ISSN 1948-5190 (online)

World Journal of *Gastrointestinal Endoscopy*

World J Gastrointest Endosc 2016 May 10; 8(9): 378-394

Published by Baishideng Publishing Group Inc

WJGE World Journal of Gastrointestinal Endoscopy

A peer-reviewed, online, open-access journal of gastrointestinal endoscopy

Editorial Board

2014-2017

The *World Journal of Gastrointestinal Endoscopy* Editorial Board consists of 330 members, representing a team of worldwide experts in gastrointestinal endoscopy. They are from 40 countries, including Australia (3), Austria (3), Brazil (6), Canada (3), China (62), Croatia (1), Czech Republic (1), Denmark (1), Ecuador (1), Egypt (3), France (1), Germany (8), Greece (10), Hungary (2), India (11), Indonesia (1), Iran (6), Iraq (1), Ireland (2), Israel (1), Italy (37), Japan (43), Lebanon (1), Lithuania (1), Malaysia (1), Mexico (4), Netherlands (1), Norway (2), Poland (4), Portugal (5), Romania (1), Singapore (3), Slovenia (2), South Korea (19), Spain (9), Thailand (2), Turkey (11), United Arab Emirates (1), United Kingdom (14), and United States (43).

Ecuador

Carlos Robles-Medranda, *Guayaquil*

Egypt

Asmaa G Abdou, *Shebein Elkom*
Ahmed AR ElGeidie, *Mansoura*
Mohamed Abdel-Sabour Mekky, *Assiut*

France

Jean Michel Fabre, *Montpellier*

Germany

Jorg G Albert, *Frankfurt*
Hüseyin Kemal Cakmak, *Karlsruhe*
Robert Grützmann, *Dresden*
Thilo Hackert, *Heidelberg*
Arthur Hoffman, *Frankfurt*
Thomas E Langwieler, *Nordhausen*
Andreas Sieg, *Heidelberg*
Jorg Rüdiger Siewert, *Freiburg*

Greece

Sotirios C Botaitis, *Alexandroupolis*
George A Giannopoulos, *Piraeus*
Dimitris K Iakovidis, *Lamia*
Dimitrios Kapetanos, *Thessaloniki*
John A Karagiannis, *Athens*
Gregory Kouraklis, *Athens*
Spiros D Ladas, *Athens*
Theodoros E Pavlidis, *Thessaloniki*
Demitrios Vynios, *Patras*
Elias Xirouchakis, *Athens*

Hungary

László Czakó, *Szeged*
Laszlo Herszenyi, *Budapest*

India

Pradeep S Anand, *Bhopal*
Deepraj S Bhandarkar, *Mumbai*
Hemanga Kumar Bhattacharjee, *New Delhi*
Radha K Dhiman, *Chandigarh*
Mahesh K Goenka, *Kolkata*
Asish K Mukhopadhyay, *Kolkata*
Manickam Ramalingam, *Coimbatore*
Aga Syed Sameer, *Srinagar*
Omar J Shah, *Srinagar*
Shyam S Sharma, *Jaipur*
Jayashree Sood, *New Delhi*

Indonesia

Ari F Syam, *Jakarta*

Iran

Alireza Aminsharifi, *Shiraz*
Homa Davoodi, *Gorgan*
Ahad Eshraghian, *Shiraz*
Ali Reza Maleki, *Gorgan*
Yousef Rasmi, *Urmia*
Farhad Pourfarzi, *Ardabil*

Iraq

Ahmed S Abdulamir, *Baghdad*

Ireland

Ronan A Cahill, *Dublin*
Kevin C Conlon, *Dublin*

Israel

Haggi Mazeh, *Jerusalem*

Italy

Ferdinando Agresta, *Adria (RO)*
Alberto Arezzo, *Torino*
Corrado R Asteria, *Mantua*
Massimiliano Berretta, *Aviano (PN)*
Vittorio Bresadola, *udine*
Lorenzo Camellini, *Reggio Emilia*
Salvatore Maria Antonio Campo, *Rome*
Gabriele Capurso, *Rome*
Luigi Cavanna, *Piacenza*
Francesco Di Costanzo, *Firenze*
Salvatore Cucchiara, *Rome*
Paolo Declich, *Rho*
Massimiliano Fabozzi, *Aosta*
Enrico Fiori, *Rome*
Luciano Fogli, *Bologna*
Francesco Franceschi, *Rome*
Lorenzo Fuccio, *Bologna*
Giuseppe Galloro, *Naples*
Carlo M Girelli, *Busto Arsizio*
Gaetano La Greca, *Catania*
Fabrizio Guarneri, *Messina*
Giovanni Lezoche, *Ancona*
Paolo Limongelli, *Naples*
Marco M Lirici, *Rome*
Valerio Mais, *Cagliari*
Andrea Mingoli, *Rome*
Igor Monsellato, *Milan*
Marco Moschetta, *Bari*
Lucia Pacifico, *Rome*
Giovanni D De Palma, *Naples*
Paolo Del Rio, *Parma*
Pierpaolo Sileri, *Rome*
Cristiano Spada, *Rome*
Stefano Trastulli, *Terni*
Nereo Vettoretto, *Chiari (BS)*
Mario Alessandro Vitale, *Rome*
Nicola Zampieri, *Verona*

Japan

Hiroki Akamatsu, *Osaka*
Shotaro Enomoto, *Wakayama*
Masakatsu Fukuzawa, *Tokyo*
Takahisa Furuta, *Hamamatsu*
Chisato Hamashima, *Tokyo*
Naoki Hotta, *Nagoya*
Hiroshi Kashida, *Osaka-saayama*
Motohiko Kato, *Suita*
Yoshiro Kawahara, *Okayama*
Hiroto Kita, *Tokyo*
Nozomu Kobayashi, *Utsunomiya*
Shigeo Koido, *Chiba*
Koga Komatsu, *Yurihonjo*
Kazuo Konishi, *Tokyo*
Keiichiro Kume, *Kitakyushu*
Katsuhiro Mabe, *Sapporo*
Iruru Maetani, *Tokyo*
Nobuyuki Matsuhashi, *Tokyo*
Kenshi Matsumoto, *Tokyo*
Satohiro Matsumoto, *Saitama*
Hiroto Miwa, *Nishinomiya*
Naoki Muguruma, *Tokushima*
Yuji Naito, *Kyoto*
Noriko Nakajima, *Tokyo*
Katsuhiko Nosho, *Sapporo*
Satoshi Ogiso, *Kyoto*
Keiji Ogura, *Tokyo*
Shiro Oka, *Hiroshima*
Hiroyuki Okada, *Okayama*
Yasushi Sano, *Kobe*
Atsushi Sofuni, *Tokyo*
Hiromichi Sonoda, *Otsu*
Haruhisa Suzuki, *Tokyo*
Gen Tohda, *Fukui*
Yosuke Tsuji, *Tokyo*
Toshio Uraoka, *Tokyo*
Hiroyuki Yamamoto, *Kawasaki*
Shuji Yamamoto, *Shiga*
Kenjiro Yasuda, *Kyoto*
Naohisa Yoshida, *Kyoto*
Shuhei Yoshida, *Chiba*
Hitoshi Yoshiji, *Kashihara*

Lebanon

Eddie K Abdalla, *Beirut*

Lithuania

Laimas Jonaitis, *Kaunas*

Malaysia

Sreenivasan Sasidharan, *Minden*

Mexico

Quintín H Gonzalez-Contreras, *Mexico*
Carmen Maldonado-Bernal, *Mexico*
Jose M Remes-Troche, *Veracruz*
Mario A Riquelme, *Monterrey*

Netherlands

Marco J Bruno, *Rotterdam*

Norway

Airazat M Kazaryan, *Skien*
Thomas de Lange, *Rud*

WJGE World Journal of Gastrointestinal Endoscopy

Contents

Biweekly Volume 8 Number 9 May 10, 2016

World Journal of Gastrointestinal Endoscopy
Volume 8 Number 9 May 10, 2016

Contents

NAME OF JOURNAL
World Journal of Gastrointestinal Endoscopy

ISSN
ISSN 1948-5190 (online)

LAUNCH DATE
October 15, 2009

FREQUENCY
Biweekly

Xiu-Xia Song, Vice Director
World Journal of Gastrointestinal Endoscopy
Room 903, Building D, Ocean International Center,
No. 62 Dongsihuan Zhonglu, Chaoyang District,
Beijing 100025, China
Telephone: +86-10-85381891
Fax: +86-10-85381893
E-mail: editorialoffice@wjgnet.com
Help Desk: http://www.wjgnet.com/esps/helpdesk.aspx
http://www.wjgnet.com

PUBLISHER
Baishideng Publishing Group Inc
8226 Regency Drive,
Pleasanton, CA 94588, USA
Telephone: +1-925-223-8242
Fax: +1-925-223-8243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.wjgnet.com/esps/helpdesk.aspx
http://www.wjgnet.com

PUBLICATION DATE
May 10, 2016

World Journal of Gastrointestinal Endoscopy

Submit a Manuscript: http://www.wjgnet.com/esps/
Help Desk: http://www.wjgnet.com/esps/helpdesk.aspx
DOI: 10.4253/wjge.v8.i9.378

World J Gastrointest Endosc 2016 May 10; 8(9): 378-384
ISSN 1948-5190 (online)

Western view of the management of gastroesophageal foreign bodies

Aurora Burgos, Luis Rábago, Paloma Triana

Aurora Burgos, Division of Gastroenterology, La Paz University Hospital, 28046 Madrid, Spain

Aurora Burgos, Luis Rábago, Division of Gastroenterology, San Rafael Hospital, 28016 Madrid, Spain

Paloma Triana, Division of Pediatric Surgery, La Paz University Hospital, 28046 Madrid, Spain

Author contributions: Burgos A collected the material and wrote the manuscript; Rábago L discussed the topic with the experience of a senior endoscopist and also supervised this report; Triana P discussed the topic and collaborated by adding the pediatric surgical experience.

