body surface area, sedative dosage, smoking history, or history of preexisting hypertension, diabetes, arrhythmias, angina, or myocardial infarction. Data such as these suggest that distinguishing those patients who are at increased or reduced risk for oxygen desaturation may be difficult prior to endoscopy.

The inability to determine reliably which patients are at increased risk for oxygen desaturation during endoscopic procedures has led to the recommendation that all patients receive supplemental oxygen and that monitoring by pulse oximetry be initiated prior to all endoscopic procedures. The risk of hypoxia during upper GI endoscopy can be reduced by keeping the dose of sedative drugs to a minimum, avoiding the use of combinations of drugs such as benzodiazepines and narcotics, using smaller-diameter endoscopes to reduce the possibility of airway compression, and administering supplemental oxygen.

Supplemental Oxygen

Numerous studies verify that oxygen supplementation prevents or reduces episodes of arterial desaturation during upper GI endoscopy. The use of supplemental oxygen has been advocated as standard practice for all patients undergoing GI endoscopy, as well as its continuation into the postendoscopy period. The rate flow (2 vs. 3 L/min) and route of administration (nasal vs. oral) appear to be of less importance than the timing of oxygen administration. Specifically, Bell et al. found that preoxygenation (administration prior to starting the procedure) significantly reduces the frequency of episodic oxygen desaturation during upper GI endoscopy.

Jurell et al. evaluated hypoxemia and electrocardiographic changes in a prospective study of sedated patients with and without documented ischemic heart disease. Supplemental oxygen significantly decreased but did not entirely prevent hypoxemia (oxygen saturation less than 90%) in cardiac and control groups. In addition, the incidence of electrocardiographic ST-segment deviation in cardiac patients who were hypoxic was significantly lower in the group receiving supplemental oxygen (p = .0015). Jurell et al. recommended that supplemental oxygen be provided to patients with ischemic heart disease who undergo conscious sedation for endoscopic procedures. However, Bowling et al. found that supplemental oxygen during endoscopy did not reduce the occurrence of cardiac rhythm disturbances in a randomized study of 103 patients over age 60 years, with the exception of supraventricular ectopic beats, which did occur more commonly in patients who did not receive supplemental oxygen.

Supplemental oxygen is most commonly administered nasally during upper GI endoscopy owing to the obvious need to access the mouth for passage of the endoscope. However, Bell et al. demonstrated that the pattern of breathing is predominantly via the mouth rather than the nose after intubation of the esophagus. Hubbard et al. studied oxygen supplementation via nasal cannula versus a catheter passed into the low oropharynx to eliminate the effect of mouth breathing. Intrasinal and intrapharyngeal methods of oxygen supplementation were found to be of similar efficacy. Novel oxygenating mouth guards have been developed (Oxyguard, Tri-Med Specialties, Overland Park, KS) to accommodate the alteration in breathing pattern that develops during endoscopy. This device is similar in design to the standard mouth guard, with the addition of a side port through which tubing may be attached to deliver oxygen. The oxygenating mouth guard has been tested in randomized studies and has been shown to better prevent severe oxygen desaturation than endoscopy without supplemental oxygenation. Some predict that use of oxygenating mouth guards will become standard practice because they eliminate the need for nasal prongs and therefore reduce costs related to the use of disposable nasal cannulas.

TECHNIQUE OF UPPER GASTROINTESTINAL ENDOSCOPY

Conventions

Certain conventions have been adopted with respect to deflection of the tip of the endoscope, use of the deflection control knobs, and the endoscopic field. Deflection of the tip is usually referred to as upward or downward and left or right. These terms have no meaning with respect to common reference points (e.g., the sky is up). The easiest way to understand the terminology of tip deflection is to relate the motion of the tip to the control section of the instrument when the insertion tube is perfectly straight. In this configuration the air/water and suction valves face upward (toward the ceiling). Thus, upward deflection of the tip bends it backward along the insertion tube in the direction of the valves; downward deflection is in the opposite direction—away from the valves. Looking along the length of the insertion tube from the control section, left deflection is toward the operator’s left, right toward his or her right. The actual motion of the tip within a patient with upward deflection may be something entirely different from upward in relation to the physical surroundings.

Terms that describe the directions in which the control knobs are turned to deflect the tip are also relative. For the purpose of description, the control section is viewed on the side that has the deflection knobs. Each knob may then be considered to move in either a clockwise or a counterclockwise direction. Thus, counterclockwise rotation of the innermost control knob deflects the tip upward. A counterclockwise turn of the outer knob deflects the tip to the left. Clockwise rotation of the inner and outer knobs results in downward and right tip deflection, respectively.

The endoscopic visual field may be divided in clockwise fashion, the 12 o’clock position being at the top of the field, 3 o’clock to the right, and so on. Most endoscopes have a small marker in the visual field at the 12 o’clock position. As one looks through a fiberoptic instrument, upward tip deflection causes the visual field to move toward the 12 o’clock position, right lateral deflec-
tion toward 3 o’clock, and so forth. For video endoscopy, upward deflection moves the endoscopic field in the direction that corresponds to the top of the video monitor.

Every beginning student of endoscopy is anxious to take hold of an endoscope, insert it into a patient, and begin work. However, two preliminary and vitally important concepts must be understood to acquire a long-range foundation for expertise in endoscopy: (1) the method of holding the instrument, and (2) the endoscope–body position relationship.

**Holding the Instrument**

The first and most important lesson in endoscopy occurs when a novice picks up the instrument with the left hand for the first time. Initial experience plays an important part in establishing a method of holding the instrument. This method, once adopted, determines in large measure the “style” of endoscopy. It should be clearly understood that the method of holding the instrument either facilitates or hinders the development of expertise, particularly in other procedures such as ERCP and colonoscopy.

