

who deal with both adult and children's surgery like to regard children as smaller adults, this is unacceptable in cases of ruptured urethra. In small boys it is a different injury, since the prostate has not developed and commonly rupture occurs just below the bladder neck. Again, if the transection is complete the orthodox splint catheter should be used, but if there is anything remaining intact to tether the bladder down to the pelvis surgery should at first be limited to suprapubic cystostomy. These children possibly face a lifelong disability and the second stage of their treatment should be supervised by a surgeon experienced in paediatric urology. One fascinating problem peculiar to children is the postoperative hesitancy to micturate—though once started the stream is free and full.

The message therefore in the management of posterior urethral injuries is that extravasation of sterile urine is not a matter of urgency for 24 hours, and attention to the patient's general condition and other major injuries can take priority. Secondly, blood at the external meatus should be watched for on first examining any patient with suspected fracture of the pelvis. Thirdly, partial rupture as opposed to complete transection of the posterior urethra is much more common than has been appreciated in the past. Fourthly, every effort should be made to preserve the remaining strand of urethra in partial rupture, thus reducing the risk of a severe disabling stricture.

Rupture of Anterior Urethra

Anterior urethral injuries are caused by the patient falling astride an object. A more awkward injury surgically is the disruption of the urethra exactly at the triangular ligament from a blow in the perineum. An inmate of one of our mental hospitals in Bristol had a long-standing vendetta with another inmate and one day he spied his enemy bending down weeding a rosebed. He crept up behind and kicked him with his ammunition boot straight in the perineum, severing his victim's urethra so

that the two ends retracted above and below the triangular ligament, leaving me with an extremely difficult repair.

Early surgical interference with anterior urethral injuries may be precipitated by distension of the tissues by the haematoma. The skin can be so tense over the extravasating blood that there is a risk of necrosis, but unfortunately drainage of the haematoma immediately converts a closed into an open wound with the inevitable risk of infection aggravating the subsequent stricture.

All these patients will develop some degree of stricturing of the urethra, depending on the extent of local infection and actual tissue necrosis, but a stricture of the anterior urethra offers relatively easy access for subsequent successful urethroplasty.

Conclusion

The management of all urinary tract injuries has moved towards a more conservative approach, and there has been a return to diagnosis by clinical acumen. Surgery can be carried out as a formal, planned operation and not as a midnight emergency, and this has relieved young accident surgeons of much anxiety both in diagnosis and treatment. I hope that I have presented a more logical approach to the diagnosis and simplified some of the confused advice on the surgical treatment.

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Gynaecology in General Practice

Physiology of Abnormal Bleeding

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Bleeding from the female genital tract is a physiological function with a wide range of normal. It is also the most important symptom of gynaecological disease. The terminology of this symptom during the reproductive phase is based on the pattern and the amount of bleeding. Menorrhagia signifies heavy but regular monthly losses. Epimenorrhoea and polymenorrhoea indicate a short cycle, whereas epimenorrhagia and polymenorrhagia denote a short cycle with heavy bleeding. Metrorrhagia indicates irregular bleeding and this is by far the most sinister. Though these labels are useful they sometimes give rise to confusion and descriptive phrases are usually more informative. There is no perfect classification of abnormal

bleeding but the time scale before, during, and after the reproductive period serves as a useful basis.

Bleeding Before Reproductive Period

The two most common causes of bleeding before the reproductive period are vaginal trauma and a foreign body. Neonatal bleeding due to maternal hormones worries the mother but she can be reassured that no treatment is required. General conditions must be excluded. They include acute leukaemia, rare local lesions such as cervical sarcoma which tend to occur in the very young and the very old, and oestrogen-producing tumours of the ovary—such as a granulosa cell tumour, theca cell tumour, and malignant teratoma, which may occur at any age.

Precocious puberty is an unusual phenomenon defined as the onset of menstruation accompanied by the development of secondary sexual characteristics before the age of 10 years.

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Ninety per cent of cases are constitutional but the diagnosis cannot be made without excluding intracranial lesions in the region of the pituitary, hypothalamus, or midbrain, which stimulate the output of gonadotrophins. Oestrogenic tumours of the ovary will cause bleeding and some breast development but the bleeding is irregular and the oestrogen levels will generally be high in relation to the pituitary gonadotrophins. Griseofulvin used in the treatment of scalp ringworm has been associated with bleeding, presumably due to hypothalamic stimulation, and other drugs may prove to have a similar effect. If there is no evidence of secondary sexual characteristics the bleeding is probably due to a local lesion in the vagina. In the absence of obvious disease, however, the child should be kept under surveillance as evidence of a pituitary lesion may appear later, and her parents should be warned that pregnancy is a possibility.

