CLINICAL PATHOLOGY IN GENERAL PRACTICE

POST-MORTEM TECHNIQUE FOR THE OCCASIONAL PERFORMER

BY

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In Britain, where the services of a pathologist are usually readily available, the general practitioner will seldom feel justified in performing a post-mortem examination. However, occasionally he may have to do so, and this article sets out to describe how the examination should be conducted. If the necropsy has not been ordered by the coroner, the consent of the nearest relative should always be obtained. In addition, details of the circumstances of the death and of the previous medical history are of the greatest value in suggesting what abnormalities should specially be sought. Whenever possible the examination should be deferred until this information is available. The following description applies particularly to cases of sudden death in an adult, but the principles are the same for most post-mortem examinations.

Mortuary and Equipment

It is wise to be sure that the examination is to be carried out under tolerable conditions. The days are gone when a post-mortem examination must perforce be done on a kitchen table or in an unadapted outhouse. Good lighting, a proper examination table, adequate hot and cold water, and some source of heat are needed; refrigerated storage space is desirable, especially in the summer months. Most local authorities do not now demur at the cost of moving a body to some suitable mortuary. In addition to premises, a reliable mortuary attendant should be available to assist. Long experience has taught me that a good one is more valuable even than instruments.

An elaborate battery of instruments is not needed. The following will be found satisfactory:

Knives: two about 6 in. (15 cm.) long, of cartilage type; a long bacon-slicer type (or bread-knife) for cutting the brain; two or three scalpels, for preference of the type with detachable blades; a small bistoury. Scissors: one large pair, 7 in. (18 cm.) long; one pair 6 in. (15 cm.), blunt-ended; one pair, intestinal pattern, in which one blade is guarded; one or two small pairs for such purposes as opening coronary vessels, etc. Forceps: at least two pairs, preferably toothed. Butcher's saw about 10 in. (25 cm.) in length. Blunt chisel and mallet. Soup ladle for removing body fluids. Coronet, especially needed by a tyro. Probes, large and small. Bone-cutting forceps. Steel tape-measure. Scales and weights—preferably registering in grammes.

In addition containers for bacteriological and other specimens, suture materials, and protective clothing will be required, as follows:

Throat swabs. Small sterile containers for C.S.F. and urine. Catheters. Clean slides. Specimen tubes. Sterile syringes and needles, including lumbar-puncture needles. Suture needles—3 in. (7.5 cm.) curved type I find most suitable. Thread—upholsterer's twine. Tow. Sponges—at least two. Surgeon's gown. Rubber apron and Wellingtons or rubber overshoes (desirable but not essential). Mask if necessary. Spectacles—desirable. Gloves: individual preference plays a part here. I recommend the thin "latex" gauntlet type, which are most comfortable if secured by an ordinary rubber band just below the elbow, and cotton overgloves. Two pairs of gloves may sound clumsy, but they are safe and efficient, as the cotton provides a better grip on slippery organs. Ordinary surgical gloves will suffice alone. Some pathologists prefer the standard rubber gauntlet gloves.

A note-book or slate must be available, and it is a wise plan to list the salient features to be noted on this before the examination begins.

Sudden Deaths

A check on my own figures shows that approximately 75% of these are due to natural causes and 20 to 25% are accidental or criminal cases (mainly accident). Of the 75%, about 40% are related to some defect of the coronary arteries, be it occlusion, thrombosis, or a complication, cardiac infarction, or cardiac rupture; 15% are due to cerebral haemorrhage or thrombosis, including subarachnoid disasters. Other common causes are massive haemorrhage and "syncope." This last presents no specific findings and may need to be inferred from the absence of pathological evidence and the general circumstances. In susceptible persons reflex vagal inhibition sometimes follows comparatively minor procedures affecting the skin, pleura, peritoneum and the vagina (a pitfall for the abortionist). Concussion, although showing changes discernible microscopically, may show little or nothing to the naked eye. A blow over the heart may be fatal and is not uncommon in, for example, steering-wheel injuries. Poisons must never be forgotten in cases of sudden death, especially carbon monoxide and coal gas. Inquiries should be made regarding the possibility of this, and a sample of blood taken for test. (The container must be completely filled.) The commonest poisons met with in practice are the narcotics, and these should be considered in cases in which the obvious findings are cyanosis of the ears, lips, lungs, etc., without pathological explanation.

With these preliminary remarks the actual examination can now be described.

First inspect the body externally and make notes of identification—for example, height, approximate weight, scars and other marks (tattoo designs), presence or absence of false teeth, etc. Note the degree of rigor mortis, the state of general nutrition, and colour. Any departure from normal must be recorded—slight yellow staining on a man's hand proved on inquiry to be due to the toxic weed-killer dinitro-ortho-cresol, and a factor in the death. A splinter beneath a toenail has yielded tetanus bacilli; a small "boil" proved to be an anthrax pustule. Inspect the eyes and the ears. Embarrassment can be caused if at an inquest questions are asked about possible blindness or deafness, which could easily have been answered by observing the presence of a glass eye or an old mastoid wound. Always turn the body over. This may sound obvious, but I have known bedsores to be overlooked because of its omission.

In many cases I make a routine procedure of doing a post-mortem lumbar puncture, which is generally easy, even in the presence of rigor mortis. Fulminating meningitis, intrathecal haemorrhage, etc., may be detected, whilst even a normal fluid may yield barbiturates more easily than, for example, urine. Pathological findings in the spinal fluid after death are not exactly parallel to those in life. The cell count in particular is deceptive, as theca cells are shed and give a falsely high figure. Of course, after death there is no spinal fluid pressure and suction with a syringe is needed.

Brain and Spinal Cord

I was taught to begin by opening the skull, on the grounds that if the body were opened first loss of blood from the great veins would change the appearances of the brain. I am not convinced that this is entirely true, but every case should be considered on its merits. The hair is parted across the vertex from just behind the ears, and the scalp cut through to the bone. The two flaps are then reflected, the front one forwards to just above the orbits and the posterior one to the occiput. Cut through the temporal muscles and then place the coronet in position as a guide for the saw cut. The saw should be used a little at a time, so that the depth of the cut right round the skull is approximately the same. When the inner table is reached, provided a fracture of the skull is not suspected, the skull cap can be most quickly removed by using a chisel. The dura is incised along the line of the cut, but in some cases it is very adherent, and then it is necessary to remove it with the bone.

To remove the brain, pull gently on the frontal lobes and sever the cranial nerves. Cut the tentorium with a scalpel (if a bistoury is available this is preferable). If the spinal cord is not required in continuity this is incised just below the medulla and the brain removed. If microscopical examination is intended the brain should be placed in a 5% formol saline fixative for at least several days, but in the ordinary way this is not necessary and the brain should be cut. Provided the same general method is used on every occasion no set procedure is needed. It is only necessary to ensure that each part of the brain is inspected in turn. My own method is to examine the organ carefully externally, looking at the vessels and the fissures, especially the fissure of Sylvius, where, for example, tubercles might be found, and then with a large bacon- or bread-knife, which should be used wet, a cut is made horizontally about $\frac{1}{4}$ in. (2 cm.) deep right through the upper part of the cerebral hemispheres. The next cut can be parallel with this and should open the lateral ventricles. Transverse incisions about $\frac{1}{2}$ in. (1.3 cm.) apart will enable the basal ganglia to be examined. Next the cerebellum should be cut in the midline, and on opening out the cut the third and fourth ventricle are viewed. The cerebellum is removed, and then transverse cuts should be made in the brain stem. A small lesion here may produce large consequences, and therefore the cuts should be close together.

Although perfection demands that the spinal cord should be examined in every case this is usually done only in cases in which the history or the examination itself indicates the necessity. To do so the body is turned over, face downwards, and with the head over the end of the table, or with a block under the chest. An incision is made over the vertebral spines and the muscles on either side are cut away to expose the laminae. These are then divided with a saw or with bone forceps. The spines and laminae and attached ligaments are then cut away, opening up the spinal canal. The cord is removed by cutting the spinal nerves. More usually the cord is severed in the cervical region, but if it is desired to remove it in continuity with the brain, the edges of the foramen magnum are cut away by sawing through the occiput on either side. To examine for a fracture of the base of the skull the dura must be stripped. Care is needed not to mistake vascular markings for a fracture. Hold the skull cup up to a strong light to inspect this; tapping its edge will yield a cracked-pot sound if a break is present.

The middle ear can be opened by driving a chisel through the tegmen on either side. To examine the pituitary cut away both posterior clinoids with a chisel. The antra may be reached through the anterior fossa.

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Opening the Thorax and Abdomen

Stand on the right side of the body and make an incision from the point of the chin down to the pubes. In the neck

the skin only is incised, over the chest cut down to the bone, in the abdomen cut through to the peritoneum, taking care not to injure a viscus. In the abdomen first make a small hole and look to see that no viscera or omentum are in the way before extending the peritoneal incision. I make a routine of cutting the abdominal recti close to the pubic attachment, as this allows the abdominal wound to be more widely opened. The soft parts over the chest are stripped back over the costal cartilages to approximately the outer edge of the clavicle. Before doing more, preliminary inspection should be made of the abdominal contents and the pelvis, and a note taken of the position of the diaphragm. In women past the age of 35 the mammary glands are examined by cutting them from the inside of the flaps without injuring the skin if possible. This is done so that small carcinomata shall not be overlooked. The costal cartilages are cut with a knife, except in the elderly, in whom bone forceps or a saw may be needed. The sterno-clavicular joint is disarticulated and the sternum and attached costal cartilages are removed. The pleural cavities can then be examined for adhesions, fluid, presence of lung collapse, ballooning, etc. The pericardium is inspected and opened.

At this point I open the pulmonary artery and its main branches, and look for emboli. Post-mortem clot must not be mistaken for this. An embolus is fairly firm, very often presenting a "mare's tail" appearance if it comes from the legs. A simple test, which is of value when in doubt, is to take the clot and place it in water. Post-mortem clot will easily break up, but an embolus does not do so. If an embolus is found, search must be made for its origin. Usually this is in the leg, the pelvis, or sometimes the abdomen. It is not always possible to find the site, but often there is roughening of the vein wall at the point of origin, and sometimes further ante-mortem thrombus is still adherent to the vessel wall.

It is best to remove the tongue, fauces, larynx, trachea, and oesophagus *en bloc* with the thoracic viscera. Dissect the skin away from the submental region and cut close to the jaw into the floor of the mouth. The tongue can be hooked forward with the left hand and the posterior attachments, including the carotid vessels, freed with a knife. By pulling forward, the next main lines of attachment are displayed—the great vessels at the root of the neck, which, when cut, allow the lungs to be pulled out provided there are no pleural adhesions. If there are, they should, of course, be broken. It is wise to ligature either the oesophagus or the oesophageal opening in the diaphragm in order to preserve the stomach contents. The thoracic viscera may then be removed by cutting through the aorta, oesophagus, inferior vena cava, and base of the pericardium.

Thoracic Viscera

To examine the thoracic viscera, the pharynx and oesophagus are first slit with scissors and examined, the condition of the tonsils and tongue, which will show significant changes, for example, in cases of corrosive poisoning, being noted. The larynx, trachea, and main bronchi are opened, also with scissors, and the contents inspected—for example, for mucopus, oedema fluid, and foreign substances.

The lungs can then be examined and cut through from the outer edge to the hilum, with subsequent cuts where necessary. Portions of the lung which appear solid should be tested by placing them in water. Anything which is thought to be abnormal should be opened up and examined. Note should be made of enlarged mediastinal glands. In the case of tuberculosis, great care should be taken to avoid splashing (a mask should be worn). Even when care has been taken in cutting a tuberculous lung, minute splashes may deposit tubercle bacilli on a glass plate held a foot (30 cm.) away.

Examination of the heart, apart from being of great importance, seems to cause difficulty to beginners. If it is remembered that both auricles and ventricles must be opened, and that the condition of all the valves, the heart

muscle, and the coronary arteries must be ascertained, it is not difficult to adopt a system. First, the right auricle can be opened by cutting from the superior vena cava to the inferior vena cava, with an incision at right angles from this into the right auricular appendix (search for thrombi); any clots should be washed away, and the tricuspid valve, which normally admits about three fingers, should be inspected. Each cusp should be examined for vegetations and scarring. The left auricle is opened by cutting between the two upper pulmonary veins and continuing this incision into the auricular appendix. Again look for thrombi, vegetations, and possible thickening of the endocardium. The mitral valve can be inspected from above, and normally admits one finger with ease and two with difficulty.

The right ventricle may be opened by an incision down from the pulmonary artery parallel to the interventricular septum but anterior to it, and the state of the contents observed. The pulmonary valves may first be tested with water and inspected. The left ventricle can be opened by an incision in its lateral aspect, and an incision at right angles to this, right across the apex, will indicate the thickness of the muscle. The aortic valve can be water tested, looked at from above, and scissors passed down from above through the valve across to the left ventricle, laying open the valve and ventricle in continuity. Alterations in the valve cusps and the state of the aortic ring are very easily observed. The orifices of the two coronary arteries should be examined. The right coronary artery rises from the right antero-lateral sinus of Valsalva and is smaller than the left. It supplies most of the right ventricle and auricle, together with a part of the left auricle. The left coronary artery, rising from the left antero-lateral sinus of Valsalva, divides into two main branches, which together supply most of the left ventricle, the interventricular septum, and also a small part of the right ventricle and the lower third of the left auricle. The main division is the descending branch, which passes down the anterior interventricular groove, and it is this branch which is most commonly affected by disease, the most frequent site for thrombosis, degeneration, or occlusion being 1 to 1½ in. (25 to 38 mm.) from the aortic valve. The other branch runs back in the auriculo-ventricular groove to supply the posterior part of the left ventricle.

It is possible to open up the coronary arteries with fine pointed scissors, but by so doing thrombi may be dislodged, and I think it preferable to make frequent cuts at right angles to the vessels with a sharp scalpel or even a razor blade. The state of the lumen can be seen at each point, and if desired the short intervening lengths may be opened with scissors. In an area of infarction the appearances vary with the time since its occurrence. For a few hours almost nothing may be visible to the naked eye, though later the infarcted area becomes swollen and shows a red haemorrhagic demarcation. If the whole thickness of the heart muscle is involved an adherent thrombus is commonly seen in the cavity involved. Ten to fifteen days after infarction organization becomes apparent, and later this granulation tissue is changed to fibrous scar.

The thoracic aorta must next be opened and inspected for degeneration. Syphilis, now becoming increasingly rare, commonly produces distortion and often dilatation of the first part of the aorta, with replacement of adventitia, media, and intima by vascular granulation tissue. Pearly white scars, often around the vasa vasorum, may produce puckering. Simple atheromatous degeneration frequently co-exists, and the yellow degenerate material can be seen if the suspected patch is cut across. It is often calcified.

Abdominal Viscera

First inspect to decide which method of approach is appropriate. Unless there is reason to suspect lesions in the small intestine this may be removed by cutting along the root of the mesentery with a sharp knife. The appendix should be examined and then the whole of the large intestine may be stripped away down to the pelvi-rectal junction, where it is cut. The small intestine can be freed by cutting

across the duodeno-jejunal junction. If it is desired to retain the contents, string ligatures can be applied. Where the contents are not of significance the duodenum can be opened as far as its second part, when pressure on the gall-bladder should produce a flow of bile, indicating the patency of the ducts. Ligatures can then be applied to the upper and lower ends of the stomach and the organ removed whole. It is opened along the greater curvature, and the appearance and smell of its contents noted, as well as the possible presence of tablets, powder, etc. A sample of the contents can be retained in case analysis is required. The presence of ulceration, gastritis, or growth in the stomach wall is readily detected. In the case of intestinal disease the whole length of the intestine must be freed and opened with intestinal scissors along the mesenteric attachment. A flow of running water is needed for proper inspection.

The spleen, which may be removed with the stomach, should be examined for size, state of capsule, and possible infarcts. In cases of suspected septicaemia the surface should be seared with a hot knife or iron, and a swab pushed through the seared area into the pulp for subsequent bacteriological examination.

The liver and gall-bladder are removed and weighed, and the gall-bladder is opened. The liver should be cut at several points with sweeping incisions, using the bacon- or bread-knife.

The pancreas should be opened, preferably along the line of its main ducts.

The kidneys and suprarenals should be seen *in situ* and dissected away without cutting the ureters or vessels until these have been displayed. The kidneys should be freed of adherent fatty tissue and bisected with the bread-knife. A small point of technique which increases safety is to place the kidney flat on the table, cover it with a sponge, and hold it with the left hand, and then cut horizontally with the right hand. Not only is the grip on the organ firm, but the risk of cutting the hand is reduced. To cut towards the palm of the hand, as some books show, is in my view dangerous. Other small organs may be opened in the same way. The kidney capsule should be stripped away so as to inspect the underlying surface, and the state of the cortex, medulla, and pelvis noted.

The bladder should be opened, and the prostate palpated and removed if there is any abnormality. In women the pelvic organs should be removed *en bloc* together with the upper two-thirds of the vagina if this is indicated—a quite simple thing to do. If abortion is suspected the vulva and vagina must be carefully inspected from below before the pelvic organs are removed. In criminal abortion there may be evidence of local injury, peritonitis or other sepsis, and air or even foreign material like paraffin or glycerin may be found in the pelvic veins.

The testes may be drawn up by enlarging the inguinal rings. I have known of massive secondary deposits from a minute testicular primary tumour.

Special Investigations

The routine having been described, there are many other points to remember. If poisons are suspected and the coroner orders an analysis, an appropriate set of containers made of arsenic-free glass should be obtained. These are supplied by the Forensic Science Laboratories of the Home Office, and a set is held at most police headquarters. The organs should be submitted in separate containers as follows: (1) Stomach and contents. (2) Intestines and contents. (3) Liver. (4) Kidneys and spleen. (5) Brain. (6) Heart. (7) Lungs (sometimes). For transmission they must be sealed with some recognizable mark and if handed to the police a receipt must be obtained so that proof is available of every step in the procedure in the event of evidence being required in court.

Where bacteriological investigation is needed specimens are usually obtained with an ordinary throat swab. In suspected septicaemia it is customary to take cultures from the heart blood and from the spleen. In both these organs

the surface should be seared with a hot iron or knife, and incised with a sterile weapon through the seared area before the culture is taken. Urine may be obtained by catheter, or a sterile syringe and needle can be used to aspirate it direct from the bladder.

Certain conditions, not uncommon, may be missed unless specially looked for. Air embolism may be the cause of death in injuries to the neck veins, and occasionally after criminal abortion with a Higginson syringe. Bubbles of air may be visible in the meninges, and the presence of air in the heart can be detected by opening the pericardium, filling it with water, and then piercing the right auricle. Obviously, if decomposition has occurred the test is invalid. Fat embolism is a common cause of death in multiple bone injuries, and fat in the lung may be demonstrated quickly by Robb-Smith's technique. Tiny pieces of lung are treated on a slide with potassium hydroxide until the red blood cells dissolve, when the fat is visible in the pulmonary capillaries. My personal preference is to take organs, especially the lung, brain, and kidneys, to the laboratory and cut frozen sections to be stained with scharlach R. It is primarily the cerebral condition which is fatal, and this is beautifully shown by the frozen method.

