A Novel Developmental Process of Intestinal Epithelial Lesions in a Calf Infected with Attaching and Effacing Escherichia coli

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ABSTRACT. A comparative study on the adhesion of attaching and effacing Escherichia coli (AEEC) to the enterocytes between the colon of a calf and the jejunum of a piglet showed differences in the developmental process of attaching and effacing (AE) lesions. In the calf, pedestals consisted of fused microvilli, while in the piglet they developed from the apical epithelial cell membranes after effacing microvilli. Microvilli adjacent to the AEEC attachment site were atrophic in the calf, whereas they were elongated in the piglet. The production of AE lesions in the calf may be indicative of a novel developmental process with AEEC infection. — KEY WORDS: attaching and effacing Escherichia coli, calf, swine.

Attaching and effacing Escherichia coli (AEEC) is one of enteropathogenic E. coli (EPEC). It colonizes the intestinal tract and adheres intimately to the enterocytes, resulting in the effacement of microvilli and formation of pedestals [3]. Although there have been many reports on attaching and effacing (AE) lesions in several species with AEEC infection [4–6], only one report dealt with the developmental process of AE lesions [2]. We investigated AE lesions on the enterocytes in a one-month-old calf and a piglet, and we found the developmental process of AE lesions in the calf was different from that in the piglet.

AEEC organisms were observed microscopically in the colon of the calf and the jejunum of the piglet in sections stained with hematoxylin and eosin. The results of immunohistochemical investigation confirmed that AEEC in the calf and piglet belonged to serogroups E. coli O111 and O103, respectively. Intestinal specimens obtained from the calf and piglet were fixed in 20% neutral buffered formalin. After washing with 0.1 M phosphate buffer, the specimens were also fixed in 1% osmium tetroxide and then embedded in the Epoxy resin. Ultrathin sections were stained with uranyl acetate and lead citrate and were examined with a transmission electron microscope (JEOL, JEM-1010).

In the colon of the calf, AEEC bacteria were attached to the apical portion of microvilli, but not observed among microvilli. Microvilli fused with one another at the sites of AEEC attachment (Fig. 1).

In the jejunum of the piglet, AEEC organisms were observed among microvilli, and the microvilli to which...
bacteria were attached became atrophic. The microvilli disappeared at the attachment sites of AEEC and the epithelial cell membranes were histologically transformed into pedestals. Microvilli and terminal webs adjacent to the attachment site were elongated (Fig. 2).

Based on the present results, the developmental processes of AE lesions in both calf and piglet are schematically illustrated in Fig. 3. In the calf, pedestal formation resulted from degeneration of microvilli without their effacement; microvilli adjacent to the attachment site became atrophic. In the piglet, on the other hand, pedestals were formed by degeneration of the epithelial cell membrane after effacing microvilli; microvilli adjacent to the attachment site were elongated.

The developmental mechanism of AE lesions in the jejunum of the piglet appeared to be consistent with that in a previous report on AE lesions in the human small intestinal enterocytes [2]. Elongated microvilli adjacent to the attachment sites have previously been reported in pigs [6], rabbits [4] and chicks [5]. The developmental mechanism of AE lesions in these animals also seemed to be consistent with that in humans.

Elongated microvilli adjacent to the attachment sites, however, were not observed in the colon of the calf. Furthermore, pedestal formation appeared to result from fusion of microvilli in the calf. There have been no previous reports describing that the pedestal formation might have been associated with degenerated microvilli.

Recently, Han et al. [1] reported differences in the process of apoptosis of the epithelial cells among species; microvilli of the apoptotic epithelial cells in the guinea pig were elongated, while those in the rat and mouse were atrophic. It is not clear whether the developmental process of AE lesions in the present calf was associated with the process of apoptosis in the epithelial cells. However, we speculate that the development of AE lesions in the calf described here may represent a novel process with AEEC infection.

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from the piglet.

REFERENCES