SCANNING ELECTRON MICROSCOPY OF THE HUMAN, GUINEA-PIG AND RHESUS MONKEY SEMINAL COAGULUM

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Summary. A relationship appears to exist between the morphological appearance of the seminal coagulum and the rate of its liquefaction. The guinea-pig and rhesus monkey coagula liquefy only poorly, and consist of thick fibres which form a solid structure. A normal human coagulum possesses an extensively organized network of long thin fibrous strands. A ‘slow liquefying’ human ejaculate shows similar patterns although it possesses a multitude of thick fibres. As the coagulum liquefies, the fibres become disorganized and turn into spherical material. Spaces within the fibrous network of the human coagulum are so small that escape of spermatozoa does not seem possible without liquefaction. This may explain the subfertility of poorly liquefying or non-liquefying human semen.

Human semen coagulates immediately after ejaculation and normally liquefies again in approximately 10 to 20 min. This occurs both in vitro (Huggins & Neal, 1942) and in the vagina (Sobrero & MacLeod, 1962). Human semen differs in this respect from that of many other species. Dog and bull semen do not coagulate at all whereas rodent, rabbit and monkey semen is ejaculated as a sperm fraction and a non-liquefying or poorly liquefying ‘plug’. Men whose semen does not liquefy or liquefies poorly are frequently subfertile (Bunge, 1970). Using the light microscope, Huggins & Neal (1942) reported the presence of many interlacing bundles of clearly defined, parallel, ‘refractile’ fibres in the human coagulum. During liquefaction, these fibres showed irregular patterns, broke up and disappeared totally when liquefaction was complete. For our studies on the biochemistry of human semen coagulation and liquefaction (Tauber, Propping, Zaneveld & Schumacher, 1973), it was of importance to determine the morphological aspects of these processes. The scanning electron microscope (SEM) with its ability to view surface structures at high magnifications and excellent depth of field appeared the instrument of choice.

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At certain periods of time after ejaculation, samples of human semen were transferred with a pipette to 2.5% glutaraldehyde in 0.05 M-phosphate buffer, pH 7.0, stopping all liquefaction immediately. The final fraction of a split ‘slow-liquefying’ ejaculate from a donor was treated in similar fashion. Such a fraction consists mostly of seminal vesicle material and requires at least 2 to 4 hr for liquefaction. Rhesus monkey coagula, obtained by electroejaculation, and a urethral (seminal) ‘plug’ from a guinea-pig were washed three times in physiological saline to remove the supernatant sperm fraction and were submerged in the fixative. After 5 to 10 days at 5°C and at least one change of fixative, the samples were washed, dehydrated (Brueschke, Zaneveld, Rodzen & Berns, 1974), sectioned, critical point dried (Anderson, 1951), coated with carbon and two layers of gold, and observed with a Mark II Cambridge Stereoscan Electron Microscope.

Immediately after ejaculation, the human coagulum appears as a dense, organized network of long, narrow fibres approximately 0.15 µm thick (Pl. 1, Figs 1 A to C). The spaces between the fibres are too small to allow movement of the trapped spermatozoa that are dispersed in large numbers throughout this network. As liquefaction takes place, the spaces between the fibres become larger (Pl. 1, Figs 1 E and F). Amorphous material appears at the surface of the fibres, consisting of small spherical globules, approximately 0.15 to 3.0 µm in diameter. Subsequently, the coagulum loses its structure as the fibres disappear and the globules take over. Finally, only globules can be found, forming smaller or larger clumps (Pl. 1, Figs 1 G and H). A ‘slow-liquefying’ coagulum possesses some very large fibres that measure 0.8 to 1.8 µm in width, and are interconnected by a meshwork of smaller fibres of approximately the same size as those of the normally liquefying coagulum (Pl. 1, Fig. 1D). The ‘slow-liquefying’ coagulum liquefies in the same way as the normal ejaculate, but much more slowly.

The guinea-pig and monkey coagula give a much more solid appearance than the human coagulum. The guinea-pig ‘plug’ is a rigid, tubular structure that presents a sponge-like appearance (Pl. 2, Fig. 2). Short flattened fibres (0.6 µm thick) form a dense narrow-spaced network. By contrast, the monkey coagulum possesses a disorganized array of fibres of variable thickness (0.2 to 0.7 µm) (Pl. 2, Fig. 3). The interstices of the monkey and guinea-pig coagula are much larger than those of the human coagulum. No spermatozoa can be found inside or on the surface of the guinea-pig coagulum. Occasionally, a few spermatozoa are present within the monkey coagulum although most of them are located on its surface (Pl. 2, Figs 3 B, C, E and F). This finding was the more remarkable since the coagulum had been washed quite extensively before fixation. Some adhesive properties may therefore exist between the monkey coagulum and its spermatozoa.

**EXPLANATION OF PLATE 1**

Fig. 1. Micrographs (SEM) of human coagulum before and after liquefaction. A to C, E to H, normally liquefying; D, slowly liquefying. The samples were fixed 3 min (A to D), 6 min (E and F) and 15 min (G and H) after ejaculation, Specimens G and H were obtained immediately after liquefaction. A, ×30; B, ×600; C, ×3000; D, ×2875; E, ×1200; F, ×3100; H, ×1200. S = spermatozoon.
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REFERENCES


EXPLANATION OF PLATE 2

Fig. 2. Micrographs (SEM) of guinea-pig coagulum. A, partly sectioned and fractured coagulum (× 16); B, surface of the coagulum (× 40); C and D, internal structure of the coagulum (C, × 1600; D, × 4000).

Fig. 3. Micrographs (SEM) of rhesus monkey coagulum. A, partly sectioned and fractured coagulum (× 13); B, spermatozoa on the smooth surface of the coagulum (× 310); C, spermatozoa appearing from surface crevices (× 660); D to F, internal structure of the coagulum (D, × 130; E, × 650; F, × 1300). S = spermatozoon.