with lung metastases. Provided enough sections are cut in any one case, both epithelial and alveolar types of growth can always be found.

There is only one exception to this, and that is seen in the rare mucoid carcinoma of the lung. So far as I am aware no case of this nature has been published from the radiographic point of view. Mucoid degeneration in neoplasms with a glandular origin is common enough, but sometimes a primary neoplasm, arising from alveolar tissue, consists purely of adult cells secreting mucus or some mucoid material. Because of the well-developed cells with a definite function these growths are only semi-malignant. They do not metastasize widely nor do they cause cachexia. They kill only by their slow replacement of normal tissue in a vital organ or organs. The following case has excited considerable pathological discussion.

The patient was an elderly man sent up for radiographic examination from the out-patient department with a diagnosis of pleural effusion on the right side. Figure 6 on Plate shows that there was such an effusion present, but the mass in the left middle lung field was unsuspected, nor could physical signs of it be detected until six months later. On screening this patient at the first examination I noticed a very peculiar movement in the left-sided mass, and duly reported "the triangular opacity on the left side quivers like a jelly on deep inspiration." Three years later the patient died, and at necropsy this triangular opacity was found to be a mucoid carcinoma in a third lobe of the left lung. On shaking the specimen

the movement of the mucoid mass was identical with that observed on the screen during life.

A second case with similar movement has since come under my observation, and has proved to be a bronchial carcinoma with advanced mucoid change.

It is obviously impossible to describe all the varying appearances which are to be seen in radiographs of pulmonary carcinoma. But there is one radiological feature common to all malignant growths of the lung. There is never normal lung tissue between the shadow of the neoplasm and the shadow of the mediastinum.

The characteristic radiographic appearances of multiple pulmonary metastases is so well known that a detailed description of them is unnecessary, but few are aware that there is a form of pulmonary tuberculosis closely simulating secondary deposits in the lungs. In pulmonary tuberculosis complicated by diabetes or bone tuberculosis the lung lesions are larger and better defined than those seen in uncomplicated phthisis or miliary tuberculosis. The differential diagnosis from metastases is based on the demonstration of a cavity and the fact that tuberculous nodes are limited to the upper two-thirds of the lung fields.

In this paper I have, as far as possible, excluded descriptions of lipiodol injection and clinical and surgical methods of diagnosis—not because I under-estimate the value of these methods, but because I feel that the radiologist should strive to get the last ounce of information from his films without outside help.

INJURY OF THE RECTUM CAUSED BY THE FAULTY ADMINISTRATION OF AN ENEMA

BY

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(With Special Plate)

I am not sure that even the possibility of inflicting a severe injury on the rectum in the course of the administration of an enema is generally realized by members of the medical and nursing professions. References to the injury in medical literature, both in periodicals and books, are extremely few in number and lacking in descriptive details. Probably the injury is regarded as only likely to happen when an enema is administered by some bungling amateur, or by the patient himself, and therefore as not of much practical importance. Now I have myself encountered three examples of it among my own patients within a period of six years, and I find from personal communications that several other surgeons have had patients who have suffered this misfortune. In my cases, and, so far as I could ascertain, in those related to me by others, the enema was administered by a trained nurse, or a nurse undergoing training, whose competence there was no reason to suspect. Again, at a meeting of the North of England Obstetrical and Gynaecological Society in 1929, W. W. King¹ described a case, and it is noteworthy that in the discussion which followed three members recorded four similar cases that had been encountered in their own practices. Further, it is likely that the less severe types may not be recognized as cases of enema injury, for there may be an interval of seven or eight days between the infliction of the injury and the first complaint of the patient to attract attention to the part; unless the observer then has the possibility in mind he can easily overlook the real nature of the lesion in the rectum.

I suspect, therefore, that the injury is by no means so very rare as it is believed to be, and that the distress of inflicting it may befall any nurse, but especially the junior nurse, who is unaware of the possibility, and therefore of the means by which it is to be avoided. Because the mishap may have the most disastrous consequences, and because it is entirely avoidable, attention should be called to it with some emphasis—even if it is a very uncommon occurrence.

The injury is always a grave one, for it causes sloughing of the mucous membrane of the anal canal and rectum, and it is commonly necessary to perform a temporary colostomy in order to promote healing of the extensive raw surface left after separation of the sloughs. Sometimes, in consequence of the dense cicatricial stricture which follows healing, the colostomy may have to be a permanent one. In some cases death has resulted from sloughing of the rectal wall into the peritoneal cavity, or from spread of sepsis along the fascial planes of the pelvis. In addition to the gravity of the injury there is another important consideration—the legal aspect. I do not know that an action for damages has ever been brought under these circumstances, but it is obvious that a patient could make a claim for damages with every prospect of success against the nurse, or, where circumstances permit, more profitably against her employer, and that the damage in terms of money might be considerable.

