Abstract

The mucosal surface of the porcine ampullary oviducts (PAO) at the follicular and luteal phases were examined under the scanning electron microscope (SEM) to observe the cell types and cellular populations. At the follicular phase, the porcine ampullary oviductal epithelial cells (PAOEC) contained a great number of high ciliated cells, whereas those at the luteal phase consisted of lesser number and were filled up with numerous of round shaped non-ciliated cells with short microvilli on the apical surface. The change of the epithelial morphology in the porcine ampullary oviducts during the estrus cycle seems to suit their functions in the reproductive process.

Key words: Oviductal epithelial cells, porcine, SEM
Introduction

The mammalian oviduct provides the appropriate environment for the important reproductive processes such as the transportation of gamete (sperm and ovulated oocyte), fertilization and the early embryonic development. The environment is achieved by the inner surface of the oviduct as well as the oviduct secretion. The inner surface of mammalian oviduct consists of the simple columnar epithelium, which consists of two types of cells, the non-ciliated (secretory cells) and the ciliated cell (Nilsson and Reinius, 1969). The first one synthesizes and releases glycoprotein in a temporally and regionally specific manner during the early pregnancy at the time of the fertilized oocytes are traversing the oviduct. This glycoprotein is localized in the secretory granules of the non-ciliated cells of the ampulla but it is absent in the other areas of the oviduct (Murray, 1992). Increasing in numbers of the studies on the benefit of PAOEC and PAOEC-condition medium on in vitro fertilization have been reported (Kitiyanant et al., 1993; Anderson and Killian, 1994; Vatzias and Hargen, 1999; Romar et al., 2001, 2003). They concluded that, PAOEC and their secretory proteins play the important roles not only to the matured sperm and fertilized oocytes but also the early developmental embryos.

Though, there are lots of studies on the important roles of PAOEC, but there is still lack of report on their morphology and population change during the estrus cycle. This study was designed to observe the morphological and population changes of PAOEC during the follicular and luteal phases by using SEM. The results could provide knowledge on morphological and population changes of the epithelial cells in the oviduct, which is a prerequisite for future studies.
Materials and Methods

Porcine oviducts were obtained from the slaughterhouse in Nakorn Pathom province and transported to the laboratory in a thermos of 0.9% normal saline at 30°C. Six oviducts of the follicular phases (estrus cycle days 15) and luteal phases (estrus cycle days 1-2) were used in this experiment. The oviducts were trimmed free from fat and connective tissues and rinsed in phosphate-buffered saline. The PAO were cut into small pieces of 2-3 mm and pre-fixed in 2.5% glutaraldehyde in 0.1 M phosphate-buffer (pH 7.2) for 2 h. They were post-fixed in 1% osmiumtetroxide in the same buffer for 24 h., then dehydrated in a series of graded ethanol alcohol (30%, 50%, 70% 80%, 90% and absolute ethanol alcohol) and dried in the critical point dryer machine (CPD). All samples were mounted on stubs with conductive carbon tape, coated with gold particle for 20 nm thick in an ion sputtering (Songthaveesin, 1998), observed and examined under SEM (CamScan Analytical, Maxim 2000S) operating at 10 kV.

Results

The observation under SEM showed that the PAO composed of two different cell types, ciliated and non-ciliated cells. The PAOE at the follicular phase showed numerous ciliated cells. The cilia consistently projected over the apex of the non-ciliated cells (Figure 1A and 2A). At the high magnification, the non-ciliated cells showed spherical shape (Figure 3A) with numerous of short microvilli (Figure 4A).

At the luteal phase, the number of ciliated cells were decreased, whereas the number of non-ciliated cells were increased (Table 1 and Figure 1B). At high magnification, the apical surfaces of the non-ciliated cells showed round shape with numerous small microvilli (Figure 2B).
Fig. 1A-2A  Ultrastructural aspects observed using SEM of PAOEC at the follicular phase showing the numerous ciliated cells (CC).
Fig. 3A-4A  Ultrastructural aspects observed using SEM of PAOEC at high magnification, follicular phase showing non-ciliated cells (NC) in spherical shape with short microvilli (SM) on the apical surfaces.
Table 1  Percentage of two cell types at the follicular and luteal phase of PAOEC

<table>
<thead>
<tr>
<th>No. of sample</th>
<th>Follicular phase</th>
<th>Luteal Phase</th>
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<tr>
<td></td>
<td>non-ciliated cells (%)</td>
<td>ciliated cells (%)</td>
<td>non-ciliated cells (%)</td>
</tr>
<tr>
<td>1</td>
<td>40</td>
<td>60</td>
<td>82</td>
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<tr>
<td>2</td>
<td>42</td>
<td>58</td>
<td>80</td>
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<td>6</td>
<td>38</td>
<td>62</td>
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<tr>
<td>Means</td>
<td>40.67±1.92</td>
<td>59.33±1.92</td>
<td>80.17±2.67</td>
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</table>

Fig. 1B  Ultrastructural aspects observed using SEM of PAOEC at the luteal phase showing the numerous non-ciliated cells (NC) and lesser number of ciliated cells (CC).
Fig. 2B  Ultrastructural aspects observed using SEM of PAOEC at high magnification, luteal phase showing non-ciliated cells (NC) in round shape with short microvilli (SM) at the apical surface.
Discussion

Two types of the mammalian oviductal epithelial cells (non-ciliated and ciliated cells) were present in the PAO in both phases. This investigation showed that the PAOEC changes in the numbers of ciliated and non-ciliated cells during follicular and luteal phases. The ciliated cells in the ampulla increased the cellular population during the follicular phase but decreased during the luteal phase. This finding is comparable to that reported by Songthaveesin (1998) for bovine oviductal epithelial cells. Although the alternation of the population of two types of cells in both phases were similar in two species, the morphology of the epithelial cells in the two species are different. In bovine, oviductal epithelial cells are a “wormlike” structure (Xu et al., 1992), instead of the small rounded spheres of porcine oviduct.

The ampullary oviduct was used in this study because it is the area of fertilization and has greater synthetic secretion when compared with the other parts (Murray, 1992). In the ampullary mammalian during follicular phase, the great number of high ciliated cells are corresponded to the transporting of ovulated oocytes. Whereas in the luteal phase, there are high number of non-ciliated cells as the small rounded spheres with short microvilli at the apical surface corresponding to their secretory substances for the nutritional support for the embryonic development (Hole and Koos, 1994). It has been suggested that the regular cycle of ciliated and non-ciliated cells of the epithelial cells in the mammalian oviduct depends upon the levels of circulating estrogen and progesterone (Verhange and Jaffe, 1986). Furthermore, PAOEC have been used for in vitro oocytes maturation, sperm preparation and early embryonic development (White, 1989; Nagai and Moor, 1990; Kitiyanant et al., 1993; Park, 1996; Vatzias and Hargen; 1999; Romar et al., 2001; 2003). Nagai and Moor (1990) suggested that glycoproteins secreted from non-ciliated oviductal epithelial cells could bind to the porcine spermatozoa and reduce the incidence of polyspermy. Therefore, further studies should be carried out to elucidate the characterization of protein secreted from non-ciliated PAOEC during the luteal phase.
Conclusion

The results demonstrated that, PAOE are changed their morphological features and the type of cells population during the estrus cycle. The functional correlation was discussed.

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References