Conflict-of-interest statement: None to be declared by any of the authors.

Correspondence to: Dr. Aurora Burgos, Division of Gastroenterology, La Paz University Hospital, Paseo de la Castellana 261, 28046 Madrid, Spain. burgos.aurora@gmail.com
Telephone: +34-91-7277158

Received: January 2, 2016
Peer-review started: January 3, 2016
First decision: February 2, 2016
Revised: February 25, 2016
Accepted: March 17, 2016
Article in press: March 18, 2016
Published online: May 10, 2016

Abstract

The best modality for foreign body removal has been the subject of much controversy over the years. We have read with great interest the recent article by Souza Aguiar Municipal Hospital, Rio de Janeiro, Brazil, describing their experience with the management of esophageal foreign bodies in children. Non-endoscopic methods of removing foreign bodies (such as a Foley catheter guided or not by fluoroscopy) have been successfully used at this center. These methods could be an attractive option because of the following advantages: Shorter hospitalization time; easy to perform; no need for anesthesia; avoids esophagoscopy; and lower costs. However, the complications of these procedures can be severe and potentially fatal if not performed correctly, such as bronchoaspiration, perforation, and acute airway obstruction. In addition, it has some disadvantages, such as the inability to directly view the esophagus and the inability to always retrieve foreign bodies. Therefore, in Western countries clinical practice usually recommends endoscopic removal of foreign bodies under direct vision and with airway protection whenever possible.

Key words: Foreign bodies; Children; Foley catheter; Flexible endoscopy

Core tip: The best modality for foreign body removal has been the subject of much controversy over the years. Non-endoscopic methods such as a Foley catheter technique have a lot of advantages, such as their simplicity and cost savings, particularly for proximally located coins. However, their complications can be potentially serious regarding airway obstruction or perforation. This article will discuss the point of view of the European and Western countries, which usually recommend endoscopic removal of foreign bodies under direct vision and with airway protection whenever possible.

Burgos A, Rábago L, Triana P. Western view of the management of gastroesophageal foreign bodies. *World J Gastrointest Endosc* 2016; 8(9): 378-384 Available from: URL: http://www.wjgnet.com/1948-5190/full/v8/i9/378.htm DOI: http://dx.doi.org/10.4253/wjge.v8.i9.378

COMMENTARY ON HOT TOPICS

We have read with great interest the recent article by Souza Aguiar Municipal Hospital, describing their management of esophageal foreign bodies in children. This is a relevant experience and we understand the authors' point of view regarding the benefits gained from using non-endoscopic methods for the removal of foreign bodies due to their simplicity and cost savings. However, we would like to point out that the management strategy is different in most of the medical hospitals in Western countries. Generally, it is recommended that endoscopic removal of foreign bodies is carried out under direct vision; in addition, among the child population it is also recommended to protect the airway with an endotracheal tube during foreign body removal. In our opinion, this should be considered as a more effective and safer practice in children.

The aim of this article is to describe a comprehensive approach towards children presenting with foreign body ingestion, and to discuss the difference between endoscopic methods and non-endoscopic methods of removing foreign bodies.

INTRODUCTION

The ingestion of foreign bodies is a frequent complaint in Pediatric Emergency services[1]. Fortunately, only 10%-20% will require removal[2] because most of them (80%) spontaneously advance distally. The primary location of lodged esophageal foreign bodies is the proximal esophagus and coins are the most prevalent foreign bodies. Other esophageal locations include: The aortic arch and the lower esophageal sphincter[1,3]. Only 1% of cases will require a surgical removal[4].

INITIAL EVALUATION/DIAGNOSIS

If the foreign body ingestion is suspected (ingestion witnessed by a caretaker, or the child has respiratory or digestive symptoms), we firstly recommend to perform simple chest and abdomen X-ray studies in all children. These X-ray studies sometimes allow us to detect the object (although not all foreign bodies are radiopaque), or complications (such as air in the mediastinum and subcutaneous emphysema, indicating esophageal perforation)[5]. Also, it allows to distinguish between different types of foreign bodies (for instance button batteries can be distinguished from coins because of a double contour from a lateral view)[6]. Although radiographic contrast could be used for foreign bodies which are not radiopaque, it generally should be avoided due to aspiration risk[5]. Computed tomography scan may be performed in selected cases if a complication is suspected. If perforation, peritonitis or small-bowel obstruction are confirmed, endoscopy is contraindicated and, in most cases, surgery is required[5].

TREATMENT

The type of object, its location, the child's symptoms, the skills of the physician, and the usual institutional practice in relation to their available means will dictate the treatment of gastrointestinal foreign bodies.

NON-ENDOSCOPIC TREATMENT

Many non-endoscopic techniques have been described in the article by Souza Aguiar Municipal Hospital, including Foley catheter balloons.

In experienced hands, particularly for proximally located coins, a Foley catheter under fluoroscopic guidance can be inserted into the esophagus to a depth distal to the site of the impacted object. Then, the balloon is inflated symmetrically and traction is applied until the foreign body is removed. Before the catheter is withdrawn, the child is placed in a prone oblique position with mild cervical extension[6].

Advantages of the Foley catheter method are: Efficacy (83%-90%), quick treatment (20 min), no need for anesthesia, available to be performed on an outpatient basis, and cost-effective with a reported savings of $5027.31 per patient[2,7].

Complications after Foley balloon extraction are rare and generally minor[8-10] but some of them could be potentially serious because the procedure is performed blindly and depends on the physician's skill. Schunk *et al*[9] reported a rate of 2% minor and 1% major complications. Minor complications included vomiting and nasal bleeding; major complications are transient airway compromise, mucosal erosion, esophageal mucosal laceration that required extensive surgical repair, respiratory distress and hypoxia[11]. To date, only one case has reportedly led to death, caused by broncoaspiration of a coin during the Foley catheter removal[12].

Careful patient selectionis critical in preventing complications. The use of Foley balloon extraction is contraindicated in the following situations[7,13]: (1) impactions of more than 72 h (or more than 24 h in some centers); (2) three unsuccessful removal attempts; (3) complete obstruction of the esophagus; (4) esophageal perforation; (5) multiple foreign body impaction; (6) signs of airway distress or obstruction; (7) children younger than 1.5 years; (8) sharp-edged foreign bodies; and (9) button batteries that have been impacted for more than 2 h. From our point of view, button batteries should always be removed endoscopically as early as possible because of the likelihood of tissue liquefaction-necrosis and perforation.

Foley catheter extraction could only be an acceptable alternative in the first two hours post-impaction if endoscopy is not available[13].

Esophageal bougienage has also been used successfully in different centers[14]. An esophageal dilator is easily and quickly passed down through the esophagus to the estimated depth of the foreign body in order to push it into the stomach. This technique is efficient (success rate of 94%-95% *vs* 100% endoscopic success rate)[14-16], can be performed quickly without anesthesia in the emergency department, and is available to perform on an outpatient basis. It has been considered to be the most cost-effective strategy in an analysis comparison of 4 management strategies for coins (endoscopy, esophageal bougienage, an outpatient observation period or an inpatient observation period)[17]. Arms *et al*[15] found a payment difference of $4200 between non-endoscopic and endoscopic techniques.

However, the esophageal bougienage method has some significant additional disadvantages[14]. On one hand, bougienage does not retrieve the foreign body and it may be contraindicated in children with potential intestinal inflammatory or fibrotic conditions, such as Crohn's disease or a personal history of duodenal or small bowel surgery with intestinal anastomosis due to the risk of gastric or intestinal obstruction requiring further invasive procedures[16]. On the other hand, it is imperative to discard the presence of multiple coins, a battery or a foreign body with a complex configuration because the identification of these foreign bodies requires urgent endoscopic removal[16]. It is unclear whether children under one year of age should be excluded from bougienage, but it may advisable, particularly since most ingestions by infants are also not witnessed. An additional disadvantage is that a second radiography is always needed to determine coin passage into the stomach or the small bowel[16]. Other disadvantages and contraindications are the same as previously pointed out concerning the use of a Foley balloon (see above): No airway protection, lack of direct visualization of the esophagus, patient discomfort and exposure to radiation.

Minor complications of esophageal bougienage are vomiting, discomfort and gagging. To date, there have been no reports of major complications associated with selected bougienage of esophageal coins in children[16] but it is still an uncommon management technique.

A third non-endoscopic uncommon procedure is the penny-pincher technique: A grasping endoscopic forceps is inserted though a soft rubber catheter and is then inserted like an orogastric tube under fluoroscopy. After the forceps reaches the object, the object is grasped and removed. The technique does not require sedation or placement of an advanced airway device[18].

So, in summary, there is still a great grade of controversy regarding non-endoscopic methods, mainly regarding patient safety. Although the complications of these procedures are reported as "low" as shown by the Souza Aguiar Municipal Hospital study, they can be severe and potentially fatal (*e.g.*, airway obstruction, perforation)[9,10], so their performance should be limited to physicians experienced in the procedures and in airway management, with suction apparatus, and oxygen supply readily available[7,15,19]. Therefore, in our opinion, endoscopic approaches are recommended in most cases[1,3,5,6,20,21] when adequate resources are available.

ENDOSCOPIC TREATMENT

Both, rigid endoscopy and flexible endoscopy procedures are safe and effective for food impaction and foreign bodies[22], allowing excellent visualization and biopsy of the esophagus if required.

Flexible endoscopy is considered as the "first line" approach with a success rate of between 80%-100% and a less than 1% risk of perforation[16,22-24]. Rigid endoscopy is considered as a "second line" when flexible endoscopy is not effective (6.6%) and possibly for those foreign bodies located in the upper esophagus[23]. This technique allows having a wider lumen that is a great help for the removal of foreign bodies[12]. Rigid endoscopy success rate is 87%-98% and perforation rate is 3%.