MECHANISM OF PRODUCTION AND CLINICAL FEATURES OF THE INJURY

The essential factor in the production of the injury is the use of a hard conical nozzle, usually of bone, sometimes of glass. The Higginson syringe is an important accessory, though no objection can be taken to this very useful and well-established article if the unguarded nozzle with which it is fitted is not employed to deliver the enema into the rectum.

The injury is caused by forcing the tip of the nozzle through the mucosa of the anal canal. Penetration of the mucous membrane by the nozzle tip may occur in certain

circumstances without gross or unpardonable carelessness on the part of the administrator; such circumstances, for example, as a poor exposure of the perineum from bad lighting and faulty position of the patient, insufficient lubrication of the nozzle, the use of some force to overcome the resistance caused by inaccurate insertion of the nozzle, and an everted condition of the anal mucous membrane, as in prolapsed haemorrhoids; any or all of these may combine to trap the nurse, particularly if she is comparatively inexperienced and therefore handicapped by a feeling of awkwardness in the giving of an enema. The nurse, unaware of the perilous position of the nozzle—for the actual puncture of the anal mucosa gives the patient little pain—proceeds to inject, with the considerable force which the Higginson syringe permits, a strong solution of soap and water into the submucous layers of the anal canal. The enema fluid strips up the mucosa of the anus and rectum over a large area, the extent of which depends upon the amount of the fluid which has been injected. The injection of fluid under strong pressure into the submucosa causes such great pain to the patient that the nurse soon realizes something is amiss and stops the enema, but not before some damage, irrevocable damage it may be, has been inflicted. The patient may experience a sensation of nausea and faintness, or he may even collapse, but in most cases these constitutional disturbances quickly pass off after the abandonment of the enema; so, too, the intense pain diminishes and becomes a mere discomfort or bearing-down sensation, of which the patient makes no complaint; no doubt he regards the discomfort as a natural consequence of a novel and very unpleasant experience. At this stage, then, to the nurse there may be no visible evidence of the injury—no swelling and no bleeding from the anus—and she ascribes the patient's distress during the injection to some abnormal sensitiveness on his part, and so no report of the incident may reach the medical man.

In a case reported by Fletcher Shaw²—that of a woman in the early stages of labour—great swelling of the perineum and vulva occurred immediately after the enema, and it seems probable that when the injury is inflicted on a woman in labour some of the fluid will tend to escape into the subcutaneous tissues of the perineum, owing to the pressure of the descending head on the rectum. In my three patients, all men, there was, according to the nurse, no perceptible swelling at the time, and in none was any complaint made to me or to the resident officer until at least a week after the injury; during the whole of this period each patient showed an irregular pyrexia, beginning suddenly at the first record taken after the enema, and a gradual deterioration in general condition. The real cause of the pyrexia and illness, in the absence of any distinctive symptoms or complaints, remained unsuspected till a week or more after the enema, when the patient first complained of pain about the anus, and inspection of this part revealed at once the explanation of the patient's illness. Examination of the anus showed a tear or gash, apparently superficial, of the anal margin, and, on inserting a finger into the anal canal, the tear was found to continue upwards into a ragged, excavated defect in the wall of the rectum; this defect extended some three or four inches up the rectum and was from one to two inches in width. The edges of the cavity were formed by indurated rectal mucosa, and represented the line of survival of this tissue; the floor consisted of sloughing tissue devoid of any mucous membrane. The entrance to the uninjured rectum at the upper limit of the lesion could be recognized by the finger-tip. In one patient, about ten days after the injury, I drew out a slough which in size and appearance resembled a handful of dirty cotton waste. The appearance of the parts some two weeks after the injury is well

shown in the illustrations, both of which were taken from the same patient.

It is clear that this extensive sloughing is due to the injection beneath the rectal mucosa of a quantity of fluid under great pressure, which strips up the mucosa and deprives it of its blood supply. The initial injury—the puncture of the mucosa—is represented by the tear which is visible at the anal margin.

Probably the nature of the enema fluid, a strong solution of soap, is also an important factor, for it is likely that the soap used for this purpose contains an appreciable amount of sodium carbonate and possibly of caustic soda. The interval between the injury and the first complaint of pain is no doubt due to the fact that it is not until the mucosa has sloughed away, and a large area of cellular tissue has thus been exposed to infection from the faecal traffic, that the inflammatory process reaches its height.

