ABSTRACT

C-type virus particles and particles, approximately 35 nm in diameter, were present in the region of the basal plate from the placenta of a rhesus monkey and two baboons. Both particles appeared to bud from the plasma membrane of the cytotrophoblast: large, pleomorphic cells with cytoplasmic extensions, indented nuclei, well-developed endoplasmic reticulum, and glycogen deposits. Extracellular particles were enmeshed within a fibrous matrix. Particles were also observed in the junctional zone, but not in the decidua. C-type virus particles from the rhesus monkey and baboons differed in ultrastructure from each other and from C-type mouse leukemia virus particles. The 35-nm-type particle was spherical with a dense central core.

INTRODUCTION

Several investigators (10, 11, 13, 14, 26) reported the presence of C-type virus particles in the chorionic villi of primate placentas. A preliminary examination of rhesus monkey and baboon placenta in this laboratory (2) corroborated this finding and revealed both C-type virus particles and particles, approximately 30 nm in size, heretofore undescribed, in cytotrophoblast cell columns and the basal plate. Results of a more extensive study of both types of particles and the morphology of cells in the basal plate are presented in this paper.

MATERIALS AND METHODS

Placental tissue of a rhesus monkey delivered at 71 days of gestation and of 2 baboons, one delivered at 167 days of gestation (Baboon 1) and the other at 176 days of gestation (Baboon 2) were processed for light and electron microscopic examination. Techniques of specimen preparation and source of the animals were previously described (2).

RESULTS

Light Microscopy

Areas consisting of many large, pleomorphic cells are demonstrated in sections from the region of the placental basal plate of the rhesus monkey (Figs. 1 and 2), Baboon 1 (Fig. 3), and Baboon 2 (Figs. 4 and Area A in Fig. 5). Part of the syncytiotrophoblast (S) is included in Figs. 1 and 3. Those cells situated more distally from the syncytiotrophoblast are usually separated by larger amounts of intercellular matrix. Some cells have outstretched cytoplasmic extensions of varying lengths, which may form bridges with neighboring cells (Figs. 1, 2, and 4, arrows). Their large nuclei are indented and have prominent nucleoli. In cells from the rhesus monkey (Figs. 1 and 2), dense cytoplasmic inclusions (g) were observed. In Fig. 5, 2 other areas could be distinguished; adjacent to Area A is a necrotic zone, B, containing dense deposits, vacuoles, and degenerating cells. Present in adjoining Area C are mostly oval cells with round to oblong nuclei, few dense granules, and little extracellular matrix.

Electron Microscopy

Rhesus Monkey. The cells observed in the electron microscope are polymorphic with cytoplasmic extensions and large indented nuclei (Fig. 9). They are either partially or completely surrounded by a framework of fibers which occasionally exhibit periodicity (f in Figs. 7 and 11b). Glycogen deposits (g in Figs. 9, 10, and 11) and a few dense granules (Fig. 9, d) are present. Extensive rough endoplasmic reticulum (er in Figs. 8 and 9), often with pronounced cisternal dilation, is a conspicuous feature of these cells. Desmosomes (Fig. 9, j) join the surfaces of some cells.

Measurement of additional particles revealed a size range of 26 to 40 nm (approximate average, 35 nm). The particles seem to bud from the cell surface (Figs. 6, 7, 11a and 11b, arrows). Figs. 11a and 11b are higher magnifications of outlined Areas a and b of Fig. 11), occasionally in a sequential arrangement (Fig. 10, arrows). Various stages of particle formation are demonstrable, from initial protrusion and thickening (Figs. 7, 11a, and 11b, short arrows) to almost complete separation from the cell (Figs. 7, 11a, and 11b, long arrows). The internal structure of the budding particles varies from a dense central core (Fig. 6) to a thick dense band adjacent to the outer envelope (Fig. 11a, center). Mature particles are spherical with a large, dense central core (Fig. 8, arrows). Immature C-type particles were occasionally observed in these specimens.