Compared with the standard practice of endoscopy in adults, it is generally recommended in children that foreign-body removal should be performed under general anesthesia with endotracheal intubation to protect the airway from aspiration[1,20,21,23,25].

Most flexible endoscopy complications are considered minor[26]. Regarding anesthesia, minor complications are described in 1.5% of patients[27] and the most frequent are bronchospasm, delayed extubation and fever[26]. Regarding endoscopy, complications are reported in 2%-3% of patients and decrease with age[28], the most common being hypoxia (1.5%) and bleeding (0.3%). Also, it has been published that a long duration between the ingestion until the endoscopy is performed, and the finding of initial mucosal injury are well-known risk factors related with complications after endoscopic foreign body removal[29].

There are few contraindications to perform an endoscopic procedure in children such as unstable airways, cardiovascular collapse, gastrointestinal perforation or peritonitis. The children's weight is rarely a contraindication, and upper endoscopic examination can be safely performed in neonates as small as 1.5 to 2 kg[21,30]. Relative contraindications include coagulopathy, thrombocytopenia, recent abdominal surgery, unstable cardiopulmonary disease, and recent oral intake[21,26].

Endoscopic treatment has a lot of advantages. As already mentioned, the greatest advantage is the capability of direct evaluation of esophageal mucosa because esophageal abnormalities in children range between 6% and 13% in different foreign bodies studies[22,23]. Endoscopic examination allows biopsy if required (*e.g.*, eosinophilic esophagitis), and also allows more complex techniques such as stricture-dilation, as

Table 1 Classifications of foreign bodies

Objects shape
Short-blunt: Coins, rings
Long: Utensils for eating, string, cord, toothbrush
Sharp-pointed: Nails, pins, tacks, toothpicks, chicken, fish bones
Objects including poisons
Button cell and disk batteries
Cylindrical batteries (these batteries do not typically discharge electrical current the way button batteries do)
Narcotic packets
Objects inducing esophageal or gastrointestinal obstruction
Magnets
Food bolus impaction
Superabsorbent polymers

Table 2 Timing of endoscopy for ingested foreign bodies

Emergent endoscopy
Esophageal obstruction (patient unable to manage secretions)
Sharp-pointed objects in the esophagus (or in the stomach/small bowel if symptomatic)
Disk or button cell batteries in the esophagus (or in the stomach/small bowel if symptomatic)
Magnets in the esophagus (or in the stomach/small bowel if symptomatic)
Urgent endoscopy
Esophageal foreign objects that are not sharp-pointed
Esophageal food impaction in patients without complete obstruction
Sharp-pointed objects in the stomach or duodenum (if asymptomatic)
Objects > 6 cm in length at or above the proximal duodenum in adults
Disk and button cell batteries in the stomach (if age < 5 and button battery > 20 mm)
Magnets within endoscopic reach (if asymptomatic)
Absorptive object
Nonurgent (elective) endoscopy
Objects in the stomach with diameter 2.5 cm in adults
Objects > 2 cm and longer than 5 cm in older children
Objects longer than 3 cm in infants and young children
Coins in the esophagus may be observed for 12-24 h before endoscopic removal in an asymptomatic patient
Disk and button cell batteries and cylindrical batteries that are in the stomach of patients without signs of gastrointestinal injury may be observed for as long as 48 h. Batteries remaining in the stomach longer than 48 h should be removed

Modified from American Society of Gastrointestinal Endoscopy and NASPGHAN Endoscopy Committee.

well as the possibility to perform a push enteroscopy in selected cases. It can be used not only for proximally located coins, but also for different types and multiple objects in any location (upper, medium or lower esophagus and also stomach or duodenum), as will be described later.

In addition, various retrieval devices can be used to remove the object (polypectomy snares, rat-tooth and alligator forceps, Dormier baskets, magnetic probes polyp graspers, retrieval nets, and friction-fit adaptors or banding caps)[6]. The most appropriate device according to the characteristics of the foreign body should be chosen. However, the type of the device can be changed depending on the success with the previous one.

We agree with the authors regarding Magill forceps. Magill forceps are angled forceps commonly used in anesthesia. They can remove some objects located in the oropharynx or upper esophagus, with the help of a laryngoscope or rigid esophagoscopy under general anesthesia[31,32]. A 96% success rate is described with this method[33].

An overtube may be used to provide airway protection in adults. In children its use has not been generally recommended due to its diameter, except in selected cases[34]. A protector hood or a transparent distal cap[6,20] can also help to avoid mucosal injury during endoscopic removal procedure of sharp objects.

ENDOSCOPIC TREATMENT: SPECIAL SITUATIONS

The risk and the timing of the endoscopic intervention depend on: The shape, size and content of the foreign body, anatomic location, and the time since their ingestion. Classifications of foreign bodies and timing of the endoscopic intervention are described in Tables 1 and 2. In the case of esophageal obstruction, button cell batteries, magnets or sharp-pointed objects in the esophagus, emergent removal is always required.

Regarding object shape, short-blunt objects (coins) are the most prevalent foreign bodies in children. If the patient is asymptomatic, coins placed especially in the distal esophagus can be observed for 12 to 24 h (Figure 1). Endoscopy is indicated if the coins remain in the esophagus or if the patient is symptomatic. Endoscopic devices that are most frequently used in this situation are snare, rat-tooth or alligator forceps or retrieval nets[6].

Long objects can be removed with a snare or basket and, in selected cases in the adult population, with the help of an overtube.

Sharp-pointed objects have risk of perforation (35%) and they must always be removed (Figure 2). We can use forceps, snares or retrieval nets. If the object cannot be reached endoscopically due to deep migration, daily radiographs should be obtained[6,20].

Regarding object location, 20% of foreign bodies lodged in the esophagus may harbor risk of aspiration and perforation, so we recommend endoscopic removal in the first 24 h of ingestion. The size will be determinant for its removal if the foreign body has already passed to the stomach (60%). In older children, objects wider than 2 cm and longer than 4-6 cm should be removed[5,35-37]. In infants and young children, the limit could be 3 cm[3]. If the object has passed the duodenum, conservative treatment is recommended (Table 2).

In relation with the type of foreign body, button cell and disk batteries are very dangerous because of the likelihood of liquefaction necrosis of the tissues and perforation. Therefore, endoscopic emergent removal is always recommended and it can be completed with a rat tooth grasper, a retrieval basket or a net[20]. In this

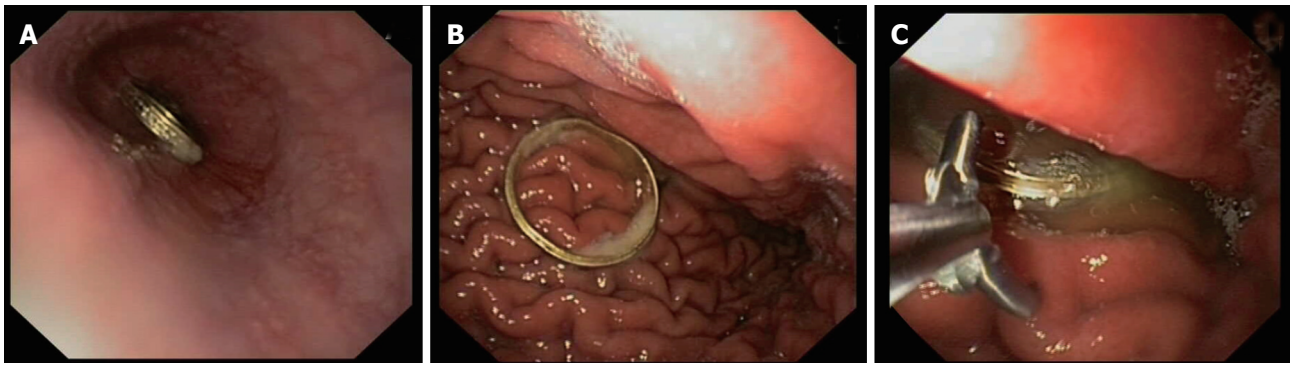

Figure 1 Short-blunt objects: A ring. The ring in the esophagus was observed for 24 h before endoscopic removal. A: Esophagus; B: Stomach; C: Rat-tooth forceps.

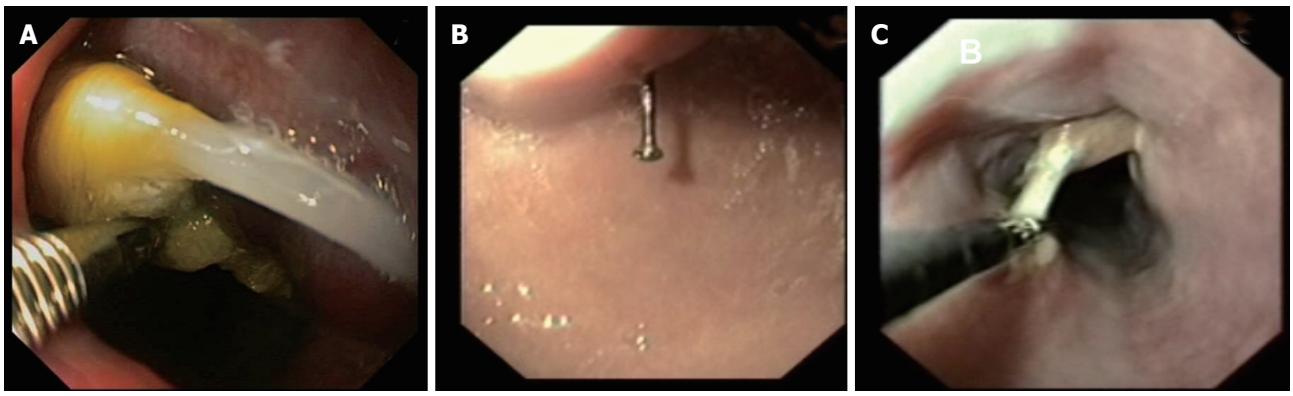

Figure 2 Sharp-pointed objects. A: Fish bone; B: Nail; C: Chicken bone. Removal with alligator forceps.