Another and still more severe type of injury, which I have not myself encountered, is that in which the wall of the upper rectum is punctured and the fluid injected either directly into the peritoneal cavity or immediately under the peritoneum. Such an injury will cause death within one or two days. This injury can only happen when a hard tube of glass or metal, several inches in length, is employed, or conceivably the ordinary bone nozzle without a flange might be responsible. An injury of this type was reported nearly a hundred years ago,³ and I have heard of a similar catastrophe that happened to a patient a few years since.

It is worth noting that when the existence of the lesion in the rectum is first discovered and one attempts to reconstruct the course of events which have led to it, there may be some difficulty in doing this; obviously, discretion has to be used in interrogating the patient, and the nurse may not unnaturally be reluctant to offer information except in reply to direct questions. When investigating the history of one of his patients whose injury had been sustained in the course of a pre-operation enema, the surgeon was met by the disarming statement that no enema had been given, but closer inquiry revealed the all-important fact that an attempt had been made to administer an enema and had quickly been abandoned owing to the distress of the patient.

It is unnecessary to say anything of the treatment of the injury. Clearly its infliction can be prevented with certainty by avoiding always the use of the unguarded bone (or glass) nozzle in the giving of an enema, and the sole purpose of this paper is to stress the need for this precaution. Whether the Higginson syringe or tube and funnel is used to supply the injecting force does not matter, provided the fluid is led into the rectum by a rubber catheter or tube, but in the event of a puncture of the anal mucosa by an unguarded nozzle tip, then it is certain that the Higginson syringe will inflict more damage than the tube and funnel, owing to the greater pressure under which the fluid is injected by the syringe. A rubber catheter or tube should then, in all cases, be fitted over the ordinary bone or glass nozzle. Instead of the catheter a conical rubber tube about five inches in length, procurable from most surgical stores, may be used; this is specially made to fit securely on the enema nozzle, and, being shorter and rather firmer than the ordinary catheter, it is easier to insert and control. I am aware that many sisters do train the nurses in their charge to use a rubber catheter, but there is no uniformity in this matter, nor is the importance of the precaution sufficiently appreciated; it is probably a fact that the majority of nurses, during some period of their training, are taught or allowed to use the unguarded nozzle without even being warned of the lurking danger, and this practice, I submit, cannot be too emphatically condemned. I may be told by many very experienced nurses that they have used the method I

condemn thousands of times without once inflicting the slightest injury, and I should not doubt such statements; no more should I doubt my own conviction that as long as such a method is generally adopted, so long shall we continue, rarely it may be, to meet with examples of this grave and easily avoidable injury.

REFERENCES

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PHARMACOLOGICAL PROPERTIES OF ISO-AMYL ETHYL BARBITURIC ACID (AMYTAL) *

BY

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Nearly thirty years ago veronal was first introduced as a hypnotic. Since then the derivatives of barbituric acid have found progressive favour as hypnotics, and, in more recent times, as premedication drugs in anaesthesia, and even as general anaesthetics.

One of the more recent derivatives is amytal (iso-amyl ethyl barbituric acid). This drug was first described by Shonle and Moment¹ in 1923, and was promptly used by Page² in pharmacological experimentation. At first the difficulty of preparing the soluble sodium salt of amytal delayed the use of this drug as an anaesthetic for human beings. Very recently, however, the presence on the market of the sodium salt of amytal in stable form has permitted its wide application as an anaesthetic in man.³ A full description of the clinical use of the barbituric acid group of drugs, both in surgical and in non-surgical cases, may be found in the *Proceedings* of the staff meetings of the Mayo Clinic.⁴ Amytal, since its introduction, however, has been widely used in physiological and pharmacological laboratories as an anaesthetic for animals. Although the direct application of information derived from animals to man is notoriously unsafe, yet the data from the clinical use of amytal resemble so closely the findings in the laboratory that a description of my own experience and that of other laboratory workers may be not irrelevant.

ROUTE OF ADMINISTRATION

In laboratory animals, at least, oral administration of the drug is unsatisfactory. The action is slow and uncertain. Subcutaneous or intramuscular injection of a 10 per cent. solution of sodium amytal is much to be preferred. The injection itself causes no distress, the onset of anaesthesia is quiet, but it is somewhat slow, being sometimes delayed for one hour or more. Intraperitoneal injection of the 10 per cent. solution is equally painless; there is subsequently no sign of peritoneal irritation, and the onset of anaesthesia is rapid—ten to fifteen minutes. Frequently there are signs of nasal irritation, the animal sneezing repeatedly and rubbing its snout with its fore-paws. Beyond this there is no disturbance and no distress. Intravenous administration of the same strength of solution causes very rapid onset of anaesthesia, but the injection must be carried out very slowly, because of severe circulatory disturbances.

In animals the subcutaneous or intraperitoneal is the route of election.

DOSAGE

In the cat and in the dog the basic dose for complete surgical anaesthesia is 50 mg. per kilogram of body weight. In the rat and in the rabbit the dose is somewhat greater.

* A communication to the Section of Anaesthetics, British Medical Association, Eastbourne, 1931.

A slightly larger dose is necessary by the subcutaneous than by the intraperitoneal or intravenous route. Twice the minimum effective dose may usually be given with safety, even by the intravenous route. In man a smaller dose seems to be effective; 20 to 25 mg. per kilogram of body weight, given intravenously, is adequate for complete surgical anaesthesia, and 12 to 20 mg. per kilogram of body weight is sufficient to lower the dose of such volatile anaesthetics as ether, or N₂O and O₂, to one-quarter of the usual amount required.⁴ Stormont, Lampe, and Barlow,⁵ working on rats, showed that premedication with amytal or other barbituric acid derivatives permitted the production of full anaesthesia with a lower percentage of N₂O and a higher percentage of O₂ than is usually necessary. All danger of oxygen deficiency during the anaesthesia was thus eliminated.

DURATION OF ANAESTHESIA

In the cat and in the dog complete anaesthesia lasts two to three hours, using the basic dose of the drug for anaesthesia. The period of surgical anaesthesia is followed by an interval of drowsiness and sleep, which may last from twenty-four to thirty-six hours. In the rabbit all the phases are very much shorter. In man, according to the dose, there is post-anaesthetic sleep and drowsiness for twelve to seventy-two hours. This considerably increases the necessary nursing attention. Neither in animals nor in man are there signs of post-operative distress.⁶

EFFECTS ON METABOLISM

The statement by early workers that carbohydrate metabolism is unaffected by amytal made this drug the anaesthetic of choice during the wave of experimental investigation into carbohydrate metabolism which followed on the discovery of insulin. This sweeping claim for amytal as a true "physiological" anaesthetic has not stood the test of time. Glucose injected intravenously is not removed from the blood at the usual rate, presumably due to inhibition of the storage of glycogen in the liver.^{7 8} Many workers claim that the blood sugar level remains unaltered under amytal anaesthesia, and that the level of the sugar in the blood responds normally to the injection both of adrenaline and of insulin.^{2 9 10} It is possible that the abnormal blood sugar levels which have been reported under amytal anaesthesia may have been due to disturbance of the animal, but this is denied by Weiss.¹¹ However this may be, there seems to be a general consensus of opinion that amytal anaesthesia has a less disturbing effect on carbohydrate metabolism than the majority of other anaesthetics in general use. This may be not without significance in anaesthesia in man if damage to the liver is feared.

As is to be expected, amytal lowers the body temperature, certainly by enforced inactivity and possibly by a direct depressor action on metabolism. Shivering is very apt to occur.¹²

Respiratory System.—All barbituric acid derivatives are respiratory sedatives. Amytal, however, in anaesthetic dosage, does not greatly diminish the minute-volume of respiration, and the respiratory centre remains sensitive to CO₂.¹³

Circulatory System.—Amytal has a definitely toxic action on the heart, and this is more marked the more rapid the administration.¹⁴ For this reason rapid intravenous exhibition of the drug is fraught with danger. The blood pressure falls rapidly, and one hour or more may elapse before it regains its previous level. This fall in blood pressure is due both to dilatation of the heart, with reduction in minute-output, and also to vaso-dilatation.^{15 16} Large doses administered rapidly may cause heart-block, ventricular fibrillation, and death. In clinical use amytal

H. H. RAYNER: INJURY OF RECTUM CAUSED BY FAULTY ADMINISTRATION OF AN ENEMA

FIG. 1.—Appearance of anal orifice two weeks after enema injury. The nozzle has evidently been plunged into a prolapsed haemorrhoid which was comparatively insignificant before infliction of the injury. Patient lying on left side.

FIG. 2.—Semi-diagrammatic sketch, from same patient, of interior of rectum as seen through speculum.

H. J. MCCURRICH: COMPRESSED FRACTURE OF LUMBAR VERTEBRA

FIG. 1.—Compressed fracture of first lumbar vertebra.

FIG. 2.—Showing reduction of compression after treatment.