Meetings

Gastrointestinal Electromyography

Gastrointestinal disease is known to be the third commonest cause of illness in the United States and of even greater importance in other countries. In order to bring together basic scientists and clinicians interested in the study of electrical activity of smooth muscle with particular reference to the investigation of disease of smooth muscle of the alimentary tract in man, a seminar on the Clinical Application of Smooth Muscle Electromyography was held at the Center for Cultural and Technical Interchange between East and West of the University of Hawaii on 16–20 December 1968. The intent of the organizers of this meeting was to provide an opportunity for all participants to acquaint themselves with each other's work and to provide a framework for free and open discussion of problems, a forum for presentation of new material, and suggestions of avenues for further investigation.

Discussions on the importance of disease of smooth muscle (motility disturbances) within the spectrum of gastrointestinal disease pointed out the present insufficient understanding of the pathophysiology of the diseases of motility of the gastrointestinal tract. A series of papers outlining the current concepts in electrophysiology and mechanical activity of the smooth muscle of the gut were given accompanied by surveys of the field of excitation-contraction coupling and the function of slow waves in the coordination of mechanical activity.

The papers of A. Bortoff (State University of New York, Syracuse) on the "Function of intestinal slow waves in coordinating mechanical activity" and of E. E. Daniel (University of Alberta) on "The electrical activity of stomach and upper intestine as a determinant of mechanical activity" both provided new information concerning the relationship of recorded electrical potentials to the fundamental electrical and mechanical events of the single cell and to whole organ physiology.

Some electrical events in circular muscle of cat colon (J. Christensen, University of Iowa) were shown by a series of recordings from the smooth muscle of the cat colon; the recordings illustrated that the regular slow electrical potentials can be regularly recorded from the circular muscle but that the longitudinal muscle is largely quiescent. In addition, these in vitro studies showed a reverse gradient of natural or intrinsic frequency of the circular muscle specimens removed from different sites of the colon. The proximal colon segments were slower than the distal segments.

The clinical studies on gastric electromyography (S. Kohatsu, Stanford University; Y. Tanaka, Jikei University) were of particular interest. These studies demonstrated, with different methods, that the gastric potential can be recorded sufficiently well from man to carry out an analysis of the fundamental rate of electrical activity. Both investigations defined a normal rate and rhythmicity of the gastric electromyogram and showed preliminary evidence that change in rate is a significant parameter of gastric function and that characteristic rate patterns follow feeding and insulin hypoglycemia. A clinical study of action potentials of the rectum and terminal colon (K. Matsuoka, Osaka University) showed a distinct difference in appearance of the recordings of electrical activity from smooth muscle of the contracted segment of a congenital megacolon as compared with recordings from normal subjects.

The general impression was that current knowledge of the electrical and mechanical physiology of the smooth muscle of the gut is sufficiently developed to interpret meaningfully the results of studies in man. The preliminary results from the studies of normal humans and patients reported were encouraging and should be expanded. It was felt that present clinical methods and techniques were adequate for continued study but the realization of improved, more powerful methods will be welcomed by all investigators. A few pleas were heard for standardization of terminology which could avoid many difficulties if carried out before gastrointestinal electromyography comes into wider use as a diagnostic tool.

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Uterine Cervix

The North American Conference on Fertility and Sterility was held in Ocho Rios, Jamaica, West Indies, 3–12 January 1969. The meeting was under the auspices of the U.S. Division of the International Fertility Association. Six sessions were organized: tubal factors in infertility, including surgical techniques; cervical factors and nidation in infertility; problems of abortion; antifertility agents including intrauterine devices, psychogenic factors in infertility; and new ideas in mechanisms of reproduction. The research presented in the session of infertility included a new tissue adhesive for use in tuboplasty, spinal anesthesia for culdoscopy, and tubal occlusion by cryosurgery. Male sterilization by vasectomy clip, successfully performed in dogs, may have clinical application for reversible sterilization in man without major surgery or hospitalization (K. Omran). The papers presented in the symposium on the uterine cervix dealt with the anatomy and pathology of the cervix; and the physiology, biophysics, and biochemistry of the cervical mucus.

The role of the uterine cervix in the reproductive process is more subtle and complex than suggested by earlier investigations. The quantity and the biophysical and biochemical characteristics of cervical mucus are under endocrine control. The amount of mucus increases progressively during the follicular phase of the sexual cycle and at ovulation it is profuse and watery. During the luteal phase, cervical mucus is scant, viscous, or gelatinous and opaque. Such mucus is much less favorable for sperm survival than during the follicular phase. Cervical mucus is a complex chemical substance containing sialoglycoproteins (containing sialic acid),

free sugars, glycogen, cholesterol, lipids, inorganic salts, free amino acids, proteins, and enzymes. Before ovulation, the concentration of these substances decrease, partly as a result of the increase in the water content. Because of a high carbohydrate content, the glycoprotein of the mucus is classified as a mucoid (K. S. Moghissi).