From a human engineering standpoint, the control section of any endoscope is designed to fit the left hand. In reality, the design of any instrument is a crude approximation because of great differences in finger length and hand size. In practice, the hand compensates for the characteristics of the instrument. Most fiberoptic endoscopes have two coaxial deflection control knobs placed near the eyepiece objective. Similar coaxial control knobs are positioned below the electronic controls (e.g., image freeze, image capture) of electronic endoscopes. The control section nearest the insertion tube is usually narrower than the upper part that houses the deflection controls and air/water and suction valves. This allows for a more comfortable grip of the instrument. Future changes in the control section will probably incorporate a more ergonomic design. The many methods for holding the endoscope can be classified into two general categories: the two-finger and the three-finger grips.

**Two-Finger Grip**

Because endoscopes have two valves, it seems desirable to place a finger (index and middle) on each valve. As the instrument is grasped, the thumb, index, and middle fingers come into relation to the valves and control knobs, leaving the fourth and fifth fingers to hold the lower, narrower part of the control section tightly (Fig. 38–1). An endoscopist with short fingers finds that this grip places the tips of the second and third fingers on the valves. For most people, however, the second and third fingers come to lie across the valves. If so, there is no point in attempting to place the fingertips squarely on the corresponding valves because this loosens the grip of the fourth and to some degree the fifth finger.

Exceptionally long fingers may reach the control knobs when the two-finger grip is used. This has an advantage in that the knobs may be operated with the index and middle fingers as well as the thumb. Lateral finger motion is limited, however, and extension of the fingers across the valves toward the control knobs provides only the small benefit of holding a knob in place after it has been turned with the thumb. In any case, the fingers of most individuals are not long enough to take advantage of this without some compromise.

When the index and middle fingers are placed across the air/water and suction valves, the instrument is held for the most part by the fourth and fifth fingers, thus the term two-finger grip. The top of the control section of many endoscopes is contoured in such a way that it comes to rest against the lateral aspect of the fourth finger, which thus supports some of the weight of the instrument. This reduces the degree of grip strength needed to hold the instrument.

The thumb is a most important appendage. Although it is possible for a few endoscopists to reach either of the two coaxial control knobs comfortably with the thumb, the left thumb of most endoscopists is only long enough to reach the inner of the two knobs (“up/down”). Deflection of the insertion tube is controlled mostly by turning the up/down deflection knob with the left thumb. The main disadvantage of placing the second and third fingers across the valves (i.e., the two-finger grip) is a partial loss of function of the thumb. This method of grasping the instrument tends to move the thumb upward along the control section. The usual result is that the left thumb contacts the inner control knob near the distal interphalangeal joint rather than at the tip of the thumb (Fig. 38–2). The knob is then moved mainly by opposition rather than flexion of the thumb. This provides a lesser range of knob motion than is possible when the tip of the thumb is on the control knob and a combination of flexion and opposition of the thumb is used to turn the control.

It takes some time to become accustomed to holding an endoscope in the left hand for prolonged periods. Until this becomes habitual, the student usually finds that the grip strength of the fourth and fifth fingers gradually decreases through the course of several procedures. The control section tends to drop downward in the hand.
so that eventually it may be supported almost entirely in the groove between the thumb and index finger (see Fig. 38–2). This greatly compromises the use of the left thumb so that the novice increasingly uses the right hand to turn both control knobs. This slovenly use of the left thumb as a “hanger” for the instrument is deplorable.

Three-Finger Grip

Another method of holding the instrument involves shifting the control section upward in the hand so that the narrower lower part of the control section is grasped with the third, fourth, and fifth fingers, thus the term three-finger grip (Fig. 38–3). This has two effects: The middle finger is no longer available to operate the air/water insufflation valve, but the tip of the thumb can now be placed on the inner deflection knob (Fig. 38–4). With this method, the left index finger must be used to operate both the air/water and suction valves (see Fig. 38–3). This is not especially difficult, although it poses a slight disadvantage in that simultaneous operation of both the air/water and suction valves can be accomplished only by shifting the instrument downward in the left hand or by using the fingers of the right hand to operate one or both valves, the latter being the preferred method. In practice, simultaneous depression of both valves is seldom necessary. The advantage of the three-finger grip is that it permits greater use of the left thumb. The left thumb has more control over the inner (up/down) deflection knob, and it can also be extended to the outer (left/right) deflection knob, allowing small lateral deflections while the insertion tube of the endoscope is maneuvered with the right hand.

Lateral Deflection

The deflection control knobs cannot be operated with any degree of skill with the left hand alone, regardless of the method used for holding the instrument. It is especially difficult to rotate the two control knobs in opposite directions. Manipulation of both knobs in addition to the suction and air/water valves with one hand becomes extremely clumsy and ineffective for all but a few exceptionally dexterous individuals. For practical purposes, the lateral deflection control knob, the outer of the two coaxial systems, is turned with the right hand. The other function of the right hand is advancement and withdrawal of the insertion tube.

Because the lateral deflection knob must also be operated with the right hand, it is not possible to laterally deflect and advance the instrument at the same time. This seems to make a case for allowing an assistant to advance the instrument while the endoscopist steers with both hands at the control section. However, this two-person
method is never as rapid or precise as when endoscopy is performed by one individual and is unnecessary when performing upper GI endoscopy. As described later, the technique of rotating or torquing the insertion tube eliminates or greatly decreases any disadvantage inherent in the inability to laterally deflect and advance the instrument at the same time. In fact, in most cases it is not necessary to remove the right hand from the insertion tube until after the tip of the instrument has reached the apex of the duodenal bulb. As also described later, using both deflection controls simultaneously while withdrawing the insertion tube is entirely possible.

The Endoscope–Body Position Relationship

The endoscope–body position relationship refers to the configuration of the insertion tube outside the patient. This is determined entirely by the position of the endoscopist or, more precisely, by the position of the control section of the endoscope relative to the point of entry of the endoscope into the patient. The expert endoscopist determines the configuration and position of the insertion tube external to the patient and takes advantage of this relation in maneuvering the instrument. Concentrating on what seems to be occurring within the patient, the novice allows the insertion tube to assume any number of configurations and is unaware that this greatly influences the ability to maneuver in both positive and negative ways.