Baboon 1. Electron microscopic examination revealed the presence of round (Fig. 15) to polygonal (Fig. 19) cells with cytoplasmic extensions (Figs. 12 and 19) and large indented nuclei (Fig. 15). Small aggregates of glycogen (Fig. 12, g), and occasionally lipid droplets (Fig. 15, l) and desmosomes (Fig. 12, j) were noted. The cytoplasm contains many stacks of rough endoplasmic reticulum (er in Figs. 15 and 19) sometimes with extremely dilated cisternae (Fig. 19). Few extracellular dense granules (Fig. 15, d) and some collagen (Fig. 12, c) are evident.

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C-type virus particles budding from the plasma membrane (Figs. 12 and 17, arrows) and many extracellular particles (Figs. 13 to 16, and 19, arrows) emmeshed within a fibrous matrix are present. Budding (Fig. 17, arrow) and immature (Fig. 16, i) particles contain an electron-dense inner layer surrounded by a moderately dense band; between this band and the outer envelope is an electron-lucent zone. Mature particles (Fig. 18, arrow), and [Figs. 19a, 19c, and 19d (right), long arrows] have a centrally located nucleoid of varying density. The ultrastructure of particles trapped between extracellular fibers was often damaged (Fig. 16, arrow). Figs. 19a to 19d, higher magnifications of the outlined Areas a to d of Fig. 19, demonstrate both 35-nm particles (short arrows) and C-type particles (long arrows), occasionally budding from the same cell (Fig. 19d). Several of the 35-nm particles are elongated with dense interiors (Figs. 19a and 19b, lower left).

**Baboon 2.** In the electron microscope, a sharp demarcation between cells from Areas A, B, and C of Fig. 5 was not apparent. Cells (Fig. 20) from Area A appear attenuated with numerous cellular extensions. The cisternae of the rough endoplasmic reticulum are often extremely dilated; variable amounts of glycogen are present. These cells are either totally or partially surrounded by a framework of fibers which occasionally display periodicity (Fig. 20a, f). Necrotic cells (Fig. 21) and cell debris were observed in Area B. In Area C, most cells (Figs. 25 and 26) are round to oval, lack cellular extensions, and have oval nuclei. The cells appear either in compact clusters or are surrounded by a fibrous matrix. Occasionally, a degenerated cell or cell debris is situated proximal to a healthy cell (Fig. 26). Profiles of rough endoplasmic reticulum are short with little cisternal dilation. Filaments (Fig. 25, F) or lipid (Fig. 26, I) are present in a few cells. Dense membrane-bound granules appear either extracellular (Fig. 25, arrows) or apparently in the process of being discharged from the cell (Fig. 26, arrow).

In Areas A and B, budding 35-nm particles are demonstrated (arrows, Figs. 20b and 20d, higher magnifications of b and d in Fig. 20; Fig. 21a, higher magnification of Area a of Fig. 21; and Figs. 12 and 13) and extracellular mature particles are shown (arrows, Figs. 20a and 20c, higher magnifications of a and c in Fig. 20; and Fig. 21b, higher magnification of Area b of Fig. 21). Occasionally, the buds are elongated or constricted (Fig. 24, arrows). A few C-type virus particles were observed in these specimens. Neither 35-nm nor C-type particles were detected in Area C.

**DISCUSSION**

Thirty-five-nm Particles (F-Type Particles). The 35-nm particles observed in this study have several features in common with C-type virus particles; they bud from the plasma membrane, they have an immature form and a mature form with a nucleoid, and although considerably smaller than C-type virus particles, they are within the size range of known viruses (18). They resemble the togavirus family in size, morphology, and budding from the cell membrane, but they do not appear to multiply within the cytoplasm. They were found, often in large numbers, in the basal plate of the placentas of the rhesus monkey and baboon. Because their biological significance is presently unclear and it is confusing to refer to particles by their size, these particles are termed F-type particles at this time.

**C-Type Virus Particles.** Although the 100-nm virus particles from rhesus monkey placenta and baboon placenta, and the mouse leukemia virus are all considered C-type, their immature form differs ultrastructurally from one another. In the rhesus monkey placenta, the C-type particle (Fig. 27) has a wide, moderately dense band beneath the outer envelope. The baboon placental virus (Fig. 28) has a band of moderate density which is adjacent to an inner-dense layer and separated from the outer envelope by an electron-lucent zone. In the mouse leukemia virus (Fig. 29), a moderately dense band is separated both from the outer envelope and an inner dense layer by electron-lucent zones. Also, the moderately dense band in the mouse leukemia C-type particle is narrower than the band in the baboon or rhesus monkey placental virus.

