3
Evisceration Techniques

The main general evisceration techniques are outlined in this chapter, but it should be remembered that alternative or improvised methods are frequently used and that special techniques are regularly required. It is hoped that all of the commonly used alternative methods are included in the present chapter together with the more routine. The specialised and less common techniques will be given in the various chapters on specific systems. In this way the majority of practices are found in this chapter to avoid extensive cross-references, allowing the more rare procedures to be described separately with organ dissection in the appropriate chapter. A degree of repetition is inevitable but this avoids the need for constant cross-referencing. The main evisceration techniques, detailed in this chapter, are the following:

- En masse (Letulle)
- En bloc (Ghon)
- Individual organs (Virchow)
- In situ (Rokitansky)

En Masse Dissection

The most rapid technique, and probably the most convenient for the technician assisting at the post mortem, is the en masse procedure. As the intestines obscure the abdominal part of the dissection and are infrequently the source of significant or fatal disease, they are usually removed separately before the remaining organs. Of course the bowel is not neglected but once separated is examined and opened later. To do this the sigmoid colon is identified and the lateral border is lifted as scalpel strokes are made posteriorly through the mesentery to free this part of the large intestine. Mobilisation can be aided by manually grasping the outer wall of the bowel and pulling this structure anteriorly. Similar dissection proceeds proximally, detaching the descending colon, hepatic flexure (being careful of the nearby

spleen), and transverse and ascending colon, eventually elevating and freeing the caecum and appendix.

The duodeno–jejunal junction, now identified as the fourth part of the duodenum, runs anteroinferiorly just beneath the lower border of the stomach. Two ligatures or clamps are applied around the small bowel in this region approximately 3 cm apart. The bowel is divided between these ties. The cut end of the distal side is elevated with one hand while the other hand dissects away the mesentery close to the bowel wall, either with scissors or by making a series of controlled sweeping movements with a PM40. This is continued distally to the terminal ileum, lifting the subsequent part of the bowel as the preceding section is dissected. Finally the ileal and caecal dissections should meet and the majority of the bowel is free except for the most distal segment. The rectum is now identified and the luminal contents massaged back up into the sigmoid colon before one slices across the rectum about 3 cm from the anorectal junction and divides any final soft tissue attachments posteriorly. The intestinal tract can now be lifted free and removed to the sink. If this is not appropriate, as in the case of matted loops of bowel resulting from adhesions, peritonitis, or widespread intraabdominal tumour, the intestines should be removed still attached to the entire internal contents and all dissected as described in Chapter 7.

Once the bowel has been removed, it is possible to begin eviscerating the remainder of the organs either from the pelvis, proceeding superiorly, or by dissecting inferiorly from the mouth and pharynx. Letulle's method follows the former route and begins with blunt dissection of the pelvic organs and peritoneum from the surrounding bones. Starting with the lowest part of the exposed abdominal contents, the prosector's hands should pass retroperitoneally and inferiorly, forcing the pelvic structures forward. Strong fingers are needed to detach the organs forcibly from the lateral wall, extending this blunt dissection as far as possible around the rectum, bladder, and prostate gland in male subjects and in females, the internal genitalia. Once freed, this group of organs is grasped by the nondominant hand and forceful traction is exerted in an upward direction while the most inferior structures are cut across using a large PM40 knife as close to the pelvic bones as possible. Extreme care must be taken at this point with controlled knife cuts because some of this dissection inevitably will be performed under limited direct visualisation.

In male patients the dissection will proceed just distal to the prostate gland, which provides a reasonable gripping site to apply the necessary traction. In females this cut should be made through the soft tissue of the upper vaginal wall, and the cervix provides the necessary traction site here. Using the same knife, the incision is extended laterally to sever the external iliac vessels and accompanying soft tissue structures. The internal aspects of the cut ends of these vessels should be inspected as they are transacted, looking particularly for atheroma and thrombi. It is important to cut laterally

toward bone with the blade angled away from the supporting hand at all times. The dissection continues laterally on both sides around the entire interior aspect of the pelvis, freeing all soft tissue attachments (except for the spermatic cord in males), with each side eventually meeting in front of the sacrum. In male cadavers the spermatic cord on each side can be traced at this point from the inguinal canal to the scrotum by firm blunt dissection of the prepubic subcutaneous tissue and the testis retracted through the defect produced and dissected free and removed with the rest of the pelvic organs. *Alternatively, the spermatic cord can be transected and the testis removed separately later*. When completed, this group of organs is pulled free from the pelvis and the abdominal organs are then approached.

The diaphragm is dissected away from the internal surface of the body wall along its complete length. This will require inserting a hand between diaphragm and liver and spleen, being careful not to injure the latter, as the capsule is easily damaged. Again it is essential to direct the knife toward the bone at all times, cutting away from fingers to avoid unnecessary injuries. Then, beginning on the left side, the abdominal contents are freed from their posterior aspect starting with the bowel (if not already removed), left kidney, ureter, and adrenal gland. This is done by first identifying the descending colon, which is then grasped, pulled medially, and the posterior mesenteric attachments divided with cuts. The initial knife cuts free the more taut attachments of this part of the colon, which will then be partly released; blunt dissection is usually adequate for further detachment. If the bowel has been removed then a similar technique is followed, starting with the perinephric soft tissue on the right. The dissection is extended as posteriorly as possible retroperitoneally, still working toward the vertebral column at the midline and then skirting the internal body wall, to include all of the retroperitoneal structures and overlying tissue. A similar technique is used throughout, with the organs and soft tissue retracted anteromedially or pushed down and protected with one hand while the other hand uses a combination of forceful blunt dissection and knife cuts to free all of the attachments. In this way the adjacent organs are also freed as they present; the spleen, left kidney, and left adrenal gland are brought into this aggregate of organs, now lying free from the posterior body wall. The dissection is continued all the way to the midline to include the paraaortic tissue and aorta, with only abdominal wall structures remaining intact.

A similar method is used to free the organs on the right side of the abdomen including liver, right kidney, right adrenal gland, ascending colon, appendix, and caecum (if present). Beginning at the caecum, a lateral cut is made in the adjacent soft tissue and the caecum and ascending colon can be pulled medially exactly as in the case of the descending colon on the left side. A combination of blunt and sharp dissection behind the ascending colon in a fashion identical to that on the left and continuing retroperi-

toneally toward the midline should similarly free all of the anterior structures. The dissection continues behind the liver, kidney, right adrenal gland, and the more medial structures, once again moving toward the aorta.

Once the midline is reached, the aorta is freed from its posterior neighbouring structures by cutting through the retro-aortic soft tissue just in front of the vertebral column. The mesenteric root is also detached from the parietal peritoneum. The right-sided organs will now be detached to join the previously freed organs on the left. In this way the abdominal organs including the duodenum (and intestines if still attached), stomach and pancreas, together with the pelvic organs, should then all be free from their anchoring tissues, and the thoracic structures are all that remain to be addressed.

A similar principle of detaching all surrounding and posterior attachments is followed for removal of the thoracic organs, with peripheral pleural adhesions being broken or cut and the lungs retracted toward the mediastinum in turn and all organs freed from the vertebral column by appropriate blunt or sharp dissection. Once again, begin on the left side and retract the lung by dividing any posterior attachments still present. The same is done on the right.

If required it is important to look carefully at the thoracic duct at this point; otherwise it will be difficult to identify later. The thoracic duct lies to the right of the vertebral column in the midline, behind the aorta. The right lung is lifted forward and pushed to the left-hand side. The parietal pleura is incised along the upper lateral aspects of the thoracic vertebral bodies and the duct identified. This is usually most easily found about 2 to 3 cm above the diaphragm. The azygous vein can also be identified and the thoracic duct should run between it and the hemiazygos vein, behind the aorta and along the anterior border of vertebral bodies. It is recommended that a loose ligature be placed around the thoracic duct, which can aid localisation and produce leverage to allow careful dissection superiorly and inferiorly before removal.

The only structures that are now intact, and restrict removal of the viscera, are the branches of the major vessels arising from the proximal aorta and the soft tissue between the thoracic aorta, superior mediastinum, and vertebral column. The vessels can be severed using the PM40 by slicing the soft tissue structures at the thoracic inlet beneath the medial clavicular area in a lateral and posterior movement to transect these large branches. The neck cuts made previously to free the cervical structures are now extended to the thoracic inlet dissection just described. Pulling the upper thoracic/cervical tissues forward and inferiorly should free all of the posterior soft tissue attachments, and all of the visceral conglomerate should now be free. The entire aggregate can now be removed to the dissection area (often this is extremely heavy so be careful; Fig. 3.1). The method of organ separation is described in Chapter 4, and organ dissection is discussed in the relevant chapters.

FIGURE 3.1. Bulky single aggregate of organs removed en masse and transferred to the dissecting table for further dissection.

The en mass technique is summarised as follows:

- Open the body in the routine manner.
- "Drop" the tongue.
- Remove the bowel from the duodenum to the rectum.
- Dissect the pelvic structures away from pelvic wall by grasping the prostate gland or cervix.
- Transect the iliac vessels.
- Detach the diaphragm from the body wall.
- Free the left kidney, adrenal gland, and ureter.
- Continue the dissection posteriorly to the midline to release the spleen and pancreas.
- Free the liver, right kidney, adrenal gland, and ureter.
- Continue medially behind the retroperitoneal structures.
- Free the thoracic organs peripherally on the left and right.
- Identify the thoracic duct if required.
- Free the thoracic organs by posterior thoracic wall dissection.
- Dissect the few remaining vascular and soft tissue attachments.
- Remove the organ conglomerate to the board and follow the dissection outlined in Chapter 4.