There are significant differences in the way fiberoptic and electronic (video) endoscopes are held in relation to the endoscopist’s body owing to the necessity with the former of looking through the objective lens (Fig. 38–5A and B). This produces slight but significant differences in the technique of upper GI endoscopy.

By necessity, the control section of the fiberoptic endoscope is held up to the eye (see Fig. 38–5A). Thus, the position of a fiberoptic instrument depends on the height and stance of the endoscopist. The control section of the electronic endoscope, on the other hand, is most comfortably positioned at about the middle of the endoscopist’s torso. Furthermore, changing the position of the control section of an electronic instrument relative to the endoscopist and patient is much easier. Raising or lowering the position of the control section relative to the surface of the examination table offers an additional and highly advantageous method of rotating the insertion tube. Some endoscopists hold the control section of electronic endoscopes upright near their epigastrium (see Fig. 38–5B), whereas others hold it at an angle from the left side of their body, with the left palm facing slightly upward (see Fig. 38–5C). The latter method is frequently adopted by endoscopists with relatively small hands who experience difficulty in grasping the control section.

Although all modern endoscopes are considered flexible, they also have certain degrees of stiffness. Resistance to deforming force is most evident in an instrument’s torque stability. This means that a twisting motion applied to the insertion tube at one end is transmitted along its long axis to the other end with little or no loss of motion, provided that the insertion tube is as straight as possible. When the instrument is straight, rotatory motion also has fidelity; that is, any degree of rotation at one end is reproduced promptly and equally at the opposite end. When the insertion tube is in a looped configuration, a twisting force applied at one end is absorbed to some degree by the loop, and the rotatory motion at the opposite end is diminished. The degree of transmission of the rotatory motion is also less predictable or may not

![Figure 38-5](image-url)

**Figure 38-5**
Various stances for performing endoscopy. A, Stance with the fiberoptic endoscope held up to the eye. B, Stance with the electronic (video) endoscope held near endoscopist’s epigastrium. C, Stance with the electronic (video) endoscope held on the left side of the body.
occur at all, in which case the quick response at the distal end of the instrument is lost.

The behavior of the insertion tube in response to rotatory motion gives rise to a guiding principle for all endoscopic procedures: The straighter the instrument, the more precise the control. The GI tract is obviously not straight, but neither is it a rigid tube. Some degree of straightening is therefore possible during virtually any endoscopic procedure. Furthermore, only part of the insertion tube is within the patient at any given time, and control of the configuration of the part that is outside the patient is obviously possible.

All of the tip motions that are possible by combined use of the up/down and lateral deflection controls can be reproduced by rotation of the insertion tube (torque) and movement of the up/down deflection control with the left thumb. This almost completely removes the disadvantages associated with the inability to advance and laterally deflect at the same time. As noted, this works only if the instrument is relatively straight. Thus, coiling or looping of the section of the insertion tube external to the patient should be avoided. In order to do this, it is usually necessary to stand back somewhat from the patient. Afraid that they will lose their position, most beginning students of endoscopy tend to stand too close to the patient, leftward from the patient’s mouth (i.e., in the direction of the patient’s feet), and to lean forward (when using a fiberscope), sometimes almost to the point of hovering over the patient (Fig. 38-6). This "novice crouch" communicates intense concentration and forewars of lifelong lower back pain, but it allows little or no effective rotation of the insertion tube. As discussed later, methods of keeping the insertion tube relatively straight within the patient can be learned.

Three basic methods are available for rotating the insertion tube of the endoscope during EGD: (1) turning the control section clockwise or counterclockwise by flexion or extension of the left wrist; (2) turning the entire body left (Fig. 38-7) or right (Fig. 38-8) beginning from a position facing the patient; and (3) raising or lowering

**Figure 38-6**
Endoscopist is standing too close to the procedure table using a fiberscope (A) and an electronic (video) endoscope (B). In either case, the loop in the instrument between the endoscopist and the table dampens rotation of the instrument except for rotation performed with the right hand.

**Figure 38-7**
Left rotation of the insertion tube is achieved by a leftward turn of the torso with a fiberscope (A) and an electronic (video) instrument (B).
the left shoulder (fiberoptic endoscopy) (Fig. 38–9) or abducting or adducting the left arm (electronic endoscopy) (Fig. 38–10).

Torquing the insertion tube with the right hand is ineffective if the control section is held in a fixed position and may damage the instrument. Up to 90 degrees of rotation to the right occurs with flexion of the left wrist, and a small degree of rotation to the left can be achieved by wrist extension. If the endoscopist simply turns from a position facing the patient to the left or right, the result is a corresponding rotation of the insertion tube in the same direction. With a fiberoptic instrument, a significant degree of left rotation occurs if the endoscopist moves his or her left shoulder downward, forward, and slightly to the left, and a small degree of right rotation also occurs by raising the left shoulder. Leftward torque can be achieved with an electronic endoscope by abducting and externally rotating the left arm, holding the control section down and away from the endoscopist (see Fig. 38–10A); rightward rotation can be achieved by abducting and internally rotating the left arm, bringing the control section up and more toward the endoscopist’s head (see Fig. 38–10B). The electronic endoscope may be slightly more maneuverable than the fiberoptic endoscope because the control section can be moved more freely. Rotation of the insertion tube can be accomplished simply by raising or lowering the left hand in relation to the surface of the procedure table.

Rotation of the insertion tube is accomplished in practice by some combination of the various maneuvers described earlier. Flexion of the left wrist and a turn by the endoscopist toward his or her right is most effective when right (clockwise) torque is desired. Lowering the left shoulder or left arm is usually satisfactory when left (counterclockwise) torque is called for.

When the insertion tube is straight, the position of the endoscopist relative to the point of entry into the patient has added importance. When the endoscopist moves to the left of the patient’s mouth, the instrument rotates to the left as well (Fig. 38–11). Because the insertion tube is held with the right hand, the endoscopist has a natural tendency to stand slightly to the left of the patient’s mouth. A similar but opposite change occurs if the endoscopist moves to the right relative to the patient’s mouth.

Although EGD was at one time performed in either a sitting or standing position, most endoscopists now prefer to stand. The earlier discussion should make it clear that a sitting endoscopist is less mobile and therefore less able to rotate the insertion tube properly. Conversely, a standing endoscopist is in a much better position to take advantage of the various methods of instrument rotation.

The behavior of the instrument in response to the maneuvers described can be demonstrated by standing at an empty procedure table in the usual position for EGD,
with the instrument laid out on the table as if it were in a patient’s stomach. It is helpful if the instrument is passed through a mouth guard, and the guard is held by an assistant at a point that approximates its usual location between a patient’s teeth. The distal tip should be deflected upward to a slight degree so as to better appreciate the motion imparted to the distal end of the instrument in response to the various maneuvers. The rotation maneuvers are then performed while observing the behavior of the deflected tip of the instrument.

**Passing the Endoscope**

As the endoscope is passed, the patient should be in the left lateral position on the procedure table, left hand under a pillow, right hand at the side, knees drawn up at a right angle to the torso, and the neck slightly flexed. The mouthguard should be in place between the patient’s teeth. The GI assistant has certain specific and important functions during passage of the instrument (see Chapter 5: The Gastrointestinal Assistant).

The endoscope may be passed by one of two methods: blind and direct vision. The most basic rule of safe and effective endoscopic practice is that the instrument should not be advanced when one is unable to see ahead. There is no reason to discard this rule for passage of the instrument, and therefore direct vision is unarguably the better method of insertion.

**Blind Passage**

The blind method of passing the endoscope requires that the endoscopist place two fingers (generally the index and middle fingers of the left hand) in the patient’s mouth and over the back of the tongue. Ideally the space between the fingers lies in the midline and forms a groove to guide the instrument downward into the pharynx. Some physicians guide the instrument tip with the index finger as the insertion tube is being advanced with the right hand.

Once within the space between the fingers, the instrument may be advanced into the posterior pharynx. Note that the deflection controls should be in an unlocked po-
sition. They are not used during this process. Resistance to further advancement of the instrument is encountered as the tip reaches the level of the cricopharyngeus. This muscular sphincter is usually located about 15 to 18 cm from the incisor teeth (or mandibular ridge). Thus, the right hand should be just behind the 20-cm mark (at about 22 or 23 cm) on the insertion tube. If the insertion tube is placed distal to the 20-cm mark, it is often necessary to shift its position backward so that an adequate length of instrument is available to reach the esophagus. This may result in a momentary loss of control. When the instrument tip reaches the cricopharyngeus, gentle forward pressure is maintained as the patient is asked to swallow. A distinct sensation of relaxation is felt as the cricopharyngeus opens and the instrument moves forward without resistance. As this last action is being performed, the endoscopist withdraws his or her fingers from the patient’s mouth.

Blind instrument passage has numerous disadvantages. The endoscopist, the endoscope, or both are more likely to suffer a bite. Sedated patients have greater difficulty in controlling their reactions and are slower in their response to commands. Placing two fingers and an endoscope in the posterior pharynx is much more likely to cause gagging than is the instrument alone. The patient is less able to initiate a swallow when he or she is barely able to move the tongue. The glottis, the pyriform sinuses, the larynx, the cricopharyngeus, and even the proximal several centimeters of the esophagus are not examined, and these structures are also more likely to be traumatized with this method. Trauma to these tissues may create the appearance of an abnormality. Certain abnormalities such as an esophageal web may be overlooked. Blind passage of the instrument is contraindicated in patients with dysphagia that suggests a proximal esophageal lesion, especially if Zenker’s diverticulum is suspected or known to be present.

**Direct-Vision Passage**

Observation begins and continues throughout the examination in the direct-vision method of insertion as the instrument tip passes the back of the tongue. All of the structures of the posterior pharynx and larynx are noted as the endoscope is advanced.

The endoscopist must actively manipulate the tip of the endoscope when using the direct-vision method. It is impossible to use the lateral deflection knob during this maneuver because its use requires that the right hand be shifted from the insertion tube to the control knob. This shift almost always results in loss of control of the instrument tip. Steering the tip to the left or right is accomplished by torquing the insertion tube with the right hand. Because the cricopharyngeus is located about 15 to 18 cm from the incisor teeth, the thumb of the right hand should be placed proximal to the 20-cm mark on the insertion tube to begin with and kept in this place until the instrument tip reaches the upper esophagus. Up and down deflection is done by the left thumb. Fortunately, most of the necessary movements are relatively fine; marked degrees of twisting or turning are not required and indicate a lack of expertise.

**Figure 38-12**

Endoscopic view of the base of the patient’s tongue during direct vision passage of endoscope. Note that the tongue is at the top of the image and the palate is at the bottom.

Before the instrument is passed, the lateral deflection control can be locked with the tip in a straight, neutral position. The endoscopist then stands slightly to the left of the patient’s mouth with both hands at about the level of the mouth. The instrument is inserted to the base of the patient’s tongue (Fig. 38-12), whereupon the tip is deflected upward with the left thumb. If this maneuver is performed properly, it generally results in a view of the patient’s epiglottis (Fig. 38-13). If this is not seen, the instrument should be withdrawn somewhat while rotating it left and right slightly with the right hand. This generally reveals an identifiable structure. Sometimes the instrument tip ends up in the left or right vallecula of the epiglottis and may give the mistaken impression that the tip is in one of the pyriform sinuses. However, its true location is easily recognized by the fact that the instrument has not been advanced far enough to reach the pyriform
Sinus and by the paler yellow color of the mucosa in this area.

Once the epiglottis is visualized, the tip of the instrument is advanced. Some downward deflection and slight rotation to the left or right may be necessary at this point to steer the tip around the epiglottis. As the instrument is advanced, the next structures visualized are the larynx, vocal cords, and pyriform sinuses (Fig. 38-14). If the patient swallows and the cricopharyngeus relaxes, the esophageal lumen is seen between the pyriform sinuses posterior to the larynx. Ideally, the instrument should be advanced in this direction, keeping to the midline by means of small degrees of rotation of the insertion tube with the right hand and directed posteriorly away from the larynx. The latter is accomplished by downward deflection with the left thumb. The patient is asked to swallow as the rosette of the closed cricopharyngeus is encountered, and then the tip of the instrument is advanced into the esophagus a few centimeters as the cricopharyngeus relaxes.