Bleeding During the Reproductive Period

Bleeding during the reproductive period may be frequent; scanty or heavy; short or prolonged; irregular, intermenstrual, or postcoital. The abnormality may be due to an aberration of function or herald gross pathology. The patient's description is coloured by her personality and the condition may be caused by her emotional state. Patience, sympathy, and reassurance are necessary to obtain a coherent story and are an important part of therapy. Some patients give a history of severe and prolonged bleeding and yet have no evidence of anaemia, whereas others referred with anaemia have confessed to heavy bleeding only after direct questioning by their general practitioner.

We are now seeing an increasing number of patients who naturally have either long or short cycles which they have previously accepted as normal but who have become worried by an article on cancer in the popular press or by an invitation to have a cervical smear. There are wide variations of normal menstruation and each woman has her own pattern, which is as much a part of her general make-up as the colour of her hair, and subject equally to natural or artificial change. No investigation or treatment is necessary for naturally short or long cycles unless they are associated with infertility, inconvenience, or a loss so heavy as to cause anaemia. Nevertheless, any change other than the normal phenomena of pregnancy and the menopause should be investigated immediately as a new pattern may signify cancer.

Physiology of Menstruation

Consideration of some aspects of the physiology of menstruation can help in the differential diagnosis and treatment of abnormal bleeding during the reproductive phase. Physiological changes in the endometrium depend on steroids secreted by the ovaries, which in turn are under the neuroendocrine control of the pituitary and hypothalamus—and therefore to some degree also of the cerebral cortex. The morphological changes in both the endometrium and the ovary are now well documented and good descriptions are available in the standard textbooks. Unfortunately, the physiological and biochemical mechanisms for these changes are still somewhat speculative.

It has been possible for some time to estimate oestrogen levels in the urine by chemical methods and measure pituitary gonadotrophins using bioassay. More recently it has become possible to estimate oestrogen in the blood using competitive protein-binding assay¹² and luteinizing hormone by radio-immunological assay. Luteinizing hormone is the pituitary gonadotrophin whose upward surge heralds ovulation and which converts the Graafian follicle into the corpus luteum. Serial estimations, therefore, of oestrogen and of luteinizing hormone may be used to determine whether the ovary is

capable of normal function and to monitor normal, abnormal, and artificially induced menstrual cycles. These are still expensive and complicated techniques and are required only in special cases.

The ovary is often wrongly blamed by both the doctor and the patient for irregularities in the menstrual cycle. Apart, however, from inflammatory disease of the pelvis and ovarian tumours, abnormalities of ovarian activity are due to faulty regulation by the neurohypophysis. The hypothalamus stimulates the pituitary in women to produce two gonadotrophins—namely, follicle-stimulating hormone and luteinizing hormone. Both of these are necessary for the development of a Graafian follicle, which contains the particular ovum selected for maturation by a process which is not yet known. The developing Graafian follicle and its surrounding specialized stroma, or theca cells, produce the oestrogen which is necessary for the proliferative phase of the endometrium. This is the build-up phase, in which the endometrium thickens to receive the ovum and is nourished by spiral arterioles developed for the purpose. The basal endometrium is nourished by separate small straight arterioles, which ensure regeneration of the endometrium after it is shed at each menstruation.^{3 4}

NEUROHORMONAL CONTROL

When the time is ripe, usually around mid-cycle, the hypothalamus produces a luteinizing hormone releasing factor (LRF), which stimulates the anterior pituitary to produce the surge of luteinizing hormone necessary to stimulate ovulation. This neurohormonal control mechanism was first postulated by Green and Harris in 1947.⁵ It is now recognized that there are six chemically distinct small polypeptides secreted by the hypothalamus which are concerned with regulating the six anterior pituitary hormones. LRF was first isolated in an impure form in 1960^{6 7}; Gregory⁸ has extracted LRF from freeze-dried ovine median eminence fragments, and Macourt⁹ has given a preliminary report on the treatment of women with this preparation in Oxford.