En Bloc Dissection

The second and seemingly more popular method of organ removal among physicians and technicians, at least in the United Kingdom, is the en bloc technique, which is a modification of a method originally described by Ghon. This involves extracting the organs in four separate blocks (plucks): the thoracic pluck (neck structures, heart, lungs, and mediastinum); the coeliac block (liver, stomach, spleen, pancreas, and duodenum); the intestines; and the urogenital block, leaving the neurological system to be removed as a fifth block as necessary.

The highest thoracic block is removed by reflecting the tongue, neck structures, and thoracic organs in much the same way as described in the previous chapter and section, but this time from above moving inferiorly, to include the pleura with the lungs. With the tongue and neck structures freed as discussed in the section on preparation, attention moves to the thorax. All pleural adhesions are obliterated manually or using a scalpel. Incisions will be necessary through the subclavian vessels beneath the medial ends of the clavicles on both sides to free all significant anchoring structures. At this point look for the thoracic duct, if relevant, before proceeding. The right lung is pushed across the chest toward the left and the medial pleural surface inspected. The thoracic duct is said to be found most easily by dissecting between the aorta and azygous vein in the region of the posterior thoracic wall. The parietal pleura is then incised along the upper lateral aspects of thoracic vertebrae and the duct identified about 2 to 3 cm above the diaphragm. The thoracic duct then runs between the azygous and hemiazygos veins, behind the aorta along the anterior border of vertebral bodies. It is useful to place a loose ligature around the duct to aid careful dissection up and down before removal.

Further blunt dissection may be necessary between the superior mediastinum and vertebral column, but it should now be possible to place a hand or hands around the larynx, pharynx, trachea, and oesophagus and pull anteriorly to strip the loose soft tissue connections of the posterior mediastinum and vertebral bodies. Further traction in a caudal direction should release all of the thoracic structures from the posterior thoracic wall as far down as the diaphragm.

It is important here to refrain from being too aggressive if there is any suggestion of laryngeal injury such as after strangulation or hanging. The tracheal cartilages and hyoid bone must be carefully palpated for evidence of such injury. If necessary this area should not be handled further until X-ray films of the larynx are taken, which may be especially relevant in forensic cases as described in the section on neck dissection in Chapter 2.

As the organs are pulled forward, the lower ends of the oesophagus and thoracic aorta are exposed and checked, and after the area around the

lower oesophagus is tied with a length of string or a clamp these can be cut through above the tie (or clamp). This of course assumes that there is no evidence of oesophageal varices, tumours, achalasia, and aneurysms within the inferior mediastinum. When the latter is the case it is advisable to follow either the en masse removal method described earlier or the modification detailed in later paragraphs for assessing lower oesophageal varices. The tie is important so as to retain the stomach contents within the gastric lumen. The cuts are made above the upper surface of the diaphragm (occasionally the diaphragm may also require some freeing), and at this point the thoracic pluck should be separate and easily removed to the dissecting area (Figs. 3.2.and 3.3). The inner parietal pleural surface of the chest wall should now be inspected for evidence of tumour, plaques, or other disease process.

One commonly used alternative to this simple method of thoracic evisceration is used in cases of portal hypertension secondary to liver cirrhosis with suspected oesophageal varices. The oesophagus is tied and severed more superiorly than usual, well away from the oesophagogastric junction. This is

FIGURE 3.2. The thoracic pluck viewed from the front. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

FIGURE 3.3. The thoracic pluck viewed from behind. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

usually around the middle portion of the oesophagus, leaving the superior part with the thoracic block and retaining the inferior segment attached to the stomach. The lower oesophagus is then removed in continuity with the stomach together with the rest of the coeliac block (see later). In this way the integrity of the lower oesophagus is maintained, and it is hoped any varices present should not collapse. The latter can be demonstrated by everting the oesophagus (turning it inside out by pushing the tied end along the oesophagus and into the gastric cardia). Everting the oesophagus may be aided by introducing long-handled forceps through the gastro–oesophageal junction lumen, clasping the tied end of the oesophagus and pulling this end back through the lower oesophagus into the gastric cavity. For optimal demonstration, the varices can be injected and the method for this is described in Chapter 7.

At this point it is useful for the novice to identify and inspect the adrenal glands prior to abdominal dissection (particularly in cadavers with a large

amount of intraabdominal adipose tissue), as they occasionally can be difficult to identify at a later stage. A brief inspection at this stage will probably be all that is required to identify or exclude significant pathology in either gland.

The next step is to identify and transect the distal duodenum close to the duodeno–jejunal junction. To do this the junction is identified by following the duodenal loop and locating a point where it begins to turn inferiorly beside the pancreas. At this site a hole about 3 cm in diameter is made in the mesentery 1 cm from the mesenteric border of the intestinal wall. Two clamps are applied or two lengths of string are tied as ligatures around the bowel wall several centimetres apart and the intestine cut between them (Fig. 3.4). Then one can either begin here or at the rectum and dissect the bowel from the mesentery using large scissors or a knife. If starting at the rectum, a hand is placed into the posterior pelvis and the rectum gripped circumferentially. Here the luminal contents are massaged back up into the upper rectum and the lower rectum is cut through with a knife or large scissors about 3 cm above the anorectal junction. It is important not to cut too inferiorly and risk penetrating the anal skin. The cut end is lifted and the mesorectum dissected.

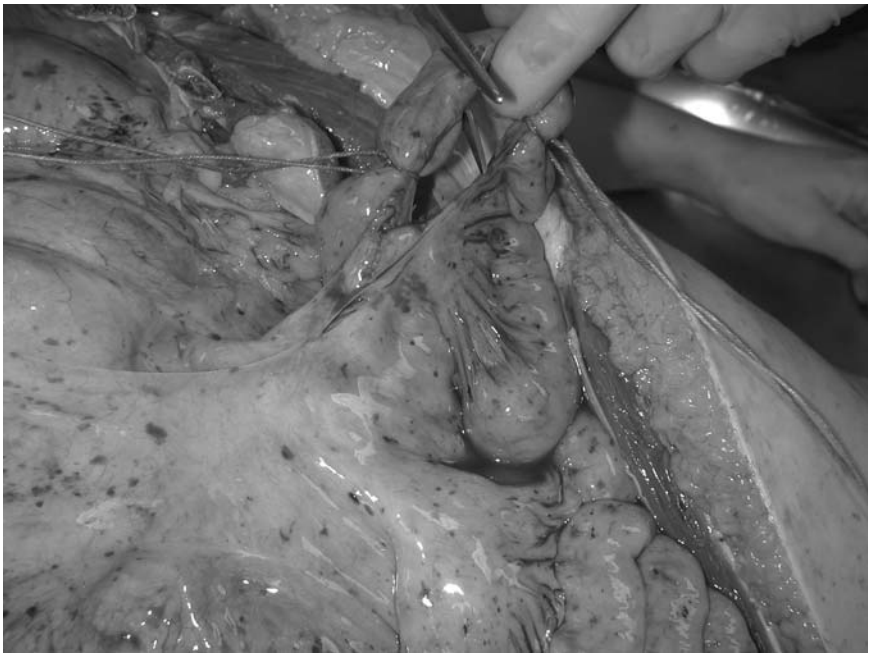

FIGURE 3.4. The duodenum is cut between two ties. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

FIGURE 3.5. The mesentery is dissected from the intestine close to its wall as long as there is no significant mesenteric pathology. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

It is preferable to dissect the intestine close to its wall (Fig. 3.5), leaving the mesentery remaining in the abdomen unless significant mesenteric pathology, such as vasculopathy, is expected. Either scissors or a PM40 can be used for this procedure; with the latter a bow and string action is required, cutting close to the bowel wall extending from the rectum to various parts of the colon to appendix, terminal ileum, and proximally (or vice versa). The small and large bowels can now be lifted from the abdomen for later dissection. In most cases nothing will be lost by dissecting the bowel out in this way, but when there is any suggestion of mesenteric vascular pathology, the mesentery should be dissected at its root in to transect the mesenteric arteries and veins close to their origins or drainage routes. For this the dissection begins at the rectum as before, but as the bowel is lifted free the mesenteric base is dissected from its attachment, remaining in continuity with the small and large intestines. If this is the case it may be better to remove the intestines with the rest of the abdominal contents as described in the previous section on the en masse technique. When intestinal contents are required for analysis a segment is tied off and sent as described earlier.