C-type virus particles have been found in the primate chorionic villi, that part of the placenta derived from the fertilized ovum, and in baboon preimplantation embryos (15), follicular oocytes, and tubal ova (12). The vertical transmission of viruses from one generation to another through the germ cells was recognized several decades ago (5). Since the basal plate consists both of fetally and maternally derived tissues, identification of cells in this area was attempted in order to determine if F- and C-type particles are associated exclusively with cells of fetal or germ cell origin.

**Identification of Cells Associated with Particles.** In the primate placenta, the basal plate consists of 3 areas: the trophoblastic shell (fetal), the decidual basalis (maternal), and the junctional zone between the two. Information provided by studies of the monkey or baboon placenta (4, 6-9, 20-23, 29, 31, 33, 35) was not entirely sufficient for the unequivocal identification of cells examined in this particular investigation as being either maternal or fetal in origin. An attempt to use reports on the human placenta (1, 3, 16, 17, 19, 24, 25, 27, 28, 30, 32, 34, 36) as a guide in distinguishing corresponding baboon and monkey tissues had limited success. Although definitive criteria for the classification of these cells have apparently not been established, it is the conclusion of the author, based on morphology, that the cells associated with particles in this study are cytotrophoblast. As compared to the undifferentiated cytotrophoblast of the chorionic villi, these cells have a well-developed rough endoplasmic reticulum, characteristic of cells involved in protein synthesis for export. Area B of Baboon 2 is the functional zone which contains degenerating cells and particles. The cells in Area C in which particles were not observed are maternal. Thus, results of this study indicate that C-type virus particles and F-type particles are confined to placental tissues of germ cell derivation.

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REFERENCES

Figs. 1 to 5. Light micrographs from the placental basal plate.

Figs. 1 and 2. Rhesus monkey. Large pleomorphic cells with cytoplasmic extensions which often form bridges (arrows) between cells, syncytium (S), and dense deposits (g). Fig. 1, × 420; Fig. 2, × 500.

Fig. 3. Baboon 1. Large cells with indented nuclei and syncytium (S). × 630.

Fig. 4. Baboon 2. Large pleomorphic cells with cytoplasmic extensions which form intercellular bridges (arrow). × 455.
Fig. 5. Baboon 2. Area A, large polygonal cells surrounded by extensive intercellular matrix; Area B, degenerating cells; Area C, round to oval cells. × 475.

Figs. 6 to 11. Electron micrographs from placental basal plate of rhesus monkey.

Figs. 6 and 7. Budding 35-nm particles (arrows) and fibers (f) which display periodicity. Fig. 6, × 187,000; Fig. 7, × 91,200.

Fig. 8. Mature 35-nm particles (arrows) and rough endoplasmic reticulum (er). × 91,200.
Fig. 9. Cells with indented nuclei, extensive rough endoplasmic reticulum (er), glycogen (g), desmosomes (l), dense granules (d), and surrounding fibrous matrix. x 18,720.

Fig. 10. Budding 35-nm particles (arrows) and glycogen deposits (g). x 55,200.
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Figs. 12 to 19. Electron micrographs from the placental basal plate of Baboon 1.

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Figs. 22 and 23. Budding 35-nm particles (arrows). × 177,600.
Fig. 24. Elongated or constricted budding 35-nm particles (arrows). × 129,600.

Figs. 25 and 26. Round to oval cells from Area C of Fig. 5 showing intracellular filaments (F), short profiles of rough endoplasmic reticulum, lipid (l), and membrane-bound granules (arrows). Fig. 25, × 12,000; Fig. 26, × 13,650.

Fig. 27. C-type particles from rhesus monkey placenta. × 62,600.

Fig. 28. C-type particle from baboon placenta. × 58,000.

Fig. 29. C-type mouse leukemia virus particle. × 63,000.
Virus Particles in the Basal Plate of Rhesus Monkey and Baboon Placenta

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