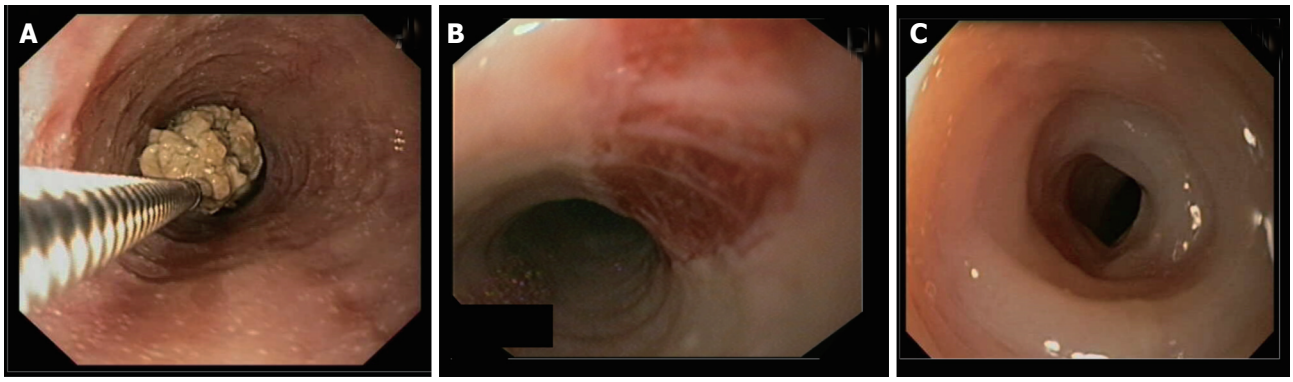

Figure 3 Food bolus impaction in patient with eosinophilic esophagitis. A: Removal with a snare; B: Esophageal rings, linear furrows and mucosal fragility; C: Stricture.

situation, we can also use a through-the-scope (TTS) balloon (Fogarty balloon or Controlled Radial Expansion balloon) to remove the foreign body. This is a similar practice as the authors recommend with the Foley catheter in the article, but with the additional help and safety provided by both, the endoscope and the balloon together, with the importance of adding the airway protection[6]. Cylindrical batteries lodged in the stomach of an asymptomatic patient may be observed for 48 h; however, batteries that do not pass spontaneously, batteries in a symptomatic patient or multiple gastric cylindrical batteries should be removed[6,35].

Magnets should also always be removed, even if only one magnet is evident[6]. If the child ingests two magnets or a magnet and a metal object, these two objects can trap a portion of bowel wall causing necrosis, fistula or perforation.

Food bolus impaction in children can often mean an underlying esophageal pathology (*e.g.*, eosinophilic esophagitis)[38]. Sometimes intravenous Glucagon is firstly used but its results are equivocal[39]. Bolus can be "extracted" or "pushed" into the stomach with a snare or retrieval net (Figure 3).

Other completely different types of foreign bodies

are narcotic packets: Unfortunately, children can transport these substances into their stomach like "body packing". In this case, endoscopic removal is contraindicated in order to avoid the rupture of the contents[6,20].

Finally, superabsorbent polymers in some feminine hygiene products (tampons) and children's toys can absorb and retain large amounts of water causing intestinal obstruction if they are ingested[40]. In the case of ingestion of superabsorbent objects, emergent or urgent endoscopy should be recommended with a retrieval net or basket for round objects and a polyp snare for larger and irregular shaped objects.

CONCLUSION

The best modality for foreign body removal has been the subject of much controversy over the years. Non-endoscopic methods such as a Foley catheter or an esophageal bougienage have many advantages, such as their simplicity and cost savings, particularly for proximally located coins. However, their complications can be potentially serious regarding airway obstruction or perforation. Only experienced hands should perform both techniques and they should be avoided if there has been previous esophageal surgery or the object has been impacted for more than 24 h. Endoscopic procedures allow direct examination of the esophagus and more complex techniques with airway control; in addition, they can be used not only for proximally coins, but also for different types and multiple objects in any location (esophagus, stomach or duodenum). Therefore, in Western countries clinical practice usually recommends endoscopic removal of foreign bodies under direct vision and with airway protection whenever possible.

REFERENCES

1 **Rahman I**, Patel P, Boger P, Rasheed S, Thomson M, Afzal NA. Therapeutic upper gastrointestinal tract endoscopy in Paediatric Gastroenterology. *World J Gastrointest Endosc* 2015; **7**: 169-182 [PMID: 25789087 DOI: 10.4253/wjge.v7.i3.169]

2 **Little DC**, Shah SR, St Peter SD, Calkins CM, Morrow SE, Murphy JP, Sharp RJ, Andrews WS, Holcomb GW, Ostlie DJ, Snyder CL. Esophageal foreign bodies in the pediatric population: our first 500 cases. *J Pediatr Surg* 2006; **41**: 914-918 [PMID: 16677882 DOI: 10.1016/j.jpedsurg.2006.01.022]

3 **Spanish Society of Pediatric Gastroenterology**, **Hepatology and Nutrition**. Spanish Association of Pediatrics (SEGHNP-AEP). Ingestion of foreign bodies. Diagnostic-therapeutic protocols of Gastroenterology, Hepatology and Pediatric Nutrition. 2nd ed. Spain: Editorial Ergón, 2010: 131-134

4 **Kay M**, Wyllie R. Pediatric foreign bodies and their management. *Curr Gastroenterol Rep* 2005; **7**: 212-218 [PMID: 15913481]

5 **Ikenberry SO**, Jue TL, Anderson MA, Appalaneni V, Banerjee S, Ben-Menachem T, Decker GA, Fanelli RD, Fisher LR, Fukami N, Harrison ME, Jain R, Khan KM, Krinsky ML, Maple JT, Sharaf R, Strohmeyer L, Dominitz JA. Management of ingested foreign bodies and food impactions. *Gastrointest Endosc* 2011; **73**: 1085-1091 [PMID: 21628009 DOI: 10.1016/j.gie.2010.11.010]

6 **Louie MC**, Bradin S. Foreign body ingestion and aspiration. *Pediatr Rev* 2009; **30**: 295-301, quiz 301 [PMID: 19648260 DOI: 10.1542/pir.30-8-295]

7 **Abdurehim Y**, Yasin Y, Yaming Q, Hua Z. Value and efficacy of foley catheter removal of blunt pediatric esophageal foreign bodies. *ISRN Otolaryngol* 2014; **2014**: 679378 [PMID: 24634788 DOI: 10.1155/2014/679378]

8 **Campbell JB**, Condon VR. Catheter removal of blunt esophageal foreign bodies in children. Survey of the Society for Pediatric Radiology. *Pediatr Radiol* 1989; **19**: 361-365 [PMID: 2771474]

9 **Schunk JE**, Harrison AM, Corneli HM, Nixon GW. Fluoroscopic foley catheter removal of esophageal foreign bodies in children: experience with 415 episodes. *Pediatrics* 1994; **94**: 709-714 [PMID: 7936900]

10 **Wang J**, Wang P. Clinical analysis on 138 cases of removing esophageal foreign bodies in children by utilizing foley catheter. *CJEBM* 2010; **10**: 1118-1119

11 **McGuirt WF**. Use of Foley catheter for removal of esophageal foreign bodies. A survey. *Ann Otol Rhinol Laryngol* 1982; **91**: 599-601 [PMID: 7149541]

12 **Hawkins DB**. Removal of blunt foreign bodies from the esophagus. *Ann Otol Rhinol Laryngol* 1990; **99**: 935-940 [PMID: 2244725 DOI: 10.1177/000348949009901201]

13 **Gasior AC**, Knott EM, Sharp SW, Snyder CL, St Peter SD. Predictive factors for successful balloon catheter extraction of esophageal foreign bodies. *Pediatr Surg Int* 2013; **29**: 791-794 [PMID: 23793986 DOI: 10.1007/s00383-013-3331-7]

14 **Allie EH**, Blackshaw AM, Losek JD, Tuuri RE. Clinical effectiveness of bougienage for esophageal coins in a pediatric ED. *Am J Emerg Med* 2014; **32**: 1263-1269 [PMID: 25178851 DOI: 10.1016/j.ajem.2014.08.007]

15 **Arms JL**, Mackenberg-Mohn MD, Bowen MV, Chamberlain MC, Skrypek TM, Madhok M, Jimenez-Vega JM, Bonadio WA. Safety and efficacy of a protocol using bougienage or endoscopy for the management of coins acutely lodged in the esophagus: a large case series. *Ann Emerg Med* 2008; **51**: 367-372 [PMID: 17933426 DOI: 10.1016/j.annemergmed.2007.09.001]

16 **Heinzerling NP**, Christensen MA, Swedler R, Cassidy LD, Calkins CM, Sato TT. Safe and effective management of esophageal coins in children with bougienage. *Surgery* 2015; **158**: 1065-1070; discussion 1071-1072 [PMID: 26239181 DOI: 10.1016/j.surg.2015.06.025]

17 **Soprano JV**, Mandl KD. Four strategies for the management of esophageal coins in children. *Pediatrics* 2000; **105**: e5 [PMID: 10617742 DOI: 10.1542/peds.105.1.e5]

18 **Gauderer MW**, DeCou JM, Abrams RS, Thomason MA. The 'penny pincher': a new technique for fast and safe removal of esophageal coins. *J Pediatr Surg* 2000; **35**: 276-278 [PMID: 10693680]

19 **Dahshan AH**, Kevin Donovan G. Bougienage versus endoscopy for esophageal coin removal in children. *J Clin Gastroenterol* 2007; **41**: 454-456 [PMID: 17450025 DOI: 10.1097/01.mcg.0000225]