It is difficult in practice to perform the last part of the direct-vision method perfectly because the instrument must be kept precisely in the midline as it is advanced toward the cricopharyngeus, and the advancement must be perfectly timed to the patient’s swallow. Therefore, the tip often ends up in one of the pyriform sinuses, frequently the left because of its dependent position, and the endoscopist encounters resistance to forward motion. The endoscopist has two options at this point. The instrument tip can be withdrawn 1 or 2 cm and another attempt can be made to pass the cricopharyngeus. Alternatively, the endoscopist may rotate the instrument slightly toward the midline. If the tip is in the left pyriform sinus, right rotation is needed. Small adjustments can also be made with the up/down control as the patient is asked to swallow while the endoscopist maintains gentle forward pressure. The required rotation and adjustment of the up/down deflection are very slight. Generally, the instrument does not immediately enter the esophagus, but each swallow reveals some clue to the location of the cricopharyngeus and thus allows for further and more directed adjustments of the tip position. Small capillary vessels in the mucosa near the cricopharyngeus run longitudinally; if these are visible, they also indicate the direction of the lumen.

Esophageal intubation may be unsuccessful by standard methods in the presence of anatomic abnormalities (e.g., Zenker’s diverticulum). Catheter- or wire-guided methods for intubating the esophagus in such cases have been described. The catheter or wire is passed under either direct vision or fluoroscopy through the accessory channel of the endoscope and into the esophageal inlet. The endoscope can then be passed into the esophagus using the wire or catheter as a guide.

The endoscope should be withdrawn promptly if the patient has excessive coughing or stridor during attempts at esophageal intubation. These are usually the first signs that the trachea has been inadvertently intubated. A practiced endoscopist often recognizes cartilaginous tracheal rings and immediately withdraws the endoscope, even before the patient responds to the presence of the instrument in the airway. If the trachea is intubated inadvertently, esophageal intubation can be reattempted after a few minutes unless laryngeal stridor persists. Persistence of stridor indicates laryngeal edema, in which case endoscopy should be postponed and the patient observed carefully.

**Esophagus**

Once within the esophagus, the instrument can be advanced easily. Direct vision should be used at all times. The surface mucosa is pale pink, smooth, flat, and somewhat glistening (Fig. 38-15). Small vessels are usually visible in the mucosa, especially in the distal esophagus. These are oriented longitudinally with the long axis of the esophagus.

The esophagus is essentially a straight tube. Although it possesses no landmarks, certain structures external to the esophagus may be noted (see Chapter 44: Hiatal Hernia and Peptic Diseases of the Esophagus). As the instru-
Entering the Stomach

If only anterior and posterior directions are considered, the course of the endoscope through the upper GI tract is from posterior to anterior to posterior. The esophagus is essentially a posterior organ, whereas the stomach lies in a more anterior plane. Viewed from above, the stomach is largely anterior in relation to the esophagus so that it can swing over the spine (Fig. 38–17). This means that a turn in an anterior direction is often needed to advance the endoscope from the distal esophagus through the cardia and into the proximal stomach. This may be accomplished by rotation to the left (anterior) with upward deflection as the endoscope passes the Z line (Fig. 38–18). The easiest method of left rotation is to lower the left shoulder in a slightly forward direction (fiberoptic endoscopy) or to abduct and externally rotate the left arm (electronic endoscopy).

An unsatisfactory alternative to direct-vision passage of the instrument tip through the cardia is to advance the endoscope without rotation or deflection. It passes through this segment and usually stops against the posterior aspect of the lesser curvature.

As the instrument tip enters the stomach, the rugal folds along the greater curvature of the body are seen (Fig. 38–19). Often a small pool of fluid is found in this dependent location. This observation is useful because it identifies the greater curvature of the stomach and therefore the opposite lesser curvature and the anterior and posterior walls. If only a small amount of fluid is present, aspiration of the gastric contents is probably unnecessary. If, however, the pool obscures the rugal folds be...
Endoscopic view of the stomach as the endoscope is advanced and rotated toward the right. The gastric rugal folds along the greater curvature are seen coursing toward the antrum, which is at the upper right.

neath, it is advisable to aspirate the gastric contents. This should be done as much as possible with the instrument tip lying parallel to the mucosal surface and alternating suction and air insufflation. Applying suction with the instrument tip perpendicular to the mucosa frequently draws some of the mucosa into the accessory channel. This delays aspiration, and the mucosa, once freed, becomes hyperemic and edematous.

If only a small volume of air was insufflated while traversing the esophagus, the stomach may still be partially collapsed. When the initial view is unsatisfactory, it is necessary to insufflate the stomach with air. The ideal degree of gastric distention is a matter of judgment. Generally, the distention should be to the point that the rugal folds just begin to separate. Later in the procedure, it may be necessary to distend the stomach to a greater degree to examine thoroughly all of the mucosa of the body, especially if small mucosal abnormalities such as vascular malformations may be present. Patients differ with respect to the degrees of gastric distention they tolerate. Some belch uncontrollably in response to small volumes, and it may be necessary to accept less than ideal distention. Excessive air insufflation almost always causes the patient some discomfort and should be used only briefly, if at all. Furthermore, excessive insufflation markedly flattens the rugal folds, leading to the mistaken impression of gastric atrophy.

**Body of the Stomach**

The endoscope is in a position of left rotation with upward tip deflection as a result of advancing from the esophagus through the cardia and into the stomach. To bring the tip through the body and toward the pylorus, it is necessary to rotate to the right as the insertion tube is advanced. After the endoscope has passed through the cardia and traversed the proximal gastric body, the insertion tube external to the patient is oriented mostly along the length of the patient’s body; that is, it is rotated about 90 degrees to the left. To accomplish the necessary right rotation as the instrument is advanced through the stomach, over the spine, and toward the pylorus, one need only bring the left shoulder (fiberoptic endoscopy) or left arm (electronic endoscopy) back to the normal midline position so that the external part of the insertion tube follows a straighter line of entry at the patient’s mouth. This usually requires that the endoscopist stand slightly back from the table. The advancement and right rotation of the insertion tube through the stomach should be a smooth, coordinated maneuver. Small adjustments of the up/down deflection are also needed, especially additional upward deflection along the lesser curvature as the tip advances through the body of the stomach.

**Paradoxical Motion**

The esophagus and duodenum are relatively fixed, narrow, and inelastic structures. The stomach, however, stretches considerably to accommodate intraluminal forces. As the tip of the instrument is advanced toward the antrum and pylorus, the insertion tube invariably comes to lie along the greater curvature. Because of the elasticity of the stomach, a considerable part of the forward force is absorbed by the greater curvature, pushing the stomach toward the pelvis as a loop forms along the curvature. Endoscopically it may appear that the instrument tip is not moving forward or even that the tip is moving away from the pylorus during this maneuver, thus the term *paradoxical motion*. It is necessary to continue to advance the instrument until the greater curvature loop is fully formed and the instrument tip begins to move forward again (Fig. 38-20). Generally this also requires additional upward deflection of the tip using the left thumb.

![Diagram showing the formation of the greater curvature loop. The point of paradoxical motion has been passed, and the instrument is being advanced toward the pylorus as the greater curvature loop continues to develop.](image)
Antrum

Two differences between the antrum (Fig. 38–21) and the body (see Fig. 38–19) of the stomach are obvious: Rugal folds are present in the body but not the antrum, and peristaltic contractions are not noted in the body but are readily observed in the antrum. At this point in the examination, the tip of the instrument is probably at the midpoint of the greater curvature or slightly beyond. Full upward deflection of the tip often reveals a view of the angularis of the stomach, although this depends on the overall configuration of the stomach itself. Some endoscopists perform the retroverted view of the fundus and proximal stomach at this juncture.

If the endoscope has been advanced to the antrum quickly, smoothly, and with minimum air insufflation, no contractions may be observable. Proceeding directly to the pylorus can be advantageous at this point. The physiologic function of the pylorus is to close in response to gastric distention so that repetitive antral peristaltic contractions grind the food against the pylorus and progressively reduce the size of the intragastric food particles. When gastric distention has been kept to a minimum and no antral contractions are occurring, the pylorus is in a relatively lax state.

Pylorus

The previous left rotation of the insertion tube is largely corrected as the tip of the instrument passes along the greater curvature into the antrum and toward the pyloric ring, and the external section of the insertion tube between the patient’s mouth and the endoscopist’s left hand is relatively straight. As the tip advances through the antrum, the pylorus should be kept in the middle of the endoscopic field. This requires small adjustments of the up/down deflection and minor degrees of rotation to the left or right. Small left or right corrections can be made with the left hand and wrist alone, provided that the external portion of the insertion tube is relatively straight.

The endoscope tip can be passed through the pyloric ring without difficulty in most patients. In other cases, however, the pylorus may be closed and may offer resistance to advancement into the bulb. This can also be an indication of disease in the region of the pylorus, which may itself be stricture. A certain amount of judgment based on experience must be exercised about how hard to push the instrument tip against the pyloric ring. If considerable resistance is encountered and the view of the ring at a distance in the antrum suggests deformity, it may not be possible to enter the bulb.

Novice endoscopists usually have considerable difficulty in crossing the pylorus. One common mistake is to persist in blindly searching for the pylorus when it has been lost from endoscopic view. Pressure exerted against the antral wall during these futile efforts usually leads to antral contractions and spasm of the pylorus. When the pylorus is lost from view while advancing the endoscope, withdrawing the tip to the proximal antrum and beginning again are always preferable.

The cardinal rule in negotiating a "spastic" or persistently closed pylorus is to keep the ring in the center of the endoscopic field as the instrument is advanced. This may require momentary adjustments of the lateral deflection. Locking the lateral deflection control knob may help to keep the tip steady, and the added rigidity may ease pyloric intubation. It may be difficult to maintain forward pressure with the right hand while changing the lateral deflection. One way to maintain gentle forward pressure is to rest the insertion tube on a pillow near the patient’s mouth. It may be necessary for the endoscopist to bend forward and press the insertion tube gently against the pillow. This maneuver preserves forward pressure and prevents the instrument from falling back into the antrum as the right hand moves to the lateral deflection control. A distinct sensation is often felt by the right hand on the insertion tube as the pylorus relaxes and allows the endoscope to enter the bulb. Passage of the endoscope through the pyloric ring produces a peculiar sensation, sometimes described as discomfort, in some patients.

Duodenal Bulb

The bulb is a relatively small structure. Generally, the endoscopist leans forward when advancing the instrument tip across the pylorus. The forward force exerted on the pylorus to gain entry to the bulb usually carries the instrument tip to the apex. As a result, most of the bulb may not have been examined. If the endoscopist leans back and places slight backward tension on the insertion tube, the endoscope tip can be brought back into the pyloric channel, from which point the bulb can be examined. This examination proceeds in a circumferential manner using both deflection controls. The mucosa of the bulb has a slightly irregular, villous surface (Fig. 38–22), and the color is a pale tan, in contrast to the pink color of the stomach. Accurately determining anatomic relationships within the duodenal bulb is frequently difficult. In the study of Straker et al., the posterior wall was located correctly by experienced endoscopists only 30% of the time.
Once the bulb has been intubated, the novice is often anxious that the instrument not return to the stomach, especially if difficulty was encountered in inserting it across the pylorus. This tendency to fall back into the antrum can be countered to some degree by keeping the right hand on the insertion tube. If the instrument does return to the stomach, the pyloric ring should be observed closely for any evidence of ulcer or other disease process, especially if difficulty was encountered in passing the ring. The endoscope almost always passes through the pyloric ring more easily after one successful passage.

**Descending Duodenum**

The endoscopic view of the apex of the duodenal bulb usually discloses no obvious lumen because of the acute angulation at the superior angle between the bulb and the proximal descending duodenum. Sometimes a valvular fold or two may be visible and a portion of the lumen may be noted, but this is unusual.

Because the lumen ahead is not clearly defined, insertion of the tip of the instrument into the descending duodenum is a partially blind maneuver. It is first necessary to place the tip at the apex of the bulb. In most cases, the course of the lumen is directed superiorly and posteriorly. In the endoscopic field, this is usually upward and to the right. Once in position, therefore, the tip is deflected almost fully upward and fully or almost fully to the right and the insertion tube is rotated 90 degrees or more to the right (Fig. 38-23). The latter rotation is best accomplished by a combination of flexing the left wrist and turning toward the right (see Fig. 38-8). This maneuver hooks the superior angle and, if performed properly, provides a view of the descending duodenum (Fig. 38-24). Locking the lateral deflection knob in the right position may help the tip to stay in the "hooked" position while the instrument is withdrawn. Toward the end of this maneuver, minor adjustments in tip deflection may be required to provide a tubular view of the duodenum.

Another method of insertion into the proximal descending duodenum also begins by positioning the instrument tip at the apex of the bulb. The tip is then deflected to the right, and the insertion tube is advanced while the tip is deflected sharply downward. In this maneuver the degree of downward deflection required may be as much as 150 degrees. Some endoscopes, however, do not provide this degree of tip angulation in the downward direction.

After the instrument tip is in the proximal descending duodenum, the next step is to withdraw the instrument. Because further correction of tip deflection may be necessary, the withdrawal maneuver can be performed with both hands at the control section. This is not difficult and

![Figure 38-22](image1)

Endoscopic photograph of the duodenal bulb. The apex is seen toward the center.

![Figure 38-23](image2)

Diagram showing maneuvers to deflect the instrument tip from the apex of the bulb into the proximal descending duodenum. Right rotation of the insertion tube is required (see Fig. 38-8) as well as full upward and right tip deflection.

![Figure 38-24](image3)

Endoscopic view of the proximal descending duodenum on completion of the maneuver illustrated by Figure 38-23.
can be done by simply lifting the left wrist upward and stepping back a slight distance from the procedure table. An alternate method of withdrawal is to use clockwise torque on the instrument tube with the right hand while controlling the up/down control knob with the left thumb.

Withdrawal of the insertion tube at this point takes up the greater curvature loop in the stomach and causes the tip to move forward in a paradoxical fashion (Fig. 38-25). This straightening of the insertion tube within the stomach and bulb generally results in advancement of the instrument to the inferior angle of the descending duodenum. The amount of instrument that must be withdrawn in this “straightening maneuver” varies but is often 30 cm or more. When the instrument is straight, only 55 to 60 cm remain within the patient. This can be noted by referring to the distance marks on the insertion tube.

When the endoscope is deeply inserted and a large loop forms on the greater curvature of the stomach, the degree of responsiveness of the insertion tube to rotation is greatly diminished, as described earlier. Once the straightening maneuver is accomplished, however, the response to rotation returns.

At the conclusion of the straightening maneuver, the instrument tip is near the inferior duodenal angle, the insertion tube is relatively straight, and the endoscopist should have both hands at the control section. The instrument should then be slowly withdrawn from the duodenum, making use of both rotation and tip deflection to gain the best possible view. The difficulty this presents is that the tip may suddenly fall back a considerable distance, even into the stomach, before an adequate examination can be made. This occurs as the tip becomes hooked, especially at one of the duodenal angles or at any point in the duodenal lumen that is more tortuous than usual.

The tendency for the insertion tube to slide suddenly back toward or into the stomach can be anticipated by noting any resistance to withdrawal. This indicates that the tip has come to a turn in the lumen and that by maintaining a view of the lumen with the deflection controls the endoscopist is also maintaining a hook at the end of the endoscope. The tip should be deflected, usually with loss of the view of the lumen, to release this hook. Further withdrawal is then possible without abruptly sliding backward.

Once the instrument tip is in the descending duodenum, it is often possible to advance the instrument by allowing a larger loop to form on the greater curvature. This often gives a somewhat different view of the descending duodenum and may allow observation of areas that were not seen well during the straightening/withdrawal maneuver. However, the formation of a large greater curvature loop may also cause the instrument tip to move paradoxically in a backward direction as the insertion tube is advanced.

In practice, it is often necessary to resort to both the withdrawn/straightened and greater curvature looped positions, as well as to intermediate combinations of these two extremes, in order to piece together a more complete picture of the descending duodenum. But even with maximum use of these maneuvers, certain parts of the descending duodenum, particularly the medial wall, may not be seen satisfactorily. The maneuver used in EGD for examination of the duodenum are very similar to those of ERCP (see Chapter 57: Technique of Endoscopic Retrograde Cholangiopancreatography).

**Distal Duodenum**

Upper G1 endoscopy is usually considered complete if the examination is carried out to the level of the inferior duodenal angle. It can be difficult to insert the instrument tip into the third part of the duodenum and extremely difficult or even impossible to reach the ligament of Treitz. Again, the reason for this is the formation of the greater curvature loop in the stomach.

It is usually possible to obtain a view of the third portion from the inferior angle. When it is essential to advance the tip into the third portion, it is usually necessary to form a loop of considerable size in the stomach. This has several limitations. It usually causes discomfort to the patient, and the standard panendoscope is not long enough to take great advantage of the forward motion achieved at the expense of loop formation. In thin patients with lax abdominal wall muscles, the formation of the greater curvature loop may be partially controlled by exerting external, upward pressure in the left upper quadrant of the abdomen. Repeated straightening and loop formation may gradually advance the instrument toward the ligament of Treitz in some cases. In a study by Brady et al., fluoroscopy disclosed that endoscopists incorrectly estimated the position of the endoscope within the duodenum in 47% of examinations. When incorrect, the distance the endoscope had been advanced was overestimated about two thirds of the time. The endoscope was inserted to the third part of the duodenum in 51% of cases and to the fourth portion or beyond in 38%. If an examination of the distal duodenum or proximal jejunum is necessary, a longer endoscope such as a pediatric colonoscope or a dedicated enteroscope should be used (see Chapter 50: Endoscopy of the Small Intestine).
Retrovers ion (Retroflexion)

The endoscopist can withdraw the instrument from the level of the pylorus while keeping both hands at the control section. This is done simply by lifting the left hand upward while stepping back from the procedure table in slight increments. Keeping the right hand at the lateral deflection knob allows the endoscopist to manipulate the distal tip in wide, circumferential arcs in order to view all areas of the wall of the stomach. Electronic (video) endoscopes can be rotated by movement of the left hand in wide circular arcs. It is not necessary to place the right hand back on the insertion tube until the instrument has reached the cardia unless the retroversion maneuver is to be performed during this part of the EGD.

The importance of the retroversion maneuver is that it provides an en face view of the angulus and the fundus of the stomach. The region of the angulus is seen only tangentially on forward view. The fundus is not seen at all.

To provide a view of the angulus (Fig. 38–26), the retroversion maneuver must be initiated at a point opposite the angulus. This is facilitated by a partial loop on the greater curvature, which allows maximum upward tip deflection without encountering the lesser curvature of the stomach with the tip of the instrument.

Once in position opposite the angulus, the instrument tip is deflected upward as far as possible with the left thumb. Generally, at least 180 degrees of tip deflection is required. Many instruments permit even greater degrees of upward deflection. The instrument is then withdrawn while the tip is kept in this attitude (Fig. 38–27). This provides a retroverted view of the instrument entering the stomach through the cardia (Fig. 38–28). In addition to withdrawing the instrument, the endoscopist must add a significant degree of rotation, as much as 180 degrees. This can be done to the left or right, but rotation to the left is easier to accomplish. If left rotation is selected, the lateral deflection should be set and locked full left (Fig. 38–29).

Rotation and withdrawal should be accomplished simultaneously by degrees. The insertion tube must be withdrawn with the right hand. In order to rotate to the left simultaneously, the left arm can be abducted and externally rotated (see Figs. 38–9 and 38–10). If the left hand (holding the control section) is brought toward the right hand at the same time and if the right hand simultaneously lifts the insertion tube upward toward the oncoming left hand, a loop forms in the external configuration of the instrument (Fig. 38–30). When this occurs, the insertion tube has in effect been rotated 180 degrees to the left.

The left rotation retroversion maneuver provides an excellent view of the fundus and cardia (see Fig. 38–28). This can be augmented by deflecting the tip to the left.
and right, using the right hand to operate the lateral deflection knob. However, this view may still be incomplete, and it may also be necessary to rotate the insertion tube to the right to complete the assessment of the area. This can be done by simply undoing the 180-degree external left loop. To do so, it is necessary to raise the left shoulder to the normal position, to step back from the procedure table, and to turn to the right (see Fig. 38–8). This must be done without further withdrawal (or advancement) of the insertion tube. Because the right hand remains on the insertion tube throughout the retroversion maneuver, it is not difficult to keep the insertion tube in place with respect to forward and backward motion even as it is being rotated through 270 degrees or more.

The retroversion maneuver can be completed simply by moving the deflection controls to a neutral position while the instrument tip is still in the proximal stomach. However, it is also advantageous to return the tip to the proximal antrum while maintaining the retroverted view. This provides an additional and somewhat different view of the proximal stomach and lesser curvature. To accomplish this, it is only necessary to unrotate the instrument back to its usual position while advancing it. When the view of the angulus is again obtained, the lateral deflection is returned to the neutral position with the right hand and the tip is deflected downward with the left thumb to obtain a view of the pylorus. Withdrawal to the level of the cardia then proceeds as described earlier.

**Withdrawal of the Endoscope**

When the tip of the instrument is returned to the cardia, it becomes more difficult to continue withdrawing the instrument without placing the right hand on the insertion tube. The distance between the endoscopist and the procedure table has become greater and the weight of the insertion tube across this distance tends to cause it to slip backward out of the esophagus. Therefore, withdrawal of the endoscope through the esophagus is performed with the right hand on the insertion tube. This still allows a satisfactory range of tip motion by means of slight degrees of rotation with the right hand in combination with up/down deflection by the left thumb. This provides very precise control of the tip and allows reexamination of the structures of the posterior pharynx and larynx.

**Air Insufflation and Suction**

Deflation of the stomach as the instrument tip approaches the cardia during withdrawal diminishes the patient’s postprocedure discomfort. Air insufflation of the upper GI tract should be controlled precisely during EGD. A common misconception of the beginning student is that further air insufflation is the answer to all maneuvering problems. This may become so automatic
and unconscious that the instrument's air insufflation mechanism is activated throughout the procedure.

Overdistention of the bowel tends to make it difficult to view certain surfaces that are seen tangentially. Suction and air insufflation can actually be used to manipulate the wall of the bowel. By collapsing the bowel, areas that are seen poorly because of a tangential alignment with the instrument tip may be seen more en face.

**Gastroscopy**

Endoscopy of the stomach, esophagus, and duodenum can be performed readily with a small-diameter endoscope via a mature gastrointestinal tract. The procedure has relatively few indications; usually this access to the upper GI tract is used when some form of pathologic obstruction is present in the esophagus or pharynx. The procedure should be performed under direct vision. Conscious sedation is usually not required.

**POSTPROCEDURE RECOVERY**

Some aspects of the patient’s recovery after a procedure are discussed in other chapters (see Chapter 5: The Gastrointestinal Assistant). The length of time required depends on the type and dosage of sedation. Most patients rest or sleep for about 30 min after the intravenous administration of meperidine, diazepam, or both. If a topical anesthetic was applied to the posterior pharynx, the patient should not attempt to drink liquids until the effect of the agent dissipates. Generally, the patient may be discharged after about 1 hr. He or she should be reminded not to drive or operate machinery for the rest of the day.

**REFERENCES**