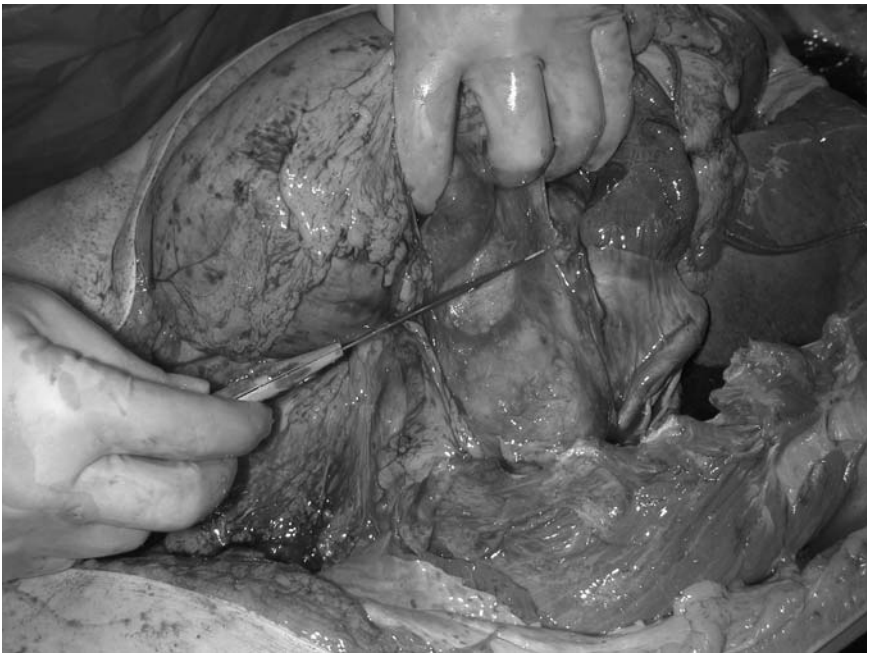

FIGURE 3.6. The abdominal organs are removed by displacing the spleen medially and dissecting the posterior soft tissue to the midline. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

Next we turn to the coeliac block, which includes the liver, biliary system, stomach, duodenum, spleen and pancreas. This group of organs is removed by carefully dissecting along a plane just anterior to the aorta and inferior to the diaphragm, cutting through the anterior aortic branches as they appear (the coeliac and mesenteric arteries). It is usual to begin on the left side of the abdomen and first free the spleen from any peripheral attachments, being careful not to damage the splenic capsule with excessive clumsiness. Then proceeding medially behind the spleen toward the vertebral column, the spleen, pancreas, and surrounding soft tissue are freed from the underlying retroperitoneal structures (Fig. 3.6). The aorta is left intact but the coeliac artery is cut close to its origin just below the liver (Fig. 3.7). *Alternatively, a short segment or ring of aorta can be taken with the coeliac block, which contains the coeliac axis*.

A similar method is followed on the right side by freeing the liver from the diaphragm superiorly and anteriorly, which will usually require cutting the posterior part of each leaf of the diaphragm and which may be aided by dissecting the falciform ligament. The liver is retracted medially and dis-

FIGURE 3.7. The coeliac block is separated by cutting through the vessels originating from the anterior aspect of the abdominal aorta. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

sected from the underlying tissues, being particularly careful not to damage the nearby right adrenal gland (Fig. 3.8). This group of organs can then be lifted free after the inferior vena cava is severed. As with the other blocks, it is important to inspect the organs for gross lesions such as tumours, ulcers, metastatic disease, or cirrhosis.

This leaves the adrenal glands, kidneys, ureters, bladder, and genital organs as the last block with the attached abdominal aorta and iliac vessels. The kidneys are inspected first by dissecting the fat around the posterolateral aspect of the kidney with a curved incision and extending the cuts medially behind the aorta. Keep a watchful eye out for benign cortical cysts while doing this because these are very common and can unexpectedly shower the prosector with cystic fluid!

Again begin on the left and free the kidney by retracting it medially while dissecting posteriorly (Fig. 3.9). Superiorly the dissection continues to include the adrenal gland with the kidney, and both are eventually freed from the underlying soft tissue. A similar method of dissection is followed

FIGURE 3.8. The liver is lifted medially and the posterior soft tissues dissected to detach the right side of the coeliac block. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

on the right, again dissecting in a medial direction behind the kidney, aiming to keep the adrenal gland with the kidney. If the dissection continues posteriorly and carefully the renal vessels will not be injured during this part of the evisceration and the soft tissue behind the ureters can also be dissected free from behind.

The ureters and surrounding vessels are located and traced to the pelvic brim, freeing the surrounding soft tissue connections. Complete the dissection of this superior group of structures from the vertebral column by retraction of the aorta and extending the blunt or scalpel dissection of the soft tissue posterior to the abdominal aorta, just anterior to the lumbar spine, down toward the lumbosacral junction. At this point the kidneys and upper abdominal aorta are freed and the lower urinary tract is still intact, but requires dissection. The idea now is to remove the pelvic organs together by dissecting around the inside of the pelvic bones and severing the large external iliac vessels. Most of this dissection can be performed with strong fingers following the line of the inner pelvic surface.

The bladder is first separated from the pubis inferiorly by blunt dissection and this dissection is continued around the urethra and prostate in males and the vagina in females and finally the rectum. Posterior soft tissue attachments are divided around the sacral promontory. By extending the retro-aortic dissection behind the common iliac vessels, the pelvic organs can now be grasped with one hand at their most inferior point and pulled up while cuts are made through the floor of the pelvis. For the routine examination the lowest point is marked by the prostate in males and the cervix and upper vagina in females. In common with the other evisceration methods, a firm grip around these structures allows an important element of leverage so that traction can be applied in a superior direction to permit a knife to pass through the urethra, vagina, and rectum, keeping the prostate and cervix intact and in continuity with the rest of the tract. The external iliac vessels are divided and any remaining soft tissue strands are dissected or pulled apart. The organs can now be removed from the body. Retaining the entire genitourinary tract complete in this way allows excellent demonstration of proximal effects of distal pathology. Dilated ureters indicate that

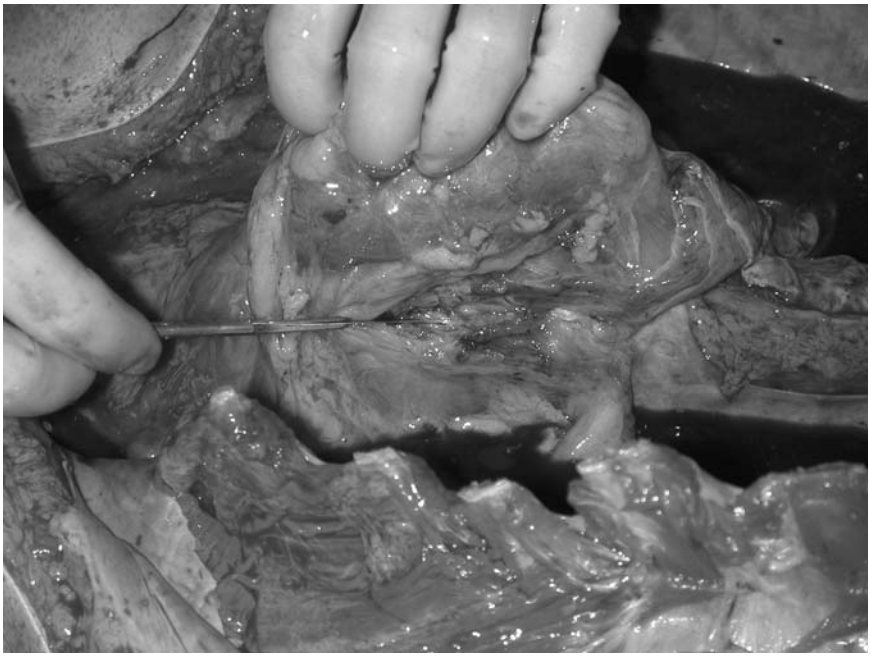

FIGURE 3.9. The left kidney is grasped and its posterior attachments divided. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

there is obstruction to urine flow in the tract beneath the dilated portion. This is commonly caused by calculi, cervical neoplasms, or benign or malignant prostatic disease obstructing the lower tract. In addition, the male urogenital tract can also be demonstrated in its entirety (if time permit) and the testes and vasa deferentia can also be included in this block. The testes are removed by retracting the spermatic cord in the inguinal canal after blunt dissection of the subcutaneous tissue of the lower abdominal wall in the pubic region using fingers. To do this, two or three fingers are forcibly introduced into the soft tissue overlying the pubic symphysis and a channel is produced from the medial part of the inguinal canal to the scrotal sac. The spermatic cord is grasped here and withdrawn toward the abdomen. Loose soft tissue attachments in the scrotum may need a little encouragement to detach by gentle scalpel cuts. Once freed the vas deferens within the spermatic cord is traced to the posterior surface of the bladder close to the seminal vesicles. These procedures are rather time consuming and rarely demonstrate significant pathological lesions relevant to the cause of death, but they may impress an examiner in an otherwise mediocre post mortem examination performance. Block dissection is again described in Chapter 4.

The standard en bloc technique is summarised as follows:

Thoracic block
- Perform routine dissection of the neck and bring the tongue down.
- Free pleural adhesions and identify the thoracic duct.
- Apply caudal traction on the neck structures, which should release posterior attachments.
- Identify the lower oesophagus, tie, and transect (if no significant pathology here; if pathology tie and transect higher).
- Divide the descending aorta.
- Remove the "pluck."

Intestinal block
- Identify the duodeno–jejunal junction.
- Tie and cut between ties.
- Identify the upper rectum/lower sigmoid colon and free them from surrounding soft tissue.
- Cut across the upper rectum and begin cutting across the mesentery close to the bowel wall (or begin at the upper duodenal tie and proceed inferiorly).
- Free the small and large intestines.
- Remove to the sink.

Coeliac block
- Identify the spleen and pull medially to enable dissection posteriorly in front of left kidney to the midline.

– Free the liver and dissect the posterior peritoneal soft tissue and retroperitnoneal tissue anterior to the right kidney to the midline.
– Lift the organ group and cut across the anterior aortic branches as they appear.
– Lift the block away for dissection (see Chapter 4).

Urogenital block
– Dissect behind the left kidney to release it (include the adrenal gland).
– Do the same on the right.
– Dissect the retroperitoneal soft tissue to expose ureters and trace to the bladder.
– Blunt dissect soft tissue around lower bladder.
– Grasp the lower bladder and prostate gland/cervix and cut below to release.
– Release the pelvic organs from peripheral attachments (include spermatic cords and testes if required).
– Divide the iliac vessels.
– Lift the block away for dissection (see Chapter 4).

