
multifrequency transducers and multichannel color Doppler machines [1]. An international working group, called DERMUS proposed that the contents for level 1 include basic ultrasound knowledge, normal dermatologic ultrasound anatomy, and common pathologic condition [2]. The minimum frequency recommended for performing dermatologic examinations was 15 MHz. We usually perform US examinations for dermatologic diseases with a high-resolution, broad-band (5MHz-18MHz) linear transducer (Nobulus Hitachi, Ltd. Tokyo, Japan). Until now, we have reported some studies in relation to the skin and subcutaneous disease [13-17]. Epidermal cyst is considered as level 1 content of the training program in dermatologic ultrasound by the international working group, called DERMUS [2].

**Epidermal Cyst**

Epidermal Cyst is a common slow-growing dermal or subcutaneous epithelial cyst, which contains keratin and is lined by the epidermis [3]. As the rate of malignant transformation into squamous cell carcinoma has been reported to range from 0.01% to 2.00% [4,12,18]. Accurate diagnosis of epidermal cyst is very important for the establishment of the treatment plan. It is also difficult to distinguish an epidermal cyst from other benign skin tumors, such as pilomatrixoma, lipoma, steatocytoma, dermatofibroma and intradermal nevus. The cosmetic outcome is less favorable in cases of inflamed or ruptured cysts because these cysts have indistinct margins, more friable cyst walls, and difficulty in complete removal owing to inflammation and fibrosis of the surrounding tissue. Therefore, preoperative diagnosis is important, and different treatment options should be planned for ruptured and unruptured cysts [5].

**Gray Scale Ultrasonographic Features**

It has been reported epidermal cyst shows 2 types as pseudotestis and nonpseudotestis [4] and the report of the classification of 5 patterns [3]. Pseudotestis type is mostly accompanied with filiform anechoic areas consistent with packed keratin lamellae, echogenic reflectors consistent with cholesterol, sebaceous foci, or calcifications. Nonpseudotestis type is mostly depicted as concentric ring sign which is consistent with alternating layers of laminated keratin and squamous cells [4]. Figure 1a showed an ovoid nodule with a laminated, concentric ring pattern with hypoechoic rim, called nonpseudotestis type of epidermal cyst pathologically confirmed. Other features are dermal attachment, focal dermal protrusion [4].

**Color Doppler Ultrasonographic Features**

Unruptured type shows usually no substantial blood flow. On the other hand, pericystic changes are demonstrated on grayscale US and color Doppler US shows pericystic and/or peripheral vascularity in ruptured type. A few peripheral blood flow signals were depicted on power Doppler US (Figure 1b). It has been reported that peripheral low echoic rim, consistent with the capsule was detected in 67% on gray-scale US [19]. It has been suggested that thin and smooth rim enhancement is shown in unruptured type, thick and irregular rim enhancement is represented in ruptured type on enhanced MRI [20]. The rim enhancement might be due to fibrosis and foreign body reaction around the cyst wall remnants and keratinous material [21].

grade 1 as previously reported [12]. This case was comprehensively diagnosed as a lipoma using high-resolution ultrasound imaging. Lipoma represent green color with a lot of orange color, suggesting soft nature on RTE (Figure 2a). Gently curved echogenic lines were noted on gray-scale US (Figure 2b). Ruptured type is softer nature than unruptured type on RTE. Park J et al. reported that RTE is able to detect differences in tissue elasticity between ruptured and unruptured epidermal cysts. Park et al. evaluated that US features of superficial epidermoid tumor with a focus on SE features that will help in the differential diagnosis of epidermoid tumor from other benign and malignant soft-tissue tumors. They concluded that superficial epidermoid tumor shows a softer nature than dose malignant tumor; however, it does not have a different SE pattern from other benign tumors [12].

Figure 2:
(a) This case was comprehensively diagnosed as a lipoma using high-resolution ultrasound imaging. Lipoma showed green color with a lot of orange color, suggesting softer nature than epidermal cyst on RTE.
(b) Gently curved echogenic lines were obtained in the mass on gray-scale US.

Conclusion
Pseudotestis and nonpseudotestis types on gray scale US and pericytic and peripheral vascularity in ruptured type on color Doppler US were shown. A softer nature than malignant tumor and the differences in tissue elasticity between ruptured and unruptured epidermal cysts on RTE were shown. These comprehensive tools using high-resolution ultrasound including gray-scale US, color Doppler US and RTE are useful for the accurate diagnosis of epidermal cyst.

References