Massive numbers of sperm adhere to cervical mucus. The successful completion of fertilization and pregnancy is related to the biophysical and biochemical characteristics of the mucus and the pattern of its accumulation around the internal and external os at the time of insemination. The site of sperm reservoir within the female reproductive tract depends on the site of ejaculation of the species. In species where the semen is deposited in the vagina or cervix (for example, primates, ruminants, and rabbits) the uterine cervix acts as a sperm reservoir and regulates the release of sperm from the mucus into the uterine lumen (E. S. E. Hafez). In swine where semen is deposited within the uterus, the uterotubal junction rather than the cervix acts as a sperm reservoir. Bovine sperm penetrates cervical mucus within 1 to 4 minutes, and is then transported from the cervix to the site of fertilization within a few minutes. Mechanical stimulation of the cervix and the external genitalia causes rapid transport of the sperm. However, little is known about the effect of cervical stimulation on the release of oxytocin and subsequent uterine contraction and sperm transport. Further research is needed to understand the role of the cervix in reproductive failure.

Cervical mucus of humans and bovines contains two mucoids with different molecular size and electrophoretic mobility. These mucoids are readily hydrolyzed by proteolytic enzymes like chymotrypsin. This degradation is associated with notable changes in the properties of cervical mucus, for example, a reduction or disappearance of *Spinnbarkeit*, ferning and viscosity and changes in electrophoretic patterns. Reduced viscosity in turn results in an acceleration of sperm migration (K. S. Moghissi). The variability of the conductivity of the cervical mucus is consistent with the time of cycle and therefore hormonal status. Patients treated with oral contraceptives show different peaks than the normals whose peaks or conductivity maxima coincide with the mid-proliferative and early secretory phases (H. A. Platt).

The viscosity and surface tension of cervical mucus are of considerable value in studying ovarian function and disorders. The proteinogram of mucus, for example, is of great diagnostic value in cases of cervical pathology. In patients free of endocervical infections, the fern test, *Spinnbarkeit* determination, and postcoital test reflect the physiological status of the endocervical glands, and therewith, the adequacy of the cervical canal and its secretions for sperm migration. Cervical hostility may not be associated with abnormalities of hormone production. In such cases sperm transport through the cervical canal may be prevented by antigen-antibody reactions reflecting immunologic incompatibility between the sperm and the female tissues.

Some of the external secretory glands (salivary, nasal, lacrimal) secrete antibody locally in the form of secretory gamma A. The uterine cervix is physiologically similar to these glands in that it serves as a barrier preventing the bacteria of the vagina from entering the uterine cavity. The vagina itself has been suggested as being capable of local antibody production against sperm, possibly affecting subsequent fertility. The ingredients necessary for local production of antibody are present in the cervix. Further studies are needed to document the possibility of stimulating the cervix to produce antibodies locally. If the cervical secretions involve local antibody production in a manner similar to the lacrimal or nasal glands, there may be significant clinical implications regarding involuntary infertility among married couples, as well as the possibility of utilization of this mechanism for inducing voluntary infertility as a method of conception control (K. Omran).

Microzone electrophoresis of human cervical mucus reveals a fraction of basic proteins which exhibit muramidase (lysozyme) activity. The principle of radial diffusion in agar-gel containing *Micrococcus lysodeikticus* as specific substrate is applied for quantitative microanalysis of muramidase in cervical secretions in women (G. F. B. Schumacher and M. J. Pearl). Muramidase declines during the phase of low basal body temperature and increases during the high basal body temperature. In patients under sequential hormonal contraception, muramidase activity declines with the administration of estrogens and increases with the administration of progestagens. Muramidase most probably plays a role in defense mechanisms against microbial invaders. Its possible biological significance as a basic protein has not been elucidated yet.

Microdose administration of norgestrel, a synthetic progestagen without estrogen, effectively prevents conception in women. These contraceptive effects may be due to pharmacological interference, at the cervical level, with possible sperm "capacitation" (M. Roland). Capacitation involves morphological, biophysical, and biochemical maturational changes in the ejaculated sperm in the female reproductive tract. This phenomenon is well documented in the rabbit, but not demonstrated in other species, including primates. The possible role of the mucus in sperm capacitation in man is of particular interest in view of the following phenomena: (i) there is a fair amount of mixing between the seminal plasma and the cervical mucus during coitus; (ii) pockets of sperm penetrate the mucus due to difference in surface tension; and (iii) a large volume of semen escapes from the vagina after withdrawal. Further studies are needed to evaluate the role of cervical mucus in sperm capacitation. Oral administration of 17-acetoxy progesterone compounds causes two antifertility effects in the rabbit. At one dose spermatozoal transport is inhibited at the cervical and uterotubal junction and fertilization is prevented. At a lower dose the eggs are fertilized but implantation is inhibited. However, the 19-norprogestins at comparatively high doses inhibit ovulation by direct effects upon the ovary. However, at low doses fertilization is unaffected but implantation is prevented (J. P. Bennett, B. H. Vickery, and R. I. Dorfman).

It is hoped with further studies of the physiology, biochemistry, biophysics, and immunology of the cervical mucus, contraceptive methods may be developed which are based on shortening the survival time of sperm in the cervical canal, or altering the processes of sperm maturation or capacitation. New, modern methods of fertility control, through blocking sperm migration and fertilization, will markedly improve the effectiveness of family planning programs.

The next World Congress on Fertility and Sterility, organized by the International Fertility Association, will be held in Tokyo, 17–25 October 1971.

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