20 **Kramer RE**, Lerner DG, Lin T, Manfredi M, Shah M, Stephen TC, Gibbons TE, Pall H, Sahn B, McOmber M, Zacur G, Friedlander J, Quiros AJ, Fishman DS, Mamula P. Management of ingested foreign bodies in children: a clinical report of the NASPGHAN Endoscopy Committee. *J Pediatr Gastroenterol Nutr* 2015; **60**: 562-574 [PMID: 25611037 DOI: 10.1097/MPG.0000000000000729]

21 **Lightdale JR**, Acosta R, Shergill AK, Chandrasekhara V, Chathadi K, Early D, Evans JA, Fanelli RD, Fisher DA, Fonkalsrud L, Hwang JH, Kashab M, Muthusamy VR, Pasha S, Saltzman JR, Cash BD. Modifications in endoscopic practice for pediatric patients. *Gastrointest Endosc* 2014; **79**: 699-710 [PMID: 24593951 DOI: 10.1016/j.gie.2013.08.014]

22 **Russell R**, Lucas A, Johnson J, Yannam G, Griffin R, Beierle E, Anderson S, Chen M, Harmon C. Extraction of esophageal foreign bodies in children: rigid versus flexible endoscopy. *Pediatr Surg Int* 2014; **30**: 417-422 [PMID: 24549805 DOI: 10.1007/s00383-014-3481-2]

23 **Gmeiner D**, von Rahden BH, Meco C, Hutter J, Oberascher G, Stein HJ. Flexible versus rigid endoscopy for treatment of foreign body impaction in the esophagus. *Surg Endosc* 2007; **21**: 2026-2029 [PMID: 17393244 DOI: 10.1007/s00464-007-9252-6]

24 **Popel J**, El-Hakim H, El-Matary W. Esophageal foreign body extraction in children: flexible versus rigid endoscopy. *Surg Endosc* 2011; **25**: 919-922 [PMID: 20734073 DOI: 10.1007/s00464-010-1299-0]

25 **Katsinelos P**, Kountouras J, Paroutoglou G, Zavos C, Mimidis K, Chatzimavroudis G. Endoscopic techniques and management of foreign body ingestion and food bolus impaction in the upper gastrointestinal tract: a retrospective analysis of 139 cases. *J Clin Gastroenterol* 2006; **40**: 784-789 [PMID: 17016132 DOI: 10.1097/01.mcg.0000225602.25858.2c]

26 **Temiz A**. Efficiency of upper gastrointestinal endoscopy in pediatric surgical practice. *World J Clin Pediatr* 2015; **4**: 113-119 [PMID: 26566483 DOI: 10.5409/wjcp.v4.i4.113]

27 **Lee WS**, Zainuddin H, Boey CC, Chai PF. Appropriateness, endoscopic findings and contributive yield of pediatric gastrointestinal endoscopy. *World J Gastroenterol* 2013; **19**: 9077-9083 [PMID: 24379634 DOI: 10.3748/wjg.v19.i47.9077]

28 **Thakkar K**, El-Serag HB, Mattek N, Gilger MA. Complications of pediatric EGD: a 4-year experience in PEDS-CORI. *Gastrointest Endosc* 2007; **65**: 213-221 [PMID: 17258979 DOI: 10.1016/j.gie.2006.03.015]

29 **Park YK**, Kim KO, Yang JH, Lee SH, Jang BI. Factors associated with development of complications after endoscopic foreign body removal. *Saudi J Gastroenterol* 2013; **19**: 230-234 [PMID: 24045597 DOI: 10.4103/1319-3767.118136]

30 **Volonaki E**, Sebire NJ, Borrelli O, Lindley KJ, Elawad M, Thapar N, Shah N. Gastrointestinal endoscopy and mucosal biopsy in the first year of life: indications and outcome. *J Pediatr Gastroenterol Nutr* 2012; **55**: 62-65 [PMID: 22210413 DOI: 10.1097/MPG.0b013e3182478f83]

31 **Crysdale WS**, Sendi KS, Yoo J. Esophageal foreign bodies in children. 15-year review of 484 cases. *Ann Otol Rhinol Laryngol* 1991; **100**: 320-324 [PMID: 2018291 DOI: 10.1177/000348949110000410]

32 **Kessler E**, Chappell JS. Upper gastro-intestinal endoscopy in chidren. *S Afr Med J* 1979; **56**: 591-593 [PMID: 550408]

33 **Cetinkursun S**, Sayan A, Demirbag S, Surer I, Ozdemir T, Arikan A. Safe removal of upper esophageal coins by using Magill forceps: two centers' experience. *Clin Pediatr* (Phila) 2006; **45**: 71-73 [PMID: 16429219 DOI: 10.1177/000992280604500111]

34 **Barth BA**, Banerjee S, Bhat YM, Desilets DJ, Gottlieb KT, Maple JT, Pfau PR, Pleskow DK, Siddiqui UD, Tokar JL, Wang A, Song LM, Rodriguez SA. Equipment for pediatric endoscopy. *Gastrointest Endosc* 2012; **76**: 8-17 [PMID: 22579260 DOI: 10.1016/j.gie.2012.02.023]

35 **Sahn B**, Mamula P, Ford CA. Review of foreign body ingestion and esophageal food impaction management in adolescents. *J Adolesc Health* 2014; **55**: 260-266 [PMID: 24686070 DOI: 10.1016/j.jadohealth.2014.01.022]

36 **Smith MT**, Wong RK. Foreign bodies. *Gastrointest Endosc Clin N Am* 2007; **17**: 361-382, vii [PMID: 17556153]

37 **Paul RI**, Jaffe DM. Sharp object ingestions in children: illustrative cases and literature review. *Pediatr Emerg Care* 1988; **4**: 245-248 [PMID: 3068636]

38 **Lao J**, Bostwick HE, Berezin S, Halata MS, Newman LJ, Medow MS. Esophageal food impaction in children. *Pediatr Emerg Care* 2003; **19**: 402-407 [PMID: 14676489 DOI: 10.1097/01.pec.0000101581.65509.17]

39 **Weant KA**, Weant MP. Safety and efficacy of glucagon for the relief of acute esophageal food impaction. *Am J Health Syst Pharm* 2012; **69**: 573-577 [PMID: 22441787 DOI: 10.2146/ajhp100587]

40 **Mirza B**, Sheikh A. Mortality in a case of crystal gel ball ingestion: an alert for parents. *APSP J Case Rep* 2012; **3**: 6 [PMID: 22953300]

P- Reviewer: Chen JQ, Lee CL, Mentes O, Xiao Q
S- Editor: Ji FF **L- Editor**: A **E- Editor**: Wu HL

World Journal of Gastrointestinal Endoscopy

Submit a Manuscript: http://www.wjgnet.com/esps/
Help Desk: http://www.wjgnet.com/esps/helpdesk.aspx
DOI: 10.4253/wjge.v8.i9.385

World J Gastrointest Endosc 2016 May 10; 8(9): 385-390
ISSN 1948-5190 (online)

ORIGINAL ARTICLE

Retrospective Cohort Study

Lower incidence of complications in endoscopic nasobiliary drainage for hilar cholangiocarcinoma

Kazumichi Kawakubo, Hiroshi Kawakami, Masaki Kuwatani, Shin Haba, Taiki Kudo, Yoko A Taya, Shuhei Kawahata, Yoshimasa Kubota, Kimitoshi Kubo, Kazunori Eto, Nobuyuki Ehira, Hiroaki Yamato, Manabu Onodera, Naoya Sakamoto

Kazumichi Kawakubo, Hiroshi Kawakami, Masaki Kuwatani, Shin Haba, Taiki Kudo, Yoko A Taya, Shuhei Kawahata, Yoshimasa Kubota, Kimitoshi Kubo, Kazunori Eto, Nobuyuki Ehira, Hiroaki Yamato, Manabu Onodera, Naoya Sakamoto, Department of Gastroenterology and Hepatology, Hokkaido University Graduate School of Medicine, Sapporo 0608638, Japan

Correspondence to: Kazumichi Kawakubo, MD, PhD, Assistant Professor, Department of Gastroenterology and Hepatology, Hokkaido University Graduate School of Medicine, Kita 15 Nishi 7, Kita-ku, Sapporo 0608638, Japan. kkawakubo-gi@umin.ac.jp
Telephone: +81-11-7161161
Fax: +81-11-7067867

Author contributions: Kawakubo K designed and performed the study and wrote the paper; Kawakami H and Kuwatani M designed the study and supervised the writing of the report; Haba S, Kudo T, Taya YA, Kawahata S, Kubota Y, Kubo K, Eto K, Ehira N, Yamato H and Onodera M collected and analyzed the data; and Sakamoto N approved the final version of the manuscript.

Institutional review board statement: This study was reviewed and approved by the Institutional Review Board of Hokkaido University Hospital.

Informed consent statement: Patients were not required to give informed consent to participate in the study because the analysis used anonymous clinical data that were obtained after each patient agreed to treatment by written consent. For full disclosure, the details of the study are published on the home page of Hokkaido University Hospital.

Conflict-of-interest statement: The authors have no financial relationships to disclose.

Data sharing statement: No additional data are available.

Received: December 21, 2015
Peer-review started: December 22, 2015
First decision: January 30, 2016
Revised: February 15, 2016
Accepted: March 14, 2016
Article in press: March 16, 2016
Published online: May 10, 2016

Abstract

AIM: To identify the most effective endoscopic biliary drainage technique for patients with hilar cholangiocarcinoma.