Individual Organ Removal (the Virchow Method)

In this technique the organs are removed one by one sequentially, isolated, and dissected immediately after removal. The majority of complete and detailed organ dissection methods are described in the relevant chapters rather than here to avoid extensive repetition. Individual organ removal is said to be the one of the most widely used techniques worldwide. As originally described, the first step was to expose the cranial cavity to assess accurately the quantity of blood in the cerebral vessels, proceeding to the spinal cord followed by thoracic, cervical, and abdominal organs, in that order. As discussed earlier, this technique is effective for normal or diffusely diseased organs, but one of the most common problems with methods such as this is destruction of structures during evisceration and the relationships between organs. Of course most adverse situations can be avoided by careful planning of the method and the utmost attention given to detail when inspecting organs in situ. The method has developed over the years and the cranial cavity is now left until last, the examination proceeding through the peritoneal, pleural, and then pericardial cavities, which are opened and inspected, with the organs removed from those areas in reverse order.

The first step is to inspect the abdominal wall. Then assess the abdominal cavity and remove any fluid and establish its amount and appearance. The abdominal organs are inspected and palpated before any dissection takes place. It is suggested that the gastrointestinal tract be checked first, including the appendix and mesenteric lymph nodes. Next assess the spleen,

liver, kidneys, and pelvic organs. The pancreas can be inspected by tearing through the omentum between the stomach and colon, opening the lesser sac.

Attention is now directed to the thorax. *If the examination is restricted to an abdominal incision only, Mallory [1] suggests that the majority of the thoracic contents can be removed from below. To do this, first the diaphragm is detached from all of its peripheral thoracic cage attachments. Next, the posterior mediastinal structures are pushed away from the vertebral column by blunt dissection with the hand. The arch of the aorta is then located and pulled inferiorly. The local structures are also pulled down and the great vessels are transected just above their origins. A firm grasp and forceful caudal traction will allow all of these structures to be released and pulled down toward the abdomen. The tissue is then cut across as high as possible.*

Routinely, however, the thoracic contents will be exposed by removing the sternum. In examining the thorax it is first necessary to inspect the pleural cavities thoroughly and collect any fluid as described previously. Next, dissect away all pleural adhesions by blunt dissection or with the knife blade. If the parietal pleura is firmly attached to the lungs it will need to be stripped with the lung as described earlier. To recap briefly, this is done by pushing the parietal pleura away from the chest wall toward the lung by finding the plane immediately outside this serosal surface at the point where the sternum has been removed and working the hand along this plane. When working in the thorax one must be careful of any sharp edges at the ends of the cut ribs. A towel can be placed over the exposed bone or the chest wall skin can be wrapped back over to cover these rough edges. Attention is turned to the anterior mediastinal soft tissue, and interstitial emphysema should be checked for. In an adult the normal thymus will be atrophic but it should be inspected at this point in case unexpected pathology is present. Now the pericardium needs to be inspected before it is opened. If a haemopericardium is present the outer surface will often appear blue before it is opened and the clotted and fluid blood can be collected through the incision described below and quantified by measuring its volume in a measuring jug. Normal pericardial fluid is straw coloured and has a volume of 5 to 50 ml. The simple way to open the pericardium is to lift the middle of the anterior wall with fingertips or forceps and snip through with medium-sized scissors to create a small hole. Then this incision is continued superiorly along the right border to the root of the large vessels originating from the heart and inferolaterally toward the apex. Lifting the sac retains any contents for assessment. Blunt dissection may be required for loose adhesions, but with dense adhesions, such as after cardiac surgery, this may not be possible and the pericardium will need to be dissected later with the heart. When the pericardial sac is emptied the external form and epicardial surface of the heart can be assessed.

The heart is then removed by lifting the apex and cutting through the attached vessels in order of presentation. This will entail transecting the

inferior vena cava first, then the pulmonary veins on both sides, followed by the superior vena cava, the pulmonary artery, and lastly the aorta. If there is a suspicion of a pulmonary embolus it is important to open the pulmonary arteries first. *Obviously it is also possible to remove the heart in the manner described later for block dissection of the two previously outlined evisceration methods. In brief, this involves passing two fingers behind the aorta and main pulmonary artery just above their origins from the left and right ventricles and cutting across these with scissors. Their lumina are inspected. Next, the heart is lifted and the veins returning blood to the heart from the systemic and pulmonary circulations are cut through as close to the outer pericardial surface as possible.*

The heart is lifted free for further dissection. The exposed posterior pericardial surface can now be inspected. Clearly either a Ghon type of evisceration or preferably the en masse technique is much more appropriate if extracardiac vascular disease is suspected such as vena caval thrombi or a dissecting aortic aneurysm. In this case more information can be gained from keeping the cardiovascular system as intact as possible so that the extent of involvement of the pathological process can be established accurately. This is discussed further in the relevant sections later in this chapter.

After the left lung is freed from all of its pleural attachments it should be lifted forward out of the pleural cavity and the root held with the non-cutting hand while the dominant hand is used to cut through this hilar tissue to detach the lung through the primary bronchus, vessels, and pleura. An identical method is used to remove the right lung. If the lungs are to be inflated it is important to cut the primary bronchus toward the carina to leave a long enough stump for cannulation. If the thoracic duct requires inspection this should be done early in the examination; otherwise it becomes too difficult to identify. This may be necessary in patients with miliary tuberculosis or a chylous hydrothorax. To do this, remove the left lung as described earlier. Before the right lung is removed it is lifted forward out of pleural cavity and pushed to the left. The parietal pleura is then incised along the upper lateral aspects of the thoracic vertebrae and the duct identified. It lies to the right and posterior to the aorta and is found by dissecting between the aorta and the azygous vein, and is most easily identified 2 to 3 cm above the diaphragm. Once the azygous vein is identified the thoracic duct will be found lying between it and the hemiazygos vein, where it runs behind the aorta along the anterior border of vertebral bodies. It is often helpful to place a loose ligature around it and carefully dissect up and down before removal. If this proves too difficult it may be necessary to first identify the cisterna chyli which lies in the abdomen in the right retro-aortic and paravertebral tissue at the level of L2–3 before proceeding superiorly into the thorax. The right lung can subsequently be removed as described previously for the left. Moving to the neck, the soft tissue attachments around the lateral and posterior aspects of the upper

oesophagus and trachea are dissected to free the structures of the neck. The organs can then either be removed for separation or dissected in situ. If removed together this is very similar to the thoracic block evisceration method described earlier for the en bloc section (without the heart and lungs). If not then the posterior wall of the pharynx is cut through just next to the uvula from behind and the pharynx is inspected. The tonsils are incised and the posterior wall of the oesophagus is slit in the midline. If the mucosal surface is normal, cut through the oesophagus (dividing into two) to open the posterior wall of the trachea. The tracheal mucosa is now inspected. Longitudinal incisions can then be made in each lateral lobe of the thyroid or the thyroid can be removed prior to dissection as described later.

The parathyroid glands should now be identified, all four if possible. If pathological, identification is usually straightforward as long as one knows where to look and what the parathyroids look like. They are flattish oval structures, yellow-brown in color, and their size is variable, about 6 mm in length by 2 to 3 mm in the other dimensions. Despite variations in number, size, and site they are usually found on the posterior surface of the medial side of the lateral lobes of the thyroid, close to the oesophagus. If it proves difficult to find them first identify the inferior thyroidal artery and trace it to the thyroid gland. The inferior parathyroid gland is usually located just below the site at which the artery enters the thyroid gland, and the superior gland lies several millimetres above this area. It is the inferior gland in fact that is particularly variable, sometimes being associated with the thymus, lying embedded in the thyroid, anterior to the lower thyroid or even on its own in the soft tissue beneath. The carotid bodies can also be seen at this point immediately at or just above the bifurcation of common carotids on the medial side. They are usually about 5 mm in length.

The abdominal organs are inspected in situ and all intraabdominal fluid is collected in a manner similar to that used for the other serosal cavities. If peritonitis is found the source should be identified by palpation and inspection before dissection. Once again, if diffuse disease is present with numerous adhesions an en bloc method of evisceration with subsequent dissection is desirable, as this will often provide more information and a clearer indication of the source than the current isolating method described here. The order of removal of the abdominal contents may vary depending on the circumstances and pathology encountered, and the preferences of the prosector. Routinely the spleen is taken out first, followed by the gastrointestinal tract, liver, and pancreas, and lastly the genitourinary tract. Finally, the posterior vascular structures are dissected in situ. It is wise to remove the normal or less abnormal organs first and leave the pathological organs for a more considered approach.

Gentle manipulation of the spleen is necessary to avoid tearing its capsule. It can either be lifted forward and sliced through along its greatest diameter or lifted out of the abdomen and the hilar structures cut

through to detach the spleen and dissected once removed. If dense adhesions are present it may be necessary to remove local diaphragmatic tissue to avoid splenic damage.

The gastrointestinal tract should now be inspected from the stomach to the rectum and the mesentery examined including the integral lymph nodes. If an area of ischaemia or infarction is seen it is important to inspect the mesenteric vessels at the outset; otherwise, it may become too difficult later on. These can be dissected in situ, following the vessels either from the bowel wall proximally or from the aortic branches peripherally, as discussed in more detail in Chapter 7. As with all vessels, dissection can be performed by making transverse slices with a scalpel or by longitudinal opening with scissors. If secondary tumour deposits or abscesses are suggested from the external appearance of the liver, the portal vein should also be opened in situ.

Unless absolutely necessary it is recommended that the gastrointestinal tract be removed to a sink before it is opened. Initially the duodenum should be opened in situ by piercing the anterolateral wall with scissors at around the second to third parts. The gallbladder is squeezed to assess bile flow to and through the ampulla of Vater. The latter is easily identified by stretching the wall and looking for a small projection. Insert a probe to localise the opening and if necessary open the common bile duct and branches in situ to identify any obstructing lesion. It may also be necessary to dissect out the pancreatic duct in situ, although this can usually be done once the organs have been removed.

Once free flow of bile has been established turn to the sigmoid colon to start the removal of the intestines. Pull the colon forward in this region to be able to cut through the mesocolon. A good grip is applied to the sigmoid and, pulling medially, the mesentery is incised. Next this incision is extended inferiorly to the lowest accessible part of the rectum before turning to the more proximal areas. Take care around the splenic flexure not to damage the spleen if this has not been removed already. Detach the transverse colon from the stomach by tearing the bridging soft tissue and continue to the hepatic flexure, ascending colon, caecum, and around the appendix. Once all the large intestine is free, go back to the rectum and cut through as low as possible to remove, once again massaging all of the luminal contents back up into the sigmoid before cutting.

Virchow's method actually describes removing the large bowel and small bowel separately but there seems to be no obvious benefit in doing it this way, and we recommend leaving the ileocaecal junction intact to avoid spillage of the luminal contents. If, however, the small bowel is to be retained with the upper abdominal organs, as described later, then the large and small intestines should be removed separately.

Moving to the terminal ileum, cut through the mesentery close to the small bowel wall and progress proximally in a sequential manner until the duodenum is reached. At this stage the mesentery can be removed by dis-

secting it free from the duodenum and the intestines removed to the sink. *Alternatively, the mesentery and small bowel can be kept in continuity with the duodenum and subsequently removed with it together with the stomach and pancreas*. The latter is best done by initially separating the stomach from the liver by blunt dissection and then cutting through the diaphragm around the oesophagus to free it.

Next the hepatic hilar structures will have to be divided, and this is accomplished by stretching the hepatoduodenal ligament to demonstrate the vessels that run here, followed by cutting through these structures in the following order: hepatic artery, common bile duct, and portal vein. These are inspected as they are cut and can be traced superiorly into the porta hepatis and early hepatic branches, and inferiorly as they present.

Now grasp all of the structures anterior to the aorta and inferior vena cava and cut from below along the plane immediately in front of the aorta toward the chest. The last structure to be cut is the lower oesophagus, which may require tying first to retain the gastric contents. If oesophageal varices are suspected, however, the oesophagus should be divided higher up and the lower portion retained with the stomach as described earlier. This group of organs is very much like the coeliac pluck obtained by means of the en bloc technique (but without the liver), and a similar organ separation and dissection technique can be applied.

In brief, the stomach and intestines can be opened with scissors, the small bowel along the mesenteric side. The stomach is usually opened along the greater curve, with care to avoid any mural lesion, which should be kept as complete as possible for later dissection. The duodenum is opened with sharp scissors through its anterior wall and the incision is continued to the pylorus proximally and the distal duodenum caudally. The large bowel is opened in a similar manner along the antimesenteric border (see Chapter 7).

The liver is usually the last organ last to be removed, although if it is clearly normal it may be removed before the rest of the intraabdominal organs to provide more space for dissection of the latter. To do this, pass the left hand between the right lobe of the liver and the diaphragm and push the liver forward out of the right hypochondrium. It is suggested that a useful tip to help removal of the liver is to slice through the entire organ in a horizontal plane at this point. Blunt dissection is required to separate the gallbladder from the undersurface of the liver, possibly with additional gentle scalpel movements, and the hepatic duct cut through. Remove the gallbladder for dissection by cutting through one wall, inspecting the mucosa and contents.

Now grasp the liver by placing the thumb under the lower anterior border and insert the remaining fingers into the long incision for grip. Lift the organ and cut through the hepatoduodenal ligament under close supervision as described earlier. Next dissect off the hepatogastric ligament, inferior vena cava, falciform ligament, coronary ligament, and the soft tissue between the

liver and right kidney, being careful not to damage the right adrenal gland. Finally, elevate the right lobe and free all the attachments here, as far posteriorly as the vertebral column. The liver can now be lifted away.

The pancreas can be identified by lifting the anterior wall of the stomach and palpating the posterior soft tissue. The soft tissue around the pancreas is dissected away and the organs can be removed for assessment. The superior border of the pancreas may be identified by following the course of the splenic artery, which lies above it.

The genitourinary tract and large abdominal vessels now remain in the body. The kidneys and adrenal glands are either removed together or each kidney is shelled out of its capsule followed by subsequent removal of the adrenal glands. Once again begin on the left side. If the kidney and adrenal gland are to be removed together, the soft tissue medial to and above the left adrenal gland is cut into and a curved incision is made toward the lateral abdominal body wall. This is joined by a further curved incision extending along the lateral border of the kidney to meet at the lateral aspect of the superior cut described. The incisions should penetrate the peritoneum and perinephric fat. The left hand is introduced into the hole produced lateral to the kidney and the latter is grasped and elevated as the soft tissue dissection is continued posteromedially. The left kidney and adrenal gland can now be held free from all lateral and posterior attachments but medially the renal vessels and ureter are still attached. Depending on the presence or absence of significant ureteric pathology the ureter is divided either high, close to its pelvic junction, or more inferiorly and can be opened along its length at this point. The renal vessels are transected as close to the aorta and inferior vena cava as possible so that the renal artery and vein can be opened and inspected. An identical procedure is followed on the right-hand side. The adrenal gland on each side can now be dissected off and the perinephric fat cleared away.

The second method involves a similar lateral curved incision on each side but then fingers are worked into the plane around the capsule, which is nicked and peeled back to expose the subcapsular surface. The kidneys are removed by peeling the capsules away medially to the hila and by cutting through the renal vessels and upper ureter. The capsules remain within the body. The adrenals are dissected free from the overlying perinephric fat.

When the lower urinary tract is obstructed, however, with associated upper urinary tract changes, the whole tract should be removed together. This method involves the same perinephric soft tissue dissection as described earlier but the renal hilar structures are not divided. The ureters are traced in the surrounding retroperitoneal soft tissue and the latter dissected away down to pelvic brim. The pelvic organs are dissected free from the lateral pelvic wall and inferior attachments (as described in both the en bloc and en masse evisceration techniques and again later) and the genitourinary tract removed in continuity for dissection as described for the genitourinary block of the Ghon technique.

In fact the pelvic organs are most neatly and easily removed by the same method that has been described previously. This involves stripping the peritoneum from the pelvic wall with strong finger action even when the structures of the upper urinary tract have already been isolated and removed. The blunt dissection begins over the anterior bladder surface, at its lower border, and the soft tissue separation is continued laterally on both sides until the fingers meet beneath rectum. Once the posterior aspect is freed from the sacrum and local tissues the only attachments inferiorly are the lower rectum and genital openings and posteriorly the peritoneum and vessels. A cut is made through the rectum, just below the prostate or urethra and vagina after the inferior structures (prostate or cervicovaginal area) are grasped with the noncutting hand and traction is exerted in an upward direction while cutting.

The posterior attachments are now transacted with care not to injure the ureters if still attached. The spermatic cord can now be located in the inguinal canal and transected to allow removal of the pelvic organs. The testes can also be removed together with the pelvic organs by dissecting the soft tissue over the pubic bones, beneath the skin, and inserting fingers around the spermatic cord into the scrotum and pushing the testes superiorly through the incision at the same time. A limited amount of careful cutting may be required to free the testis completely. If the cord has been severed the testes can be removed on their own in this way. Organ separation and dissection will again follow the same protocol as that for the genitourinary block of the en bloc technique.

At this stage there are few remaining structures left in the body to be examined. The inferior vena cava and its branches can be opened in situ, extending the dissection to include iliac vessels and more peripheral veins if required. Similarly the aorta should be opened in situ throughout its length, including iliac vessels and main branches, although it is obviously easier to remove the thicker walled aorta intact before opening than the thinner and more delicate venous structures. Vertebral bone marrow can be assessed by sawing the bodies of the lower lumbar vertebrae parallel to the surface about 1 cm deep using either a handsaw or an electric saw. For a more detailed description of this and extensive bone marrow sampling see Chapter 10.

The Virchow (individual organ) technique is summarised as follows (organ dissection may occur at the same time):

- Inspect the abdominal contents.
- Inspect the pleural cavities.
- Open the pericardium and remove the heart.
- Remove the left and then the right lungs.
- Assess the pharynx, oesophagus, trachea, parathyroid glands, and thyroid gland.

- Remove the spleen.
- Assess biliary tract patency.
- Remove the intestines.
- Open the stomach.
- Remove the liver.
- Remove the pancreas.
- Shell out the left and right kidneys and adrenal glands.
- Trace the ureters.
- Dissect the pelvic structures.
- Inspect and open the large arteries and veins.

In Situ Method (Rokitansky Technique)

Following this method, the thorax and abdomen are opened in the usual fashion and the cavities and organs are inspected in situ before they are dissected. The superior mediastinal structures are examined first, beginning with the thymus, then the arch of the aorta and its main branches, and finally the superior vena cava and its branches. Inspection then turns to the pleural cavities, where all fluid is collected and adhesions divided as described earlier. Now grasp and lift the right lung forward, keeping the hilum intact, and make a superficial longitudinal cut in pleura with the scalpel or PM40 along the lateral vertebral bodies at the posteromedial aspect of the right pleural cavity to expose the azygous vein and the thoracic duct. Inspect these carefully. The right lung is then lifted out of the chest and laid on the anterior chest wall. Angling it slightly with the left hand, hold the front half of the medial surface toward the prosector. After this is done, a longitudinal slice is made through all three lobes from anterior to posterior about 2 cm below the anterior border. The slice is made deeply, almost completely through the substance of the lung, to almost divide the lung into two equal halves. Further cuts are made through any focal lesions identified. The lung is then placed back into the right cavity. The left lung is lifted from the left pleural cavity and an identical procedure is followed on this side, slicing through both lobes, and the lung returned to the thoracic cavity.

The heart and pericardial cavity are inspected and opened next. The first step is to pick up the anterior pericardium with toothed forceps and cut superiorly and inferiorly after making a small hole in the sac. Any fluid or blood is obviously removed at this point for quantification. This allows the anterior border of the heart to be inspected through the hole and the heart can be lifted out of the hole by inserting a hand around the heart and pushing the pericardium aside. As the heart is lifted it is swung slightly to the right so that the right ventricle and auricle lie against the cut ends of the ribs of the right chest cage. Then the first incision is made with a PM40, cutting into the left border of the heart from the apex and continuing the dissection to the area where the left pulmonary veins drain into the left

atrium. Try to avoid cutting through the mitral valve during this incision and wait until the ventricle has been opened completely, the contents removed, and the valves palpated and assessed completely before continuing. Then the point of the knife is inserted through the valve and the incision continued to the left pulmonary veins. The endocardial surface of the left atrium and ventricle can now be examined. The incision should be made in such a way as to leave the anterior and posterior papillary muscles intact so that they can be examined without being transected. Then lift the heart again and do the same on the right side.

Insert the point of the knife through the wall at the right border of the heart at the apex and cut from the apex to a point midway between the junction of the entry points of the vena cavae into the right atrium. Hold the knife with the blade pointing outward and cut from inside to out (endocardium to epicardium). The edges of the incision are then held apart and the endocardial surface of the right atrium and ventricle should then be wiped with a sponge and examined. Next grasp the apex again with the left thumb inside the cavity of the right ventricle. Push the point of the knife through the pulmonary conus and valve to a point 3 cm above the valve where an incision is made through the anterior wall of the artery. Then the incision is continued to cut through the pulmonary artery and anterior left ventricular wall in a line toward the apex, keeping as anteriorly as possible.

The aorta now needs to be opened. To do this grasp the apical area again by holding the triangular wedge of myocardium of the anterior wall of the heart between the fingers and thumb of the left hand. Lift this tissue and rotate the heart slightly to the right while passing the knife or the blade of a large pair of scissors through the left ventricle into the aorta. As with the pulmonary artery, the point of the knife should be pushed through the anterior aortic wall above the valve and a cut made through the aorta, which will also divide the posterior part of the pulmonary outflow tract, anterior right ventricular wall, and part of the ventricular septum. *Alternatively, scissors can be used to cut through the aorta, cutting across the pulmonary valve about 1 cm above the valve ring extending into the aorta.* This latter method retains the septum intact and the valves can be inspected more easily.

Attention now turns to the abdomen. Again, all of the intraabdominal organs are examined before dissection begins and the peritoneum inspected. Once a complete gross examination has been made, dissection starts with the liver. The left hand is passed between the right lobe of the liver and the diaphragm, lifting the liver out of the right hypochondrium. Once the liver is exposed, a deep transverse cut is made across both lobes. The gallbladder is then inspected and dissected free from its hepatic attachments. Cut the cystic duct close to the common bile duct and remove the gallbladder before opening. To remove the liver lift it once again with the noncutting hand with the thumb underneath and the fingers inserted into

the previous transverse incision and expose the hepatoduodenal ligament. With gentle slicing movements, open the structures contained within the ligament; the hepatic artery, common bile duct, and portal vein. These are inspected as they are cut and can be traced superiorly and inferiorly as they present. Then cut through the inferior vena cava, the falciform ligament, the coronary ligament, and the soft tissue above the right adrenal gland. The liver should now be separate and can be inspected in isolation and moved out of the way for later examination.

The spleen is then lifted out of the left hypochondrium and rested on the rib cage on the left. A horizontal section is made through the bulk of the parenchyma from the diaphragmatic surface to the hilum. The cut surface is inspected before the hilar structures are severed and the spleen removed.

To gain access to the right kidney first lift the caecum and dissect the posterior soft tissue attachments of this and the ascending colon. Displace this section of the large intestine medially to reveal the underlying right kidney. Grasp the kidney with the noncutting hand and dissect the surrounding soft tissue laterally by making a curved incision in the perinephric fat parallel to the convex outer border. Continue the dissection posteriorly and superiorly, freeing all of the soft tissue but being careful to leave the hilar vessels, ureter, and adrenal gland intact (Fig. 3.9). Dissect the hilar soft tissue to identify the renal vessels and cut across these midway to the kidney. The ureter is untouched at this stage. Now bisect the kidney from its convexity to the hilum through calyces and pelvis and inspect the cut surface. Strip the capsule by gripping the cut edge with toothed forceps and peeling it away; examine the subcapsular surface. Open the renal pelvis with scissors by piercing the wall and cut along the ureter inferiorly down to the pelvic brim (Fig. 3.10). Make a sagittal section through the right adrenal gland and inspect the cut surface. The procedure is virtually identical for examining the left kidney and adrenal gland but in this case it is the soft tissue around the descending colon that needs to be separated in order to expose the underlying kidney and adrenal gland.

To free the pelvic organs, blunt dissection of the peripheral soft tissue is required, using strong finger movements to separate the organs from the pelvic side wall beginning in the prevesicular space and extending posterolaterally to end behind the rectum. Grasp the most inferior structures, the prostate gland or cervix and upper vagina, with the noncutting hand and apply traction in an upward direction while the PM40 sweeps across the pelvic floor with the blade dividing all of the soft tissue. The posterior soft tissue attachments between the rectum and the coccygeal bone are dissected off and the pelvic organs are lifted out onto the front of the symphysis pubis. The iliac vessels are left intact. The rectum is opened through its posterior wall and cleaned, and the mucosal surface is inspected.

Removal of the urogenital organs will vary to some extent depending on the gender of the cadaver. In males pointed scissors are used to make a hole in the anterior wall of the bladder and the incision continued into the

FIGURE 3.10. The ureters are opened with scissors form the renal pelvis to the bladder. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

urethra, cutting through the prostate gland. The cut surface is inspected as the cuts are made. Now examine the ureteric openings on each side from the inner aspect of the bladder and probe if necessary. The testes are withdrawn into the abdomen by blunt dissection beneath the pubic skin and Poupart's ligament. Firm manipulation with the fingertips may be necessary to free the spermatic cord and testis. Once free, both are retracted into the pelvis. Each is cut in half to demonstrate the pulp of the testis and a section is made through the epididymis.

Returning now to the posterior aspect of the pelvic block of organs, the rectum is dissected off by cutting along its anterior wall and the underlying seminal vesicles incised. If the penis needs to be removed the anterior skin incision is extended to a point about halfway along the dorsal side of the penis. The enveloping skin is dissected off by lifting each cut edge in turn followed by scalpel slices along the dermo–subcutaneous tissue junction laterally so that the dissection on each side meets in the midline at the ventral aspect. The penis is divided immediately proximal to the coronal sulcus. The corpora cavernosa with integral urethra are now forced back into the pelvis under the pubic arch and the lateral attachments divided.

In females the bladder is opened through the anterior wall via the urethra continuing the incision upwards in the midline. Again the ureteric orifices and mucosa should be inspected. The vagina and uterus can be opened by either cutting through the anterior wall again with scissors through the external cervical os or similarly through the posterior wall after removing the rectum. The former method will obviously cut through the posterior bladder wall and separate the bladder into two halves. Once the central fundal area is reached in the uterus the incisions are extended laterally on each side to the cornu. The fallopian tubes are opened longitudinally with scissors from the fimbrial end. The ovaries are sectioned longitudinally. All pelvic organs can now be removed from the body if necessary.

The remaining organs still lying within the abdominal cavity are the stomach, intestines, and pancreas. Start by opening the stomach by making a 4-cm incision in the anterior wall at the level of the pylorus with the pointed end of a pair of scissors. Examine and collect any contents as described previously. Carry this incision superiorly about 2 cm below and parallel to the lesser curve up to the cardia and esophageal junction. To examine the duodenum first dissect all attachments between the upper gastrointestinal tract and the transverse colon. Return now to the pyloric incision and continue this inferiorly through the gastroduodenal junction along the anterior wall of the duodenum as far as the beginning of the jejunum. Wash off any adherent material from the gastric and duodenal mucosa and inspect the surface closely. Localise the ampulla of Vater and probe it. Once probe patency is established, insert scissors through the opening and cut to expose the bile duct mucosal surface.

To inspect the pancreas cut through the adipose tissue attached to the stomach and lift the lower border of the stomach upwards. The transverse colon can be displaced downwards and the anterior surface of the pancreas should now be exposed. A transverse cut across the pancreas with a scalpel will demonstrate the parenchyma and it should be possible to identify the main pancreatic duct. After a small probe is placed into its lumen the duct is opened toward both the head and the tail with small scissors.

Although Rokitansky's method describes opening the intestines while they are still within the body, this will clearly be a very messy procedure in most cases and removal of the bowel to the sink before opening as described for all the other methods is highly recommended. However, for the sake of completeness the former method will be outlined here. Begin by incising the wall of the most distal part of the terminal ileum and insert the hook-ended bowel scissors. Cut with the scissors proximally along the underside at the border of the attachment of its mesentery. Continue the cutting all the way to join the anterior duodenal incision. At this point the large intestine is opened by returning to the terminal ileum and cutting distally through the ileocaecal valve into the caecum and beyond. The dissection proceeds distally by cutting through the anterior longitudinal muscle band to the previously cut end of the upper rectum. The appendix

is opened longitudinally with scissors. It is only at this stage that the stomach, intestines, and pancreas are removed from the body by cutting through all of the mesenteric attachments.

The last remaining structures to be examined are the internal body surfaces, diaphragm, vertebral column, and large posterior vessels. There is no need in most cases to remove the diaphragm and it can be inspected in situ, as can the inner surface of the body wall (including the pelvis). The vertebral column is inspected for deformities and if required a piece of lumbar vertebral bone removed with either a handsaw or electric saw for examination. For the latter the saw cuts are made parallel to the surface about 1 cm into the bulk of the vertebral bodies. Finally, all that remains to be done is to dissect, open, and inspect the inferior vena cava and its branches, the iliac veins, and the abdominal aorta with its branches.

The in situ (Rokitansky) method is summarised as follows:

- Inspect the mediastinum and pleural cavities.
- Lift the lungs anteriorly and slice each lobe.
- Open the pericardium and dissect the heart, first the left side and then the right.
- Inspect the abdominal contents.
- Slice the liver.
- Dissect the gallbladder.
- Slice the spleen.
- Slice the kidneys and adrenal glands.
- Open the bladder.
- Dissect the internal genitalia.
- Open the stomach.
- Slice the pancreas.
- Open the intestines.
- Open and inspect the large posterior vessels.

Removal of the Brain

Removing the brain is part of every routine post mortem. In the majority of post mortems the brain is examined macroscopically for any focal pathology. In cases of known neurological disease or when unexpected lesions are detected on gross examination the brain is fixed and suspended in formalin for about 6 weeks before it is sliced and sections taken.

Standing at the top end of the table with the body supine and the head raised on a supporting block, make a skin incision through the scalp from behind one ear to the other over the vertex. This should begin about 1 cm behind one of the ear lobes, proceeding in a coronal plane to a corresponding point behind the other ear. A scalpel with a fresh sharp blade should

be used. The initial incision is made by inserting the scalpel through the skin down to bone and then turning the scalpel over with its back toward the periosteum and continuing the incision superiorly with the point of the blade travelling toward the vertex. This should part the overlying hair rather than cutting it. It is often helpful to wet the hair and brush it away before making any incisions. The skin is reflected anteriorly and posteriorly to expose the superior surface of the skull. The anterior flap should be stripped by forceful retraction of the scalp forward over the face while gentle sweeping strokes of the scalpel are made toward the calvarium, extending this to a level just above the orbits. A similar procedure is followed for the posterior flap, continuing to the occipital protruberance (Fig. 3.11).

A saw (usually of the electric oscillating type) is then used to make a series of interconnecting cuts through the skull around the periphery. Prior to sawing, the temporalis muscles on each side are cut through along the line of the subsequent saw cuts (Fig. 3.12). When using the saw it is important not to cut too deeply because the dura and leptomeninges should be removed intact with the brain if possible and not left attached to the skull. The sawing begins at the mid-temporal zone of one side with the line of the cut running anteriorly toward the forehead and then continued backwards at an angle ending just above and behind the contralateral ear.

Two further cuts begin at these end points angled backward toward the occipital protruberance, where they should meet at an angle of about 160°. The mallet and chisel or skull key are then used to crack the inner part of the table of the skull and this plate of skull separated. The dura is separated

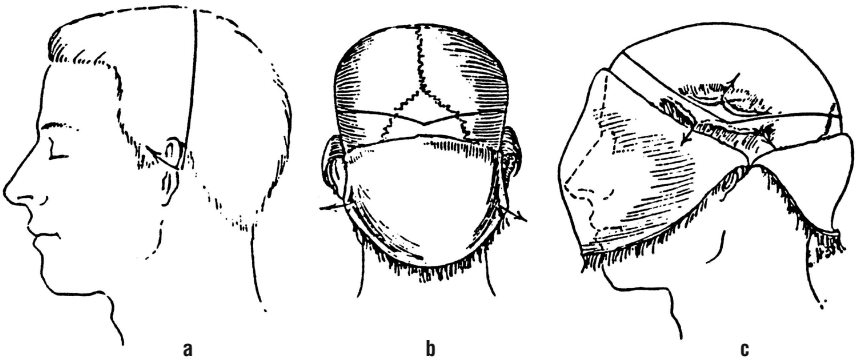

FIGURE 3.11. Diagram of the scalp and skull incisions to be made in preparation for removal of the brain. **(a)** Scalp incision from behind the left ear over the vertex to end behind the right ear. Reflection of the scalp exposes the underlying skull. **(b)** View from the posterior aspect showing the line of saw cuts converging on the occiput. **(c)** Lateral view to demonstrate lateral and anterior saw cuts. Note division of the temporalis muscles on both sides. (Modified from Mallory 1938 [1]; with permission.)

from the inner surface of the skull vault by blunt dissection with the fingers and the skull cap can then be removed (Fig. 3.13). The quality of the bone should be inspected (e.g., thickness in Paget's disease and deposits in myeloma). The sagittal sinus is inspected for any thrombosis (seen especially in postpartum patients and in those with severe dehydration). It can then be opened with scissors. At this stage the meninges should be inspected for signs of haemorrhage or infection. The latter may present as dull opacity to the meninges or as frank pus.

Once the cerebral hemispheres are exposed the dura is freed anteriorly by lifting and incising it followed by cutting the falx at its insertion into the crista galli of the ethmoid with curved scissors (with tips away from the parenchyma). The dura should then be withdrawn from the anterior to posterior direction, tearing or cutting the tiny intervening blood vessels. Let the dura hang over the occiput posteriorly, still attached. The frontal lobes should then be easily accessible and two fingers can be placed gently in front of these lobes, one on either side, between the dura and the cortex, while the brain is edged away from the base of the skull and the frontal lobes lifted. From then on it is best to perform all cuts from the anterior aspect and support the brain from behind. The olfactory nerves are easily seen

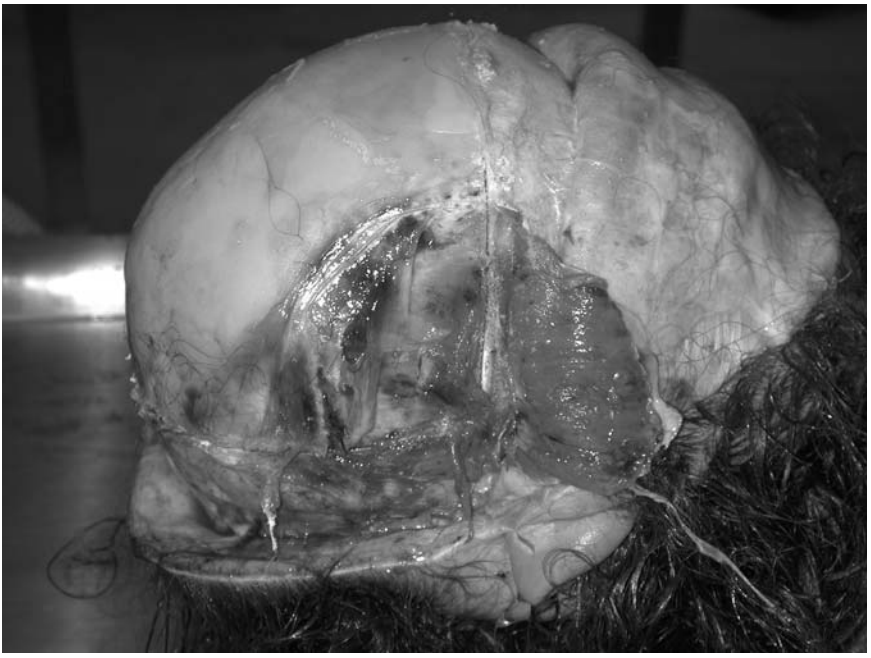

FIGURE 3.12. The scalp reflections allow the temporalis muscles to be detached for easier and safer sawing. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

FIGURE 3.13. The skull cap is removed to expose the underlying dura. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

when the frontal lobes are retracted and these will usually come free from the cribriform plate without any need for further dissection. The optic nerves are transected as far anteriorly as possible. Working backwards, the internal carotid arteries are then sectioned, inspecting for atheroma and/or luminal thrombus, followed by the pituitary stalk and oculomotor nerves.

The dura is released along the ridge of the lesser wing of the sphenoid bone by incising with scissors from the medial to the lateral direction (extending as far laterally and posteriorly as possible). To do this, the temporal lobes are lifted and, proceeding away from the midline, the tentoria cerebelli are cut from their anterior borders, staying as close to the petrous part of the temporal bone as possible. The brain should now fall back further to expose the front of the brain stem. Working still further posteriorly, sever the cranial nerves as they come into view from around the medulla oblongata, continuing to support the weight of the brain with the noncutting hand. Finally, introduce a scalpel through the foramen magnum into the cervical spinal canal and cut across the cervical cord as it joins the brain stem in a single motion, severing the vertebral arteries at the same time. It should now be possible to deliver the brain by rotating the inferior

surface upwards with one hand while supporting the superior surface (which is now underneath) with the other. It may be necessary to cut the small amount of posterior dura that remains attached.

The base of the brain is inspected to check the vessels of the circle of Willis for atheroma and aneurysms and to check for evidence of tonsillar or temporal herniation (evidence of raised intracranial pressure). The brain is then weighed before it is suspended in formalin as soon as possible to be examined later. It should not be left on a flat surface for even a short length of time because distortion will inevitably occur and this hampers subsequent assessment. The delay in examination is deliberately intended to allow complete fixation of the brain, thus making it firmer before subsequent slicing. Slicing the fresh brain is to be avoided if there is significant (particularly microscopic) pathology because its consistency makes it difficult to handle without causing an element of distortion and mutilation. If there has been a subarachnoid haemorrhage, however, this rule does not apply. In this case the pathologist should wash off the blood around the base of the fresh brain to try and identify the source of bleeding and locate the likely aneurysm before fixation.

It is extremely important to obtain and demonstrate consent for retention of the brain should this be considered necessary. If consent is obtained then the brain should be fixed prior to slicing. For fixation, a hook (a plastic curtain hook is perfect; a paper clip will do but may well rust) or length of string is placed under the largest basal artery (nearly always the basilar). This is connected to a supporting string attached to both sides of an adequately sized container. The latter should be of sufficient volume that the brain can lie away from all of the sides and base and be surrounded by an ample amount of formalin.

After the brain is removed the pituitary fossa is inspected, covered by the diaphragma sella (Fig. 3.14). The posterior wall is formed by the sphenoid bone, which is broken forcibly with a clamp or pair of forceps. The dura is thereby detached posteriorly, and a blunt instrument or scalpel can be inserted into the fossa from the side. This should be introduced as low as possible in order that the pituitary gland can be elevated, delivered superiorly, and dissected free, hopefully complete without being crushed (Fig. 3.15). Special techniques for removing the spinal cord, eyes, and entire pituitary fossa are described in Chapter 12.

The procedure for removal of the brain is summarised as follows:

- Reflect the scalp skin and detach the temporalis muscles.
- Saw the skull peripherally on both sides to meet frontally and occipitally.
- Remove the skull cap and inspect the bone and meninges.
- Free the dural attachments and falx cerebri.
- Lift the frontal lobes and divide the cranial nerves as they appear.
- Divide the internal carotid arteries and pituitary stalk.

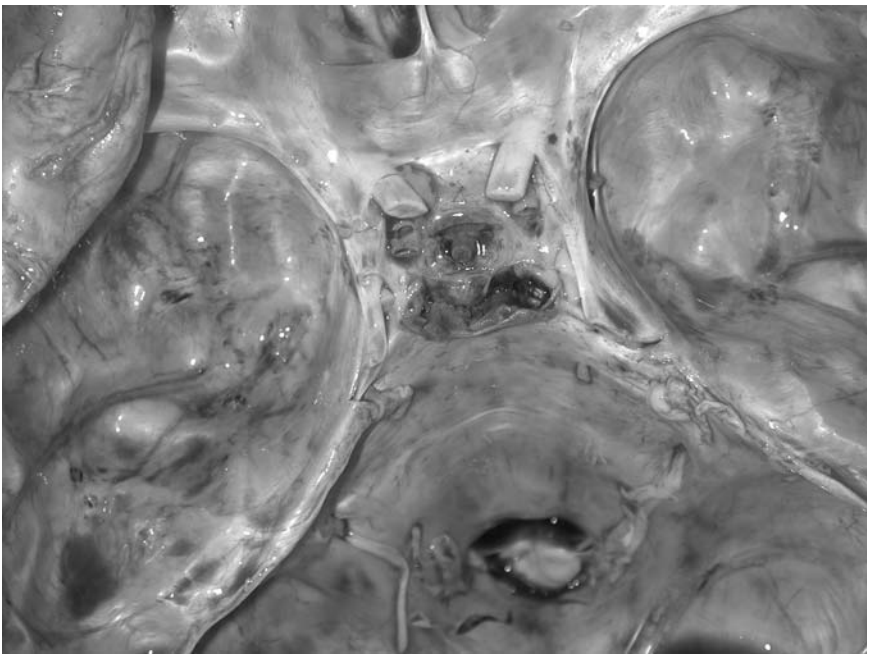

FIGURE 3.14. The pituitary fossa and surrounding structures are exposed. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

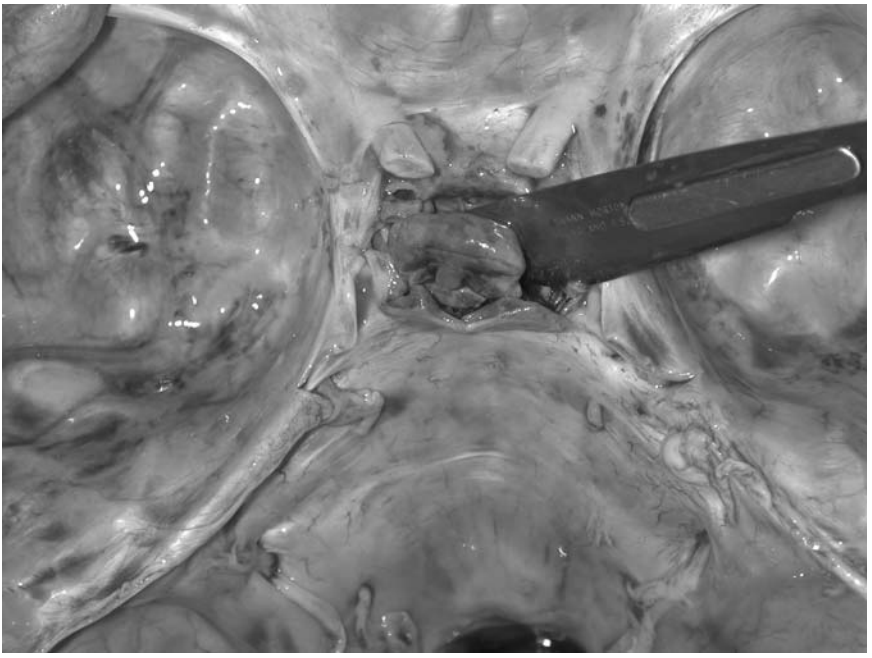

FIGURE 3.15. The pituitary gland is delivered from the pituitary fossa. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

– Dissect the dura from the sphenoid bone and tentoria cerebelli to expose the anterior brain stem.
– Insert the scalpel into the foramen magnum and divide the upper cervical spinal cord and vertebral arteries.
– Remove the brain.

Examining the Middle Ear

It is occasionally necessary to inspect the internal ear. One example of such a situation is systemic sepsis from an unknown source. As it is difficult to identify which particular organ chapter should include this part of the dissection it is outlined here for convenience. If inspection of the middle ear is all that is required then the latter can be visualised by chipping off the overlying bone making up its roof with a chisel. To locate this area, expose the base of the skull after removal of the brain, strip the attached dura, and locate a position two thirds of the way from the calvarium to the foramen in the middle cranial fossa, just anterior to the arcuate eminence on the ridge of the petrous temporal bone and posterolateral to the foramen spinosum (Fig. 3.16). A sharp-ended chisel is placed anterior to this ridge and a sharp blow made with a mallet in an anteroposterior direction. A second chisel blow is then made lateral to this about one third of the way from the dural surface to the middle of the base of the skull. A third chisel cut is made with the chisel turned through 90° between the first two cuts. It should now be possible to remove the tegmen tympani and expose the middle ear. Pus or blood should be seen easily and a swab taken for microbiological analysis if necessary.

This is clearly suboptimal for detailed inspection, as much of the important and minute features can be lost and fragments of bone are spread across the area of inspection. A more detailed method for exposing and inspecting the middle ear involves making four saw cuts in the petrous temporal bone. For this an electric saw with a T-blade is used to make the first anteroposterior cut 1 cm medial to the squamous part of the temporal bone into the external auditory meatus. This cut should be approximately 2 cm deep. The second anteroposterior cut is made, also 2 cm deep, 1 cm lateral to the sella turcica. A third 2-cm deep cut joins these anteriorly, 1.5 cm anterior and parallel to the petrous temporal bone. The fourth and final cut is made parallel to the latter approximately 3 to 4 mm below the superior surface. A T-bar is inserted here and this plate of bone levered off to expose the middle ear.

Alternatively, the whole internal ear can be removed for more formal study. Either a trephine needle can be used to core out the inner ear region using the landmarks described above, or a larger block of bone can be removed using an oscillating saw. This involves cutting a square of tissue, which is removed, decalcified, and sectioned for microscopic observation. Again the

FIGURE 3.16. An indication of the area of interest for examination of the internal ear. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)

boundaries should follow the principles described earlier, with deep cuts made with the saw, one just lateral to the medial border of the orbital cavity/lateral border of the pituitary fossa, a second just behind the lesser wing of the sphenoid, a third just in front of the arcuate eminence, and the

last laterally to join the previous two. These cuts must be deep and reach the soft tissues behind the face and therefore obviously should be made with extreme care in order to avoid undesirable damage, which may not be reconstructable. Once the four cuts are made, this block can be lifted free by directing a long-handled scalpel into the saw cuts while lifting the bone with forceps and freeing the underlying soft tissues. Decalcification can be performed using the methods described on p. 255, followed by sectioning on a large section microtome.

Reference

1. Mallory FB. Pathological technique: a practical manual for workers in pathological histology, including directions for the performance of autopsies and microphotography. Philadelphia: WB Saunders, 1938.