When the Graafian follicle has released the ovum it is converted also by the luteinizing hormone into the corpus luteum, which produces the ovarian steroid progesterone. The corpus luteum, which is responsible for the second half of the cycle, produces oestrogen as well as progesterone, and probably the human corpus luteum is unique in its capacity to produce oestrogen from progesterone.¹⁰ This is important when considering therapy. The fact that the corpus luteum produces oestrogen as well as progesterone has been shown by showing a higher venous blood level in the vein draining the ovary containing the corpus luteum than in the one on the other side.¹¹ The postovulatory, or secretory phase, of the endometrium therefore, requires oestrogen as well as an adequate level of progesterone. If fertilization does not take place the corpus luteum regresses and consequently there is a drop in the production of progesterone and oestrogen. There is a loss of fluid from the stroma of the endometrium, which becomes thinner. The coils of the spiral arterioles are compressed with diminution of blood flow, and the endometrium becomes necrotic and is shed.

BLOOD CLOTTING

With the development of our understanding of the hormonal control of the menstrual cycle our knowledge of the factors concerned in blood coagulation has also increased. Immunological techniques have allowed *in vivo* studies of fibrinolysis, which plays a part in the curious phenomenon of noncoagulability of menstrual blood. In fact the blood does form clots at first, but these are simultaneously broken down by the proteolytic enzyme plasmin. Rybo¹² has shown that the level of plasminogen activators in the endometrium is raised in women

with menorrhagia, while Basu¹³ has shown that there is usually an increase during menstruation of fibrinogen degradation products in the general circulation, which is excessive in women with menorrhagia. This increase is not due to increased fibrinolytic activity in the systemic blood,¹⁴ but probably to an increased fibrinolytic activity within the uterus itself.¹⁴ The precise relationship between menorrhagia and increased fibrinolytic activity in the uterus is not certain, and both may have a common cause, such as increased vascularity of the uterus or altered activity of the steroid hormones.

Whatever the mechanism may be there is now rather more than a purely empirical basis for using antifibrinolytic drugs in treating dysfunctional menorrhagia. So far there has been no tie up between hormone levels and the increased fibrinolytic state in menorrhagia, and though hormones are still a more effective form of treatment of this, the antifibrinolytics provide a second line when hormone therapy is contraindicated. Unfortunately they too have the disadvantage of causing possible thromboembolism.

(This article will be continued in next week's *B.M.J.*)

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Computers in Medicine

Simulation of Clinical Diagnosis: A Comparative Study

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Summary

This paper presents a comparison between three different modes of simulation of the diagnostic process—a computer-based system, a verbal mode, and a further mode in which cards were selected from a large board. A total of 34 subjects worked through a series of 444 diagnostic simulations.

The verbal mode was found to be most enjoyable and realistic. At the board, considerable amounts of extra irrelevant data were selected. At the computer, the users asked the same questions every time, whether or not they were relevant to the particular diagnosis. They also found the teletype distracting, noisy, and slow.

The need for an acceptable simulation system remains, and at present our Minisim and verbal modes are proving useful in training junior clinical students. Future simulators should be flexible, economical, and acceptably realistic—and to us this latter criterion implies the two-way use of speech. We are currently developing and testing such a system.

Introduction

Two years ago a preliminary study drew attention to an increasing shortage both of clinical teachers and of patients suitable

for teaching and reported the initial results of attempts to simulate the diagnostic process by using a computer-based system.¹ Several important questions, however, were left unanswered, for though simulation seemed to offer certain advantages in teaching clinical diagnosis it was far from clear whether the computer had to be used in an on-line real-time situation (or even whether the diagnostic simulator need be computer-based at all). To investigate the situation further we have therefore constructed several simulators of varying types, and these have been studied in the department of surgery since the summer of 1970. We report here a critical analysis of our experience to date.

Modes of Simulation

Computer-based Simulator.—This mode was derived from the computer-based diagnostic simulator previously described in detail^{1, 2} but with two major changes from the system then reported. Firstly, a Computer Technology Limited Modular One computer replaced the Elliott 903C computer originally used, and the Modular One computer was used within a multi-access format. Secondly, since the initial teaching programme exerted considerable control over the student's data-gathering processes, for the present study we had to write a completely new set of teaching programmes, which differed from their original counterparts in that they allowed the user to collect clinical information in whatever quantity and whatever sequence seemed most appropriate. These were written by two of us (J.C.H. and F.T. de D.) during the first half of 1970.

Minisim Mode.—The second and third modes of simulation did not involve the use of computer-based systems. The "Minisim" mode was derived in part from work carried out by Rimoldi and associates at the Loyola Institute of Psychometrics in Chicago³ and consisted of a large board on which were

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