METHODS: In total, 118 patients with hilar cholangiocarcinoma underwent endoscopic management [endoscopic nasobiliary drainage (ENBD) or endoscopic biliary stenting] as a temporary drainage in our institution between 2009 and 2014. We retrospectively evaluated all complications from initial endoscopic drainage to surgery or palliative treatment. The risk factors for biliary reintervention, post-endoscopic retrograde cholangiopancreatography (post-ERCP) pancreatitis, and percutaneous transhepatic biliary drainage (PTBD) were also analyzed using patient- and procedure-related characteristics. The risk factors for bilateral drainage were examined in a subgroup analysis of patients who underwent initial unilateral drainage.

RESULTS: In total, 137 complications were observed in 92 (78%) patients. Biliary reintervention was required in 83 (70%) patients. ENBD was significantly associated with a low risk of biliary reintervention [odds ratio (OR) = 0.26, 95%CI: 0.08-0.76, *P* = 0.012]. Post-ERCP pancreatitis was observed in 19 (16%) patients. An absence of endoscopic sphincterotomy was significantly associated with post-ERCP pancreatitis (OR = 3.46, 95%CI: 1.19-10.87, *P* = 0.023). PTBD was required in 16 (14%) patients, and Bismuth type III or IV cholangiocarcinoma was a significant risk factor (OR = 7.88, 95%CI: 1.33-155.0, *P* = 0.010). Of 102 patients with initial unilateral drainage, 49 (48%) required bilateral drainage. Endoscopic sphincterotomy (OR = 3.24, 95%CI: 1.27-8.78, *P* = 0.004) and Bismuth II, III, or IV cholangiocarcinoma (OR = 34.69, 95%CI: 4.88-736.7, *P* < 0.001) were significant risk factors for bilateral drainage.

CONCLUSION: The endoscopic management of hilar cholangiocarcinoma is challenging. ENBD should be selected as a temporary drainage method because of its low risk of complications.

Key words: Hilar cholangiocarcinoma; Endoscopic nasobiliary drainage; Endoscopic biliary stenting; Endoscopic sphincterotomy; Complications

Core tip: This retrospective study evaluated the risk of complications associated with a temporary endoscopic biliary drainage for hilar cholangiocarcinoma. Endoscopic nasobiliary drainage (ENBD) had a significantly lower incidence of biliary complications than biliary stenting. Endoscopic sphincterotomy significantly reduced the rate of post-endoscopic retrograde cholangiopancreatography pancreatitis, but was associated with bilateral drainage. Therefore, ENBD should be selected as a temporary biliary drainage method for patients with hilar cholangiocarcinoma.

Kawakubo K, Kawakami H, Kuwatani M, Haba S, Kudo T, Taya YA, Kawahata S, Kubota Y, Kubo K, Eto K, Ehira N, Yamato H, Onodera M, Sakamoto N. Lower incidence of complications in endoscopic nasobiliary drainage for hilar cholangiocarcinoma. *World J Gastrointest Endosc* 2016; 8(9): 385-390 Available from: URL: http://www.wjgnet.com/1948-5190/full/v8/i9/385.htm DOI: http://dx.doi.org/10.4253/wjge.v8.i9.385

INTRODUCTION

Surgery is the only curative treatment for patients with hilar cholangiocarcinoma, and the routine use of preoperative biliary drainage should be avoided[1,2]. However, preoperative drainage is mandatory to assess the surgical resectability and obtain pathological confirmation[3,4]. In other words, surgical resectability cannot be accurately assessed before biliary drainage.

Endoscopic biliary drainage is widely accepted as the standard therapy for palliation of malignant biliary obstruction[5,6]. Because of severe complications and tumor seeding, percutaneous transhepatic biliary drainage (PTBD) is not recommended as a routine preoperative drainage method[7,8]. Therefore, endoscopic nasobiliary drainage (ENBD) is usually selected for temporary biliary drainage in patients with hilar cholangiocarcinoma, especially in high-volume centers. In patients who are not candidates for surgery after a work-up for resectability, endoscopic biliary drainage using a self-expandable metallic stent is often performed because of the long stent patency[6,9].

No studies have evaluated the safety of endoscopic biliary drainage as a bridge to definitive surgery or palliative treatment in patients with hilar cholangiocarcinoma. The aim of this study was to evaluate the complications associated with temporary endoscopic biliary drainage in patients with hilar cholangiocarcinoma from the initial biliary drainage to the definitive surgery or palliative treatment.

MATERIALS AND METHODS

Study design

This retrospective study was performed at a tertiary care university hospital in which > 50 cases of major hepatectomy are performed every year. The prospectively collected endoscopy database at our department was searched for patients who underwent biliary drainage of hilar cholangiocarcinoma for temporary purpose from 2009 to 2014. We excluded patients who underwent PTBD or self-expandable metallic stent (SEMS) placement as an initial drainage technique. In patients who underwent curative surgery, all complications that occurred from initial drainage to surgery were reviewed. In the remaining patients, all complications that occurred from initial drainage to palliative treatment were assessed. Palliative treatment included SEMS placement, bypass surgery, and permanent PTBD. The severity of each complication was defined by a lexicon from the American Society for Gastrointestinal Endoscopy. The study was approved by the institutional review board of Hokkaido University Hospital (014-044) and complied with the Health Insurance Portability and Accountability Act regulations (UMIN000017178).

Endoscopic management of hilar cholangiocarcinoma

Written informed consent was obtained from each patient before endoscopic retrograde cholangiopancreatography (ERCP). In our institution, the initial drainage technique for patients with hilar cholangiocarcinoma is usually unilateral ENBD to the future remnant liver lobe[8]. However, in other hospitals, the selection of initial drainage technique depended on each endoscopist. In patients who had previously

Table 1 Patient characteristics (N-118)

Age, yr (mean, SD)	69 (9)
Male/female	74/44
Preoperative bilirubin, mg/dL (median, range)	2.0 (0.5–24.9)
Bismuth I/II/IIIa/IIIb/IV, *n*	18/25/35/5/35
Initial biliary drainage at our institutions, *n* (%)	43 (36)
Initial drainage ENBD/EBS, *n*	85/33
Unilateral/bilateral, *n*	102/16
Sphincterotomy, *n* (%)	74 (63)
PTPE, *n* (%)	54 (46)
Surgery, *n* (%)	71 (60)
Time to surgery, days (median, range)	62 (4-233)

ENBD: Endoscopic nasobiliary drainage; EBS: Endoscopic biliary stenting; PTPE: Percutaneous transhepatic portal vein embolization.

Table 2 Complications

Initial draiange	ENBD (*n* = 85)	EBS (*n* = 33)
ENBD dislocation	20	6
EBS occlusion	8	14
ENBD occlusion	14	7
Contralateral cholangitis	25	12
Accidental ENBD extubation	2	2
Cholecystitis	0	3
Liver abscess	0	2
ENBD induced ulcer	0	1
Inappropriate location	1	1
Pancreatitis	12	7
(Mild/moderate/severe)	(5/2/5)	(3/2/2)

ENBD: Endoscopic nasobiliary drainage; EBS: Endoscopic biliary stenting.

undergone drainage, biliary reintervention with ENBD was considered in the following situations: Catheter obstruction, segmental cholangitis, spontaneous catheter dislocation, accidental ENBD tube removal, and/or ENBD-induced duodenal ulcer formation. Catheter obstruction was diagnosed in patients with a high fever (> 38 ℃) and elevated serum hepatobiliary enzyme concentrations. Segmental cholangitis was defined as cholangitis that occurred in an undrained area. In patients with catheter obstruction, the previous endoscopic biliary stent (EBS) or ENBD tube was exchanged for an ENBD tube in the same segment. In patients with segmental cholangitis, an additional ENBD tube was placed in the segment in which cholangitis was suspected. PTBD was performed in patients with segmental cholangitis if ENBD failed or after severe post-ERCP pancreatitis.

Resectability assessment

The criteria for surgical resectability were basically determined according to our previous study[10,11], and some patients with advanced age or comorbid diseases did not undergo surgery. Portal vein embolization was performed as necessary[12]. If the patient was determined to have unresectable disease, endoscopic SEMS placement, PTBD, or bypass surgery was performed as a palliative treatment.

Statistical analysis

Results are reported as mean ± SD for quantitative variables and as percentage for categorical variables. We analyzed the risk factors for all complications, biliary reintervention, and PTBD using age, sex, Bismuth type I/II/III or IV cholangiocarcinoma, total bilirubin concentration before initial drainage, EBS placement/ENBD, unilateral/bilateral disease, and sphincterotomy. Risk factors for post-ERCP pancreatitis were evaluated using age, sex, EBS placement/ENBD, unilateral/bilateral disease, and sphincterotomy. In patients who underwent unilateral initial drainage, we evaluated risk factors for bilateral drainage using these factors. Statistical analysis was performed by JMP version 11 (SAS Institute Inc., Cary, NC, United States).

RESULTS

Patient characteristics

During the study period, 125 patients underwent endoscopic biliary evaluation and drainage for temporary purpose at our institution. Two patients were excluded because of previous PTBD placement at the previous hospital. Five patients who underwent SEMS placement at the time of initial drainage were also excluded. Therefore, 118 patients were included and evaluated in this study. The patients' baseline characteristics are shown in Table 1. Eighty-five patients underwent ENBD for initial drainage, while the remaining underwent EBS placement. One hundred and two patients underwent unilateral initial drainage and 16 underwent bilateral drainage. Seventy-four patients underwent endoscopic sphincterotomy at the time of the initial drainage. The initial drainage was performed at other hospitals in 75 patients. Seventy-one patients underwent definitive surgery, while the remaining underwent palliative treatment. Palliative treatment included SEMS placement or PTBD. The median time to the final treatment was 64 d (range: 4-233 d).

