Review

The use of guidewires in diagnostic and therapeutic endoscopic retrograde cholangiopancreatography (ERCP)

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The success of a specialized examination depends on the choice of the most appropriate guidewire and its appropriate handling. The choice, preparation, use and removal of a guidewire demands that the endoscoping doctor and his assistant have fully understood the specification, the properties, the restrictions, the details regarding handling and accessory compatibility. This is due to the fact that the placement of a guidewire needs coordination between both operators, an optimally organized ERCP room and each operator to have fully understood every detail concerning and specific function of the guidewire. In addition it is also necessary that the operators should be able to clearly communicate and understand each other perfectly well.

ERCP ROOM

In an ideal ERCP room the operators should have easy access to all necessary accessories and guidewires so that minimal time is wasted during the procedure. In the accessory storage area clear labels facilitate the unobstructed course of the procedure in the dark chamber. By restricting the number and the range of accessories we could additionally lessen the time search. For most procedures one or two guidewires suffice, even though special guidewires are maintained for occasional use during uphill situations or for other specific indications.

Supplies such as radiographic contrast, water, sterile saline, gauze squares, syringes of appropriate sizes, caps for unused accessory ports, specimen containers and biopsy and cytology fixative should be close at hand on or near a waist-high work surface. Waste disposal must be within easy reach.

The television monitors for endoscopy and radiology should be side by side and equally visible both to the endoscopist and to his assistant. The monitoring assistant should also have complete access to the area surrounding the head of the patient while the technical assistant to the area adjacent to the endoscopist, to the work surface, and to storage areas. High quality fluoroscopy resolution is necessary for the diagnostic mistakes by artifacts to be surpassed.

GUIDEWIRE CHARACTERISTICS AND SPECIFICATIONS

The choice of a guidewire for general use or for a special application depends on what the guidewires can do and what we ask of them. The natural attributes of guidewires could be restricted when tip length and flexibility, axial and lateral strength of the shaft, surface friction, torque transmission, radiopacity, and electrical conductivity are required. Guidewires cover two main endoscopic needs: access and trackability. For access through the papilla, in a duct across a stricture, in a branch of a duct, in a stent or a cyst, a highly flexible slippery tip is required with or without angulation to allow torquing.

On the other hand, the passing of catheters, stent systems, sphincterotomes, cytology sheaths, dilators balloons, stent extractors or miniscopes demands a stiffer shaft that can be made taut and curvilinear to allow tracking along its axis. A low friction surface on the guidewire allows a smaller axial force in the promotion of a device but could also lessen the capacity of the endoscopist to

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preserve tension without loss of position.

Increased friction could facilitate the preservation of the wire tension at the expense of impending device movement. The presence of friction between guidewire and device also makes it essential to apply opposing forces (push device, pull wire or pull device, push wire) which assist the promotion or withdrawal of the device. Even with low "frictionless" guidewires these principles, even less evident, should be mentioned, so that problems be avoided. If the use of a guidewire for whatever purposes certainly causes problems, a single wire could have many characteristics to satisfy many needs.

A guidewire is made from three components: the shaft inner core the outer coating or sheath and the tip. The original standard wire is a stainless steel coil covering a monofilament core and painted with a thin layer of teflon to reduce surface friction. The tip is made flexible by tapering the inner core which may also be made movable to provide variable tip flexibility.

The entire wire is densely radiopaque. Although inexpensive and possessing considerable axial strength, this wire is characterized by kinkability of the core, surface friction from the coil sheath and poor radiofrequency electrical insulation due, in part, to defects in the Teflon coating. Because it is not suitable for sphincterotomy, it should be pulled back into the spincterotome before cautery is applied, or it should removed completely to avoid the small risk of conducting current to the assistant. Modern sphincterotomes minimize this risk further by carrying a separate guidewire lumen.

The introduction of memory metals such as nitinol from military research revolutionized guidewire technology and spawned the development of unkinkable, strong, flexible guidewires that could be coated in a variety of ways to reduce friction. A surface covering a spectrum from Teflon to proprietary hydrophilic materials that become partly or completely slippery when wet may be condined to part of the tip. Some products attempt compromise by combining slippery flexible tips with stiffer, less slippery shafts for ease of handling, whereas others use an entirely slippery guide to reduce friction at any point of contact, the consequence being slightly more difficulty in handling. Methods are available to use the 260 cm length, with improvement in handling and reduction in cost. Because nitinol may be made to vary there are regular and stiffer shaft versions of many wires.

