The Fluorescent Diagnosis of Stoma Mucosa

ABSTRACT
The aim of this study was to explore the use of fluorescence technology to distinguish and explore different types of stoma mucosal lesions that often appear as healthy under white light. Fluorescence technology is a fast and non-invasive method for imaging tissue in many situations. Fluorescence technology is a very sensitive and specific technique useful in diagnosing small changes that are invisible using white lighting procedures. In stoma nursing care, this technique allows the clinician to view the nature of the mucosa concisely and detect aberrant tissues in detail. However, fluorescence technology is not widely practised.

BACKGROUND
An intestinal stoma is the surgical opening through the abdominal wall for faecal or urinary diversion. The stoma is a part of the small or large bowel that can be seen protruding through the abdominal wall. A stoma is commonly indicated in operations for malignant colorectal cancers. Every patient needs to learn stoma and skin care for rehabilitation during recovery, whether the stoma is temporary or permanent in nature. During the rehabilitation period, patients may need to come back for stoma examination and rehabilitative care assessment in the clinic.

The risk of complications from stoma formation is lifelong, but the incidence of complications is highest in the first 5 years of the postoperative period. Complications are generally classified as early or late complications. Early complications include inappropriate location, skin excoriation, leakage, stoma retraction, dehydration, and stoma necrosis. Late complications include parastomal hernia, stomal prolapse, stenosis, and peristomal dermatitis.2

The most frequent stoma complications can be classified as stoma-related or peristomal skin disorders. A study by Kalashnikovs et al. showed that among 1,427 patients, 533 patients had 742 stoma complications. Of the 742 stoma complications, 387 were stoma-related and 355 were peristomal skin disorders. The most frequent stoma-related complications were parastomal hernia (25%), mucocutaneous separation (19%), retraction (14%), prolapse (17%), and stenosis (10%). On the other hand, the most frequent peristomal skin disorder was contact dermatitis (89%).2

Complications resulting from a stoma undermine a patient’s ability to manage their own care, prolong adaptation to the stoma, and lead to repeated hospitalisations.3 Stoma nurses play an important role in assessing patient risks. The common practices that most stoma nurses focus on during a patient’s visit to the clinic include determining if appliances leak, examining peristomal skin, and evaluating the para-
Mucositis is an inflammatory process of the mucosa due to radiation or chemotherapy, characterised by atrophy of squamous epithelial tissue, vascular damage, and inflammatory infiltration concentrated at the basement region. Epithelial atrophy is followed by ulceration. Sites of mucositis are often covered by a fibrous-inflammatory (pseudomembranous) exudate. However, stoma mucositis and stoma bleeding are often covered by a fibrous-inflammatory infiltration concentrated at the basement of squamous epithelial tissue, vascular damage, and ulceration. Major bleeding from the exposed mucosa is thought to be inevitable due to exposure to air, inflammation and infection, repeated trauma, tearing, or inappropriate stoma care. Uncontrolled stoma bleeding may result in unnecessary hospital admissions and blood transfusion for massive bleeding. Visual examination with a torch can identify significant bleeder or injuries to the mucosa; however, fluorescence is an objective diagnostic tool to explore different stoma appearances even when a lesion is not visible. Fluorescence not only aids in accurately locating a lesion, but also aids in identification of mucosal ulceration to minimise the risk of stoma perforations.

WHAT IS FLUORESCENCE?
Clinically, fluorescence is commonly used in medicine and surgery. In ophthalmology, foreign bodies in the cornea, lacrimal tests, corneal abrasions or ulcers can be easily detected by fluorescence under a slit lamp. Neoplasms, tumours, and abnormal cells with extravasation can be easily observed in the gastrointestinal tract with fluorescence. In colorectal nursing, the use of fluorescence for stoma mucosa assessment is a new concept.

In many studies, fluorescence diagnostics have been described as very sensitive and specific, especially in diagnosing small changes that are invisible under white light endoscopic procedures. Fluorescence is generated by endogenous molecules, such as aromatic amino acids, nicotinamide adenine dinucleotide, or porphyrins. Fluorescence is a fast and non-invasive method for imaging precancerous and cancerous tissues in many situations. This method has been discussed in a variety of applications in the fields of oncology, dermatology, laryngology, pulmonology, gynaecology, and gastroenterology.

Intestinal stoma assessment is often limited to visual examination and palpation. Endoscopy is occasionally needed to determine the level of stoma necrosis postoperatively and identify the need for emergency revision surgery. Stoma assessment should be performed in good light, and the use of a magnifying glass can be helpful. However, even with the assistance of a magnifying glass, only the surface structure of the mucosa can be seen by visual inspection under white light. Detailed examination by experienced stoma nurses is necessary to detect complications. In the clinical setting, the stoma mucosa may appear healthy, red, and moist, but have invisible signs and symptoms. Fluorescent diagnostics have evolved, and fluorescence is now useful for the diagnosis of mucosal lesions.

AIM
The aim of this study was to explore the use of fluorescence technology to identify different types of stoma mucosal lesions, which often appear healthy under standard examination with white light. This study is the first advanced nursing innovation to use fluorescence diagnostics technology for a detailed examination of the stoma mucosa.

METHODS
Patient recruitment was performed by a nurse consultant during the stoma patient follow up visit to the “Wound and Stoma Clinic”. The recruited subjects varied from...
the early postoperative period to 3 years post-operation. Subjects were recruited for fluorescence examination if they complained of stoma bleeding. The stoma mucosa was examined with a simple light source (standard stoma nursing assessment). For the fluorescence examination, a fluorescent strip was completely immersed in 10ml of 0.9% normal saline. The stained saline was applied to the stoma mucosa. The stoma was visualised using a microscope with a 10X objective and blue light in the dark. The principle of fluorescence diagnostics is based on scanning and analysing the reflected light from the mucosa. Thus, under blue light, a red-green image of the stained stoma is created. Healthy stoma mucosa appears as a smooth, moist, evenly reflective layer with no staining. On the other hand, an unhealthy or injured stoma appears rugged, dry, leathery and stained under fluorescence.

RESULTS
From June 2014 till May 2015, we examined 127 patients with stoma (either colostomy or ileostomy) in our wound clinic. Interestingly, we noted several clinical findings that were not easily diagnosed without fluorescent examination of the stoma, but appeared clearly under fluorescence. We identified different types of target diagnoses (Fig. 1a – 1d)

*Figure 1a. The stoma appears as normal mucosa, with a smooth and evenly reflective surface under fluorescence.*

*Figure 1b. Fluorescence detects a diffuse fibrous/inflammatory mucosal surface identified as mucositis.*

*Figure 1c. The fluorescence demonstrates a linear tear corresponding to the site of bleeding.*

*Figure 1d. The fluorescence clearly demonstrates a patchy mucosal abrasion at the stoma base.*
Despite the appearance of viable red stoma. In total, we examined 127 stomata using fluorescence, with 153 diagnoses including mucositis (47%), local ulceration (7%), laceration (3%), local bleeder (14%), mucosal tear (13%), and nothing abnormal (16%).

**Perspectives for Wound Care**

Wound management of stomal mucositis is focused on the control of bleeding and the treatment of local inflammation. Bleeding often occurs in different areas from the stoma mucosa. Thus, a sealant plaque is applied to protect the whole stoma mucosa. The sealant plaque is formed by a “stoma powder” containing pectin and karaya (Fig. 2-3), coupled with a stoma skin protective spray (Fig. 4). The sealant plaque minimises and stops bleeding from dilated capillaries in the mucosa. Haemostatic outcomes may be markedly and gradually improved by the sealant in a week, as the sealant layers become more firm and thickly coat the stoma mucosa. The challenge is to encourage patience and provide detailed patient education, including an instruction sheet. Patients may return early for plication of stitches (Fig. 5) or local treatment with an adrenaline and silver nitrate stick if the stoma bleeding cannot be easily controlled. Alternatively, for patients who are diagnosed with stoma ulceration or laceration, hydrogel may be applied to the affected lesions after stoma cleansing.

**Discussion**

Like any other assessment tool, there are limitations to fluorescence diagnosis of stoma mucosa. The main concern is vascular integrity, which may not be clearly detected, leading to a misdiagnosis under fluorescence. Vascular compromise of intestinal stomata ranges from mild ischaemia and vasospasm with mucosal sloughing, to infarction and necrosis. Additionally, venous outflow obstruction may lead to significant venous congestion and compromised bowel perfusion, which may also cause necrosis of the stoma. Vascular compromise represents the most serious early complication of stoma creation. Failure to trans-illuminate the nonviable mucosa beneath the stoma surface may lead to stoma revision. Vascular compromise below the fascia can also be evaluated with a paediatric proctoscope or flexible endoscope.

Although fluorescence is a highly sensitive diagnostic tool to identify different mucosal aetiologies in a clinical setting, the limitation is low validity among different stoma nurse practitioners in different centres. The validity may be improved if fluorescence diagnostic tools can be standardised in nursing protocols and included in clinical training. In addition, the lighting hue and the low frequency of the blue light, plus the low power of the hand-held microscope may affect diagnostic accuracy. The technology of fluorescence diagnostic tools, as well as nursing protocols for examining stoma, may advance in the near future.

**Conclusion**

Stoma mucosal lesions are often inevitable. Careful consideration of patients’ complaints and a detailed examination of the stoma are of the utmost importance in stoma nurs-
ing care. Although a stoma may appear healthy under the naked eye, minor stoma complications may exist. Fluorescence diagnostics is a user-friendly, non-invasive, and sensitive diagnostic tool for examining stoma mucosal lesions and underlying structures in a more detailed manner (Fig. 6). Promotion of the advantages of this diagnostic method is necessary, and fluorescent technologies warrant further assessment among clinicians. Based on the fluorescence diagnostics technique, we are going to explore algorithms for diagnosis and treatment of “invisible” stoma mucosal lesions and advanced wound assessment in the near future.

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Fig 6. Stoma examination using the Fluorescence Diagnostics in the Wound and Stoma Clinic.

REFERENCES