Complications

Between the initial drainage and final treatment, 118 complications in 92 patients were observed (Table 2). Biliary reintervention was required in 83 (70%) patients; the incidence was 35%, 53%, and 63% within 30, 60, and 90 d, respectively. The reasons for biliary reintervention were contralateral cholangitis (*n* = 37), ENBD dislocation (*n* = 26), EBS occlusion (*n* = 22), ENBD occlusion (*n* = 21), accidental ENBD removal (*n* = 4), inappropriate tube location (*n* = 2), and ENBD-induced duodenal ulcer formation (*n* = 1). PTBD was required in 16 (14%) patients with contralateral cholangitis but who underwent failed endoscopic drainage. Post-ERCP pancreatitis was observed in 19 patients; the severity was mild in eight, moderate in four, and severe in seven.

Table 3 Risk factors for biliary reintervention

	OR	95%CI	*P* value
Age (+1 yr)	1.01	0.96-1.06	0.626
Female/male	1.23	0.50-3.14	0.650
Bismuth I	1		
Bismuth II	1.53	0.38-9.19	0.555
Bismuth IIIa/b/IV	2.06	0.68-6.11	0.195
Preoperative Bil (+ 1 mg/dL)	0.97	0.91-1.05	0.492
EBS/ENBD	3.80	1.32-13.02	0.012
Unilateral/bilateral	2.62	0.74-9.20	0.132
Sphincterotomy	1.32	0.53-3.25	0.551

ENBD: Endoscopic nasobiliary drainage; EBS: Endoscopic biliary stenting.

Table 4 Risk factors for percutaneous transhepatic biliary drainage

	OR	95%CI	*P* value
Age (+1 yr)	0.96	0.92-1.08	0.220
Female/male	2.48	0.73-8.71	0.143
Bismuth I	1		
Bismuth II	0.54	0.02-15.15	0.683
Bismuth IIIa/b/IV	10.15	1.62-214.7	0.010
Sphincterotomy	2.36	0.69- 9.43	0.178
EBS/ENBD	2.63	0.70-9.89	0.149
Unilateral/bilateral	8.77	1.09-214.7	0.040
Preoperative bilirubin (+ 1 mg/dL)	1.02	0.93-1.12	0.604

ENBD: Endoscopic nasobiliary drainage; EBS: Endoscopic biliary stenting.

In 102 patients who underwent initial unilateral drainage, 49 (48%) required bilateral drainage.

Risk factors for biliary reintervention

Multivariate analysis showed that EBS placement was a significant risk factor for biliary reintervention (OR = 3.80, 95%CI: 1.32-13.02, *P* = 0.012). ENBD was significantly associated with a low risk of biliary reintervention (OR = 0.26, 95%CI: 0.08-0.76, *P* = 0.012) and *vice versa* (Table 3).

Risk factors for PTBD

Multivariate analysis showed that patients with Bismuth III and IV cholangiocarcinoma (OR = 10.15, 95%CI: 1.62–214.7, *P* = 0.010) and initial unilateral drainage (OR = 8.77, 95%CI: 1.09-214.7, *P* = 0.040) were significant risk factors for PTBD (Table 4).

Risk factors for post-ERCP pancreatitis

Multivariate analysis showed that absence of endoscopic sphincterotomy was significantly associated with post-ERCP pancreatitis (OR = 3.46, 95%CI: 1.19-10.87, *P* = 0.023) (Table 5).

Risk factors for bilateral drainage

In the multivariate analysis of 102 patients, those with Bismuth II/III/IV cholangiocarcinoma (OR = 34.69, 95%CI: 4.88-736.7, *P* < 0.001) and the presence of endoscopic sphincterotomy (OR = 4.43, 95%CI: 1.61-13.51, *P* = 0.004) were significant risk factors for bilateral drainage (Table 3).

Table 5 Risk factors for post-endoscopic retrograde cholangiopancreatography pancreatitis

	OR	95%CI	*P* value
Age (+1 yr)	0.95	0.89-1.01	0.078
Female/male	1.45	0.48-4.36	0.501
EBS/ENBD	2.24	0.70-7.09	0.171
Unilateral/bilateral	1.46	0.31-11.24	0.661
No sphincterotomy	3.46	1.19-10.87	0.023

ENBD: Endoscopic nasobiliary drainage; EBS: Endoscopic biliary stenting.

Table 6 Risk factors for bilateral drainage (*n* = 102)

	OR	95%CI	*P* value
Age (+1 yr)	0.95	0.89-1.01	0.077
Female/male	1.76	0.66-4.91	0.259
EBS/ENBD	3.12	0.97-11.26	0.056
Bismuth I	1		
Bismuth II	34.69	4.88-736.7	< 0.001
Bismuth IIIa/b/IV	1.12	0.36-3.53	0.843
Sphincterotomy	4.43	1.61-13.51	0.004
Preoperative bilirubin	1.07	0.98-1.17	0.156

ENBD: Endoscopic nasobiliary drainage; EBS: Endoscopic biliary stenting.

DISCUSSION

In this study, endoscopic biliary drainage of hilar cholangiocarcinoma for temporary purpose had a high morbidity rate. However, ENBD was associated with a significantly lower risk of biliary reintervention than EBS placement. Endoscopic sphincterotomy reduced the risk of post-ERCP pancreatitis, but was significantly associated with bilateral drainage.

The treatment strategy for hilar cholangiocarcinoma depends on the surgical resectability. Surgical resectability was determined not only by the tumor itself but also the presence of jaundice, liver function test results, performance status, and/or comorbid diseases. Endoscopic biliary drainage is usually necessary after endoscopic biopsy of the bile duct to prevent post-ERCP cholangitis. We previously demonstrated that ENBD is the most suitable preoperative drainage method for hilar cholangiocarcinoma because it is associated with a lower complication rate than are EBS and PTBD[8]. Preoperative drainage did not affect the mortality rate among jaundiced patients with hilar cholangiocarcinoma[13,14]. In a recent study, surgeons preferred endoscopic biliary drainage to PTBD to avoid tumor seeding and severe complications[7,15]. Actually, during the study period, only two patients underwent PTBD as the initial biliary drainage method. This study showed that ENBD is still the most suitable initial temporary drainage method for the management of hilar cholangiocarcinoma. This means that ENBD should be selected as a tem-

porary drainage method in jaundiced patients with hilar cholangiocarcinoma regardless of the surgical resectability. In previous studies involving patients who were not candidates for surgical resection, an endoscopic SEMS was deployed in place of an ENBD tube because of the longer patency duration than a plastic stent[9,16].

Post-ERCP pancreatitis is an unresolved problem in endoscopic biliary drainage[17,18]. Prophylactic pancreatic stenting and rectal indomethacin has been recommended to prevent post-ERCP pancreatitis[19]. This study showed that endoscopic sphincterotomy can reduce the incidence of post-ERCP pancreatitis without prophylactic pancreatic stenting or rectal indomethacin, which is consistent with the findings of previous retrospective studies[15,20]. However, endoscopic sphincterotomy did not reduce the incidence of post-ERCP pancreatitis in patients with distal malignant biliary obstruction before ENBD[21,22]. The risk of post-ERCP pancreatitis was higher in patients with hilar cholangiocarcinoma than in patients with pancreatic cancer[22]. The effect of endoscopic sphincterotomy before endoscopic biliary drainage for hilar cholangiocarcinoma on post-ERCP pancreatitis should be clarified in a randomized prospective study.

PTBD was historically a standard preoperative management technique for hilar cholangiocarcinoma[23]. However, the development of endoscopic biliary drainage and the high risk of severe complications rendered it salvage therapy[4]. In the present study, 14% of patients required PTBD for the management of contralateral cholangitis, and highly advanced biliary stricture was significantly associated with PTBD. This is consistent with previous reports[24]. Although multiple ENBD is possible, surgeons and endoscopists should understand the limitations of ENBD, especially for highly advanced hilar cholangiocarcinoma[4].

There is still controversy regarding the superiority of unilateral or bilateral drainage for management of hilar malignant biliary obstruction. In the present study, 49% of patients who underwent unilateral initial drainage required bilateral drainage until the surgery or palliative treatment because of contralateral cholangitis. In patients with unresectable malignant hilar biliary obstruction, bilateral drainage was associated with a longer stent patency time than was unilateral drainage. However, bilateral drainage was sometimes technically difficult, especially in patients with highly advanced biliary strictures[25]. Additional studies are required to compare unilateral and bilateral endoscopic biliary drainage for temporary biliary drainage.

This study had several limitations. This was a retrospective nonrandomized study. Each endoscopist chose the endoscopic biliary drainage method and necessity of endoscopic sphincterotomy. The usefulness of inside stent placement for temporary preoperative drainage was recently reported[26]. The superiority of ENBD to inside stent placement requires clarification in future studies. Furthermore, few patients in this study underwent preoperative neoadjuvant therapy, in which the preoperative period was much longer. The safety of surgery after SEMS placement was reported, and temporary SEMS placement should be evaluated[27].

Endoscopic biliary drainage for temporary purpose in patients with hilar cholangiocarcinoma has a high morbidity rate. Until surgical resectability is determined, ENBD should be selected for temporary endoscopic biliary drainage because of its low reintervention rate. Endoscopic sphincterotomy should be considered to prevent post-ERCP pancreatitis. Further studies are required to identify a more suitable management technique for patients with hilar cholangiocarcinoma.

COMMENTS

Background

Surgery is the only curative treatment for patients with hilar cholangiocarcinoma, and the routine use of preoperative biliary drainage should be avoided. However, surgical resectability cannot be always accurately assessed before biliary drainage. No studies have evaluated the safety of endoscopic biliary drainage as a bridge to definitive surgery or palliative treatment in patients with hilar cholangiocarcinoma.

Research frontiers

The authors previously reported endoscopic nasobiliary drainage (ENBD) is the most suitable for preoperative biliary drainage in patients with hilar cholangiocarcinoma. The authors provide support to the preference of ENBD for both preoperative and palliative biliary drainage in patients with hilar cholangiocarcinoma.

Innovations and breakthroughs

ENBD had a significantly lower incidence of biliary complications than biliary stenting in patients with hilar cholangiocarcinoma.