Tips usually incorporate a radiodense material such as platinum or tungsten (because nitinol is poorly visible on fluoroscopy, and taper to increase flexibility. Some also include a slippery hydrophilic coating. The external surface may have visual markings either to aid in positioning during exchanges and decrease the need for continuous fluoroscopy or allow linear distance measurement for stent length assessment. These are stripes (Zebra and Jaguire) or graduated marking (Tracer, Protector) (Table 1).

Several guidewires are marketed as sphincterotomy compatible (Protector, Tracer, Zebra, Jagwire), but probably all intact coated wires are effectively insulated against transmission of both short ciruits and induced currents. Guidewires are supplied in lengths of 400, 450 or 480 cm to allow exchange of accessories without loss of guidewire handling. For such manouvres, the minimum length of guidewire should be 20cm more than twice that of the accessory being exchanged, to allow for guidewire length beyond the tip of the accessory. In practice, the 450 or 480 cm lengths of coated guidewires are sufficient for all ERCP applications, including the rare use of the enteroscope for patients with surgically altered anatomy. As an alternative, some experts have developed methods for using the 260cm completely hydrophilic guidewire for access, exchange and placement applications, which allows the advantages of a hydrophilic guidewire without the disadvantage of handling a long, slippery surface.

Accessory diameters are usually denoted by outer, rather than inner diameter and their lumen sizes must therefore be remembered, color coded, or read from the label. Perchaps one day, there will be metric standarization. The endoscopist should be fully cognizant of the interactions between diameters of endoscope channels, accessory outer diameters and inner diameters of lumens, and the diameters of guidewires in order to plan and execute a particular sequence of steps during ERCP. Fortunately, manufactures have all chosen 0.035 inches as the standard guidewire diameter for the vast majority of accessories.

APPLICATIONS

During ERCP, guidewires fulfill three main applications: successful catheterization, preserving catheterization and placing devices. The channel of catheters through which guidewire passes should be free from radiographic contrast, and rinsing with saline or water is in order. This helps all coated guidewires to pass through even if they are not hydrophilic, by removing of any stickiness caused by the contact with the contrast. Both the endoscopist and assistant should fully understand the

Table 1. Guidewires available for use in ERCP

Product	Diameter (in)	Lenght (mm)	Inner core	Outer sheath	Tip material	Remarks
Standard wire (WC) (B)	0.018 0.021 0.025 0.028 0.035	400,450,480 400,450,480 400,450,480 400,450,480 400,450,480	Stainless steelq	Stainless steel coil, Teflon painted	Stainless steel tapered core + coil/St+C	Kinkable; some havegraduated marking, some have movable core
Protector Plus Elite Protector Petite Elite (WC)	0.035 0.035 0.021	480	Nitinol	Teflon	Platinum, 0.033", Elite A + St	Graduated markings; sphincterotomy compatible
Tracer, Tracer ST Tracer Hydrid (WC)	0.035	260,480	Nitinol	Teflon	Platinum/St + A ST 60-cm Aqua-coat, 15-cm on Hybrid	Graduated markings, hydrophilic tip sphincterotomy compatible
Axcess 21 (WC)	0.021	480	Nitinol	None	Platinum/St 6cm platinum/St + A	Designed for difficult access conditions
Roadrunner (WC)	0.018	480	Nitinol	None		
Zebra (MV)	0.035	450	Nitinol	Teflon	Platinum, 0.027" tip/St + partial J	Blue + white spiral stripes, stiff shaft available, sphincterotomo my compatible
Jagwire (MV)	0.025 0.035	450 260,450	Nitinol	Teflon + Endoglide coating	Tungsten/St + A 5-cm hydrophilic tapers to 0.027"	Black+yellow spiral stripes, stiff shaft available, sphincterotomy compatible
Glidewire (MV)	0.018 0.025 0.035	450 260,450 260,450	Nitinol	Hydrophilic coat on entire length	Platinum/St + A Hydrophilic	Completely hydrophilic, stiff shaft available
Pathfinder (MV)	0.018	450	Nitinol	Endoglide	Platinum, shapeable, 11 cm hydrophilic	Stiff shaft
Director (B)	0.035	480	Nitinol	Teflon	Hydrophilic/40 cm St + A, 0.027"	1:1 torque
Iguana (B)	0.035	260,450	Nitinol	HydroSil	HydroSil Visible markings 0.027"	Stiff shaft available Sphincterotomy compatible

St: straight; C: curved, A: angled, ST: stiffer tip, WC: Wilson–Cook, MV: Microvasive, B: Bard, ": inches

maneuvers which take place as well as the contact between them to be clear.

Unclear instructions from within and outside might not be easily understood when proffered in relation with terms like ready, insert, push, advance, make a loop, pull back, rotate, keep going, stop, well done and excellent.

The assistant should repeat the instructions to confirm that the appropriate maneuver takes place. This reinforces the good communication, reduces stress and increases the possibilities for success.

We usually see a group working together speaking in a lower voice because each one of them knows how to react to the actions of the other. Thus an easy and fast communication is established between them by noting the speed of hand movements and the feel of the guidewire or accessory in conjunction with movement and positioning of the guidewire and radiopaque markers or parts of the accessory on the monitors.

If during the effort to catheterize the major papilla the catheter or sphincterotome fails, the next step is to use a guidewire even though some experts prefer the precut papillotomy for all potentially therapeutic situations.

In some cases a cholangiogram or, less frequently, a pancreatogram fails, which results in the incapacity to decide about the appropriate treatment. The catheter or sphincterotome is useful as carrier for a straight-tipped 0.035 inch guidewire, preferably hydrophilic, which is handled by the assistant making short probing movements while the endoscopist preserves the catheter tip within the papilla.

The usual handling should be done for shortening the intramural segment of the bile duct raising the angulation in the direction 11 o'clock so that the common bile duct is successfully catheterized, or angulation to 3 o' clock so that the possibility of the guidewire slipping into the desired pancreatic duct is maximized.

If, despite all that, failure continues, it makes sense to make an effort with a 0.025 or 0.018 inch guidewire. A guidewire with angled tip has a small advantage in this case because there are few possibilities that the angle of the guidewire will orient itself appropriately, because the area is usually insuficient to use rotation. For the catheterization of minor papilla a special tapered catheter or sphincterotome with a 0.021 or 0.018 inch guidewire is used.

After achieving pancreatography or cholangiography, deep cannulation of each duct could be weak due to tortuosity of the intrasphincteric segments. Fluoroscopic guidance using the contours and axes of the ducts already filled with contrast, increases the use of the techniques we described.

When cannulation of the common bile duct or the main pancreatic duct is achieved, there are cases where the guidewire should reach a more proximal part of the system for the placement of a catheter, extraction bdlolom, drainage tube, stent or miniscope.

What is required is a straight, very flexible-tipped guidewire, which is intensified with the appropriate position of carrying catheter and endoscope tip. Looping of the advancing guidewire tip may allow directability and deep access or an angled tip with roation/torque can also help access a more proximal duct. A stiffer accessory, such as an extraction balloon is sometimes useful for the right direction, especially if a cateterization of left hepatic duct is required and certainly the inflation of the balloon prevents the insertion of a guidewire in the cystic duct. A frequent application of the guidewires are the catheterization of a duct proximal of a stenosis for the taking of cytologic materkal and, if needed, drainage. And in that case a very flexible-tipped guidewire is required to negotiate the stricture while the stiffer part of the wire remains below the stricture for support. This improves the directability and transmission of axial forces to the tip advancement.

Having a variety of guidewires, one needs to choose a shorter or larger tip length and hydrophilic coating according to the anatomy of the duct, the distance of the stenosis by the papilla, the length of the stenosis and the ductal space proximal to the stricture. Failure to pass through a stenosis is rare with the current guidewires.

It is possible to change the first guidewire with a large-diameter wire with more strength and tractability, if we need more or less surface friction, a longer wire, replacement during the preparation for sphincterotomy or a defective guidewire. After placing a guidewire in the desired ductal location a wide series of devices could pass for diagnostic and therapeutic purposes. These include cytology and other sampling systems, manometry catheters, catheter dilators, balloon dilators, sphincterotomes, plastic and metallic stents, nasobiliary tubes nasopancreatic tubes, cholangioscopes and pancreatoscopes. As with the initial accessory, all lumina should first be flushed with saline or water and then passed over the guidewire.

The more the friction between guidewire and accessory the more the assistant needs to exert a pulling force, which is often refered to as "creating tension" in the guidewire.

It is also interesting for the endoscopist to preserve a juxtapapillary position with the endoscope tip and with the elevator raised to avoid pushing the guidewire further into a duct or creating a loop into the duodenum.

In conclusion, the complexity and the sophistication of several techniques, which are combined with ERCP have advanced at the same time as the guidewire technology. The executives of ERCP should understand all characteristics, capabilities and specifications of the guidewire is which are used in their unit, and so increase the success of the procedure.

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