Pneumothorax, if suspected, may be detected by putting water between the skin flap and the ribs, and opening an intercostal space with a knife and watching for the emission of air.

Conditions not specifically mentioned which may be missed are electrocution, be it from faulty apparatus or lightning discharge. Here small burns can be found, particularly at the entry or exit point of the current, while the clothes may be singed or even stripped off the body. I remember an example in which a bone and metal collar-stud disappeared except for the small metal portion, which was driven into the trachea.

Acute encephalomyelitis may be detectable only by microscopical examination of the brain, but a clue is often given by a definite increase in cells in the spinal fluid.

Thyroid conditions, whether toxic or myxoedematous, may be associated with sudden death, and myxoedema may be easily missed in menopausal cases unless the thyroid is examined microscopically.

Uraemia, usually associated with hypertension and kidney lesions, may be proved by analysis, and here again the spinal fluid seems to give reliable results.

Glucose estimations in deaths from diabetes are unreliable, owing to post-mortem glycolysis.

In injuries to the neck fracture may occur, with crushing of the spinal cord, and yet not be immediately visible owing to self-reduction. It will be revealed only by opening the cervical cord and by careful dissection.

Conclusion

It is quite impossible, in a limited space, to cover the whole field of post-mortem work, and I would conclude by giving the advice that the safest working rule is never to cut anything without first being sure that evidence likely to be needed later is not being destroyed. In addition, it is no bad plan to include in the post-mortem kit some hand-book on the subject, of which I would mention particularly *Post-Mortem Appearances*, by Joan Ross, published by Oxford Medical Publications, and *Practical Pathology, including Morbid Anatomy and Post-Mortem Technique*, by James Miller and James Davidson, published by A. and C. Black. There are no doubt other publications equally valuable.

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EVOLUTION OF HOSPITAL AND LOCAL AUTHORITY ANTENATAL CARE UNDER THE N.H.S. ACT

BY

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Present-day antenatal care is becoming increasingly complex. To prevent overlapping of the services and to ensure that the expectant mother receives the best possible care it is essential that an integrated service, based on good team-work of all those concerned, should be established.

In this article attention is directed mainly to those expectant mothers who are to be delivered in hospital. The arrangements for antenatal care for such cases vary from area to area. The patient may attend an antenatal clinic held at the hospital. She may perhaps attend a local authority antenatal clinic situated at a distance from the hospital and be cared for by a medical officer of the local health authority, usually, however, being seen at least once during pregnancy by a consultant or some other member of the hospital staff. A third procedure is that a bed for the patient may be booked by a general practitioner merely by filling in a form; the antenatal care from then on will be in his hands.

Conditions of Antenatal Care

There should be firm links between the antenatal clinic and the hospital, so ensuring continuity of medical policy throughout the antenatal period, labour, and the puerperium to the post-natal visit. Moreover, the patient should know her medical attendants, who should try to know her as a person as well as deal with her medical problems.

Notes made during the antenatal period should be available in hospital when the patient is admitted either as an antenatal case or in labour.

The clinic should be so situated that there is no undue travelling on the part of the patient. Long waiting should be avoided, and the "sausage-machine" tactics of the larger clinics must be avoided. The atmosphere should be friendly and stress the normality of pregnancy.

Finally, such investigations by the obstetrician as may be required must be readily available and, wherever possible, they should be done at the clinic itself.

Application of these Conditions in Practice

(a) The antenatal clinic attached to the hospital could fulfil most of the conditions mentioned above more easily than by any other arrangement. Local factors, however, usually cause the hospital clinic to fall short of the ideal. For instance, it may be geographically difficult for the patient to reach the hospital. Another disadvantage is that, by the concentration of large numbers of patients, the clinic becomes unmanageable in size, with the result that there is prolonged waiting and loss of the personal touch.

(b) The local health authority antenatal clinic, being situated near the patient's home, is usually accessible and