Applications

Endoscopic biliary drainage for temporary purpose in patients with hilar cholangiocarcinoma has a high morbidity rate. Until surgical resectability is determined, ENBD should be selected for temporary endoscopic biliary drainage because of its low reintervention rate.

Terminology

ENBD is one of the biliary drainage methods. The advantage of ENBD over biliary stenting is the monitoring of bile, cholangiography, bile cytology, and removability. The disadvantage is the discomfort of the patients.

Peer-review

In this retrospective study, the authors end up into some conclusions, the majority of which are well known from previous studies. What is new is that according to their findings ENBD was a better approach and with lower complications.

REFERENCES

1 **Kondo S**, Takada T, Miyazaki M, Miyakawa S, Tsukada K, Nagino M, Furuse J, Saito H, Tsuyuguchi T, Yamamoto M, Kayahara M, Kimura F, Yoshitomi H, Nozawa S, Yoshida M, Wada K, Hirano S, Amano H, Miura F. Guidelines for the management of biliary tract and ampullary carcinomas: surgical treatment. *J Hepatobiliary Pancreat Surg* 2008; **15**: 41-54 [PMID: 18274843 DOI: 10.1007/s00534-007-1279-5]

2 **Khan SA**, Davidson BR, Goldin RD, Heaton N, Karani J, Pereira SP, Rosenberg WM, Tait P, Taylor-Robinson SD, Thillainayagam AV, Thomas HC, Wasan H. Guidelines for the diagnosis and treatment of cholangiocarcinoma: an update. *Gut* 2012; **61**:

1657-1669 [PMID: 22895392 DOI: 10.1136/gutjnl-2011-301748]
3 **Nagino M**, Takada T, Miyazaki M, Miyakawa S, Tsukada K, Kondo S, Furuse J, Saito H, Tsuyuguchi T, Yoshikawa T, Ohta T, Kimura F, Ohta T, Yoshitomi H, Nozawa S, Yoshida M, Wada K, Amano H, Miura F. Preoperative biliary drainage for biliary tract and ampullary carcinomas. *J Hepatobiliary Pancreat Surg* 2008; **15**: 25-30 [PMID: 18274841 DOI: 10.1007/s00534-007-1277-7]
4 **Kawakami H**, Kondo S, Kuwatani M, Yamato H, Ehira N, Kudo T, Eto K, Haba S, Matsumoto J, Kato K, Tsuchikawa T, Tanaka E, Hirano S, Asaka M. Preoperative biliary drainage for hilar cholangiocarcinoma: which stent should be selected? *J Hepatobiliary Pancreat Sci* 2011; **18**: 630-635 [PMID: 21655974 DOI: 10.1007/s00534-011-0404-7]
5 **Isayama H**, Nakai Y, Kawakubo K, Kogure H, Hamada T, Togawa O, Sasahira N, Hirano K, Tsujino T, Koike K. Endoscopic retrograde cholangiopancreatography for distal malignant biliary stricture. *Gastrointest Endosc Clin N Am* 2012; **22**: 479-490 [PMID: 22748244 DOI: 10.1016/j.giec.2012.04.024]
6 **Kawakami H**, Itoi T, Kuwatani M, Kawakubo K, Kubota Y, Sakamoto N. Technical tips and troubleshooting of endoscopic biliary drainage for unresectable malignant hilar biliary obstruction. *J Hepatobiliary Pancreat Sci* 2015; **22**: E12-E21 [PMID: 25379788 DOI: 10.1002/jhbp.186]
7 **Takahashi Y**, Nagino M, Nishio H, Ebata T, Igami T, Nimura Y. Percutaneous transhepatic biliary drainage catheter tract recurrence in cholangiocarcinoma. *Br J Surg* 2010; **97**: 1860-1866 [PMID: 20799295 DOI: 10.1002/bjs.7228]
8 **Kawakami H**, Kuwatani M, Onodera M, Haba S, Eto K, Ehira N, Yamato H, Kudo T, Tanaka E, Hirano S, Kondo S, Asaka M. Endoscopic nasobiliary drainage is the most suitable preoperative biliary drainage method in the management of patients with hilar cholangiocarcinoma. *J Gastroenterol* 2011; **46**: 242-248 [PMID: 20700608 DOI: 10.1007/s00535-010-0298-1]
9 **Mukai T**, Yasuda I, Nakashima M, Doi S, Iwashita T, Iwata K, Kato T, Tomita E, Moriwaki H. Metallic stents are more efficacious than plastic stents in unresectable malignant hilar biliary strictures: a randomized controlled trial. *J Hepatobiliary Pancreat Sci* 2013; **20**: 214-222 [PMID: 22415652 DOI: 10.1007/s00534-012-0508-8]
10 **Kondo S**, Hirano S, Ambo Y, Tanaka E, Okushiba S, Morikawa T, Katoh H. Forty consecutive resections of hilar cholangiocarcinoma with no postoperative mortality and no positive ductal margins: results of a prospective study. *Ann Surg* 2004; **240**: 95-101 [PMID: 15213624 DOI: 10.1097/01.sla.0000129491.43855.6b]
11 **Kawakami H**, Kuwatani M, Etoh K, Haba S, Yamato H, Shinada K, Nakanishi Y, Tanaka E, Hirano S, Kondo S, Kubota K, Asaka M. Endoscopic retrograde cholangiography versus peroral cholangioscopy to evaluate intraepithelial tumor spread in biliary cancer. *Endoscopy* 2009; **41**: 959-964 [PMID: 19802775 DOI: 10.1055/s-0029-1215178]
12 **Hirano S**, Kondo S, Tanaka E, Shichinohe T, Tsuchikawa T, Kato K, Matsumoto J, Kawasaki R. Outcome of surgical treatment of hilar cholangiocarcinoma: a special reference to postoperative morbidity and mortality. *J Hepatobiliary Pancreat Sci* 2010; **17**: 455-462 [PMID: 19820891 DOI: 10.1007/s00534-009-0208-1]
13 **Farges O**, Regimbeau JM, Fuks D, Le Treut YP, Cherqui D, Bachellier P, Mabrut JY, Adham M, Pruvot FR, Gigot JF. Multicentre European study of preoperative biliary drainage for hilar cholangiocarcinoma. *Br J Surg* 2013; **100**: 274-283 [PMID: 23124720 DOI: 10.1002/bjs.8950]
14 **Sugawara G**, Ebata T, Yokoyama Y, Igami T, Takahashi Y, Takara D, Nagino M. The effect of preoperative biliary drainage on infectious complications after hepatobiliary resection with cholangiojejunostomy. *Surgery* 2013; **153**: 200-210 [PMID: 23044266 DOI: 10.1016/j.surg.2012.07.032]
15 **Kawashima H**, Itoh A, Ohno E, Itoh Y, Ebata T, Nagino M, Goto H, Hirooka Y. Preoperative endoscopic nasobiliary drainage in 164 consecutive patients with suspected perihilar cholangiocarcinoma: a retrospective study of efficacy and risk factors related to complications. *Ann Surg* 2013; **257**: 121-127 [PMID: 22895398 DOI: 10.1097/SLA.0b013e318262b2e9]
16 **Kawakubo K**, Kawakami H, Kuwatani M, Kudo T, Abe Y, Kawahata S, Kubo K, Kubota Y, Sakamoto N. Single-step simultaneous side-by-side placement of a self-expandable metallic stent with a 6-Fr delivery system for unresectable malignant hilar biliary obstruction: a feasibility study. *J Hepatobiliary Pancreat Sci* 2015; **22**: 151-155 [PMID: 25345586 DOI: 10.1002/jhbp.173]
17 **Coté GA**, Kumar N, Ansstas M, Edmundowicz SA, Jonnalagadda S, Mullady DK, Azar RR. Risk of post-ERCP pancreatitis with placement of self-expandable metallic stents. *Gastrointest Endosc* 2010; **72**: 748-754 [PMID: 20630513 DOI: 10.1016/j.gie.2010.05.023]
18 **Freeman ML**, DiSario JA, Nelson DB, Fennerty MB, Lee JG, Bjorkman DJ, Overby CS, Aas J, Ryan ME, Bochna GS, Shaw MJ, Snady HW, Erickson RV, Moore JP, Roel JP. Risk factors for post-ERCP pancreatitis: a prospective, multicenter study. *Gastrointest Endosc* 2001; **54**: 425-434 [PMID: 11577302 DOI: 10.1067/mge.2001.117550]
19 **Dumonceau JM**, Andriulli A, Elmunzer BJ, Mariani A, Meister T, Deviere J, Marek T, Baron TH, Hassan C, Testoni PA, Kapral C. Prophylaxis of post-ERCP pancreatitis: European Society of Gastrointestinal Endoscopy (ESGE) Guideline - updated June 2014. *Endoscopy* 2014; **46**: 799-815 [PMID: 25148137 DOI: 10.1055/s-0034-1377875]
20 **Matsubayashi H**, Fukutomi A, Kanemoto H, Maeda A, Matsunaga K, Uesaka K, Otake Y, Hasuike N, Yamaguchi Y, Ikehara H, Takizawa K, Yamazaki K, Ono H. Risk of pancreatitis after endoscopic retrograde cholangiopancreatography and endoscopic biliary drainage. *HPB* (Oxford) 2009; **11**: 222-228 [PMID: 19590651 DOI: 10.1111/j.1477-2574.2008.00020.x]
21 **Hayashi T**, Kawakami H, Osanai M, Ishiwatari H, Naruse H, Hisai H, Yanagawa N, Kaneto H, Koizumi K, Sakurai T, Sonoda T. No benefit of endoscopic sphincterotomy before biliary placement of self-expandable metal stents for unresectable pancreatic cancer. *Clin Gastroenterol Hepatol* 2015; **13**: 1151-8.e2 [PMID: 25632802 DOI: 10.1016/j.cgh.2015.01.008]
22 **Kawakubo K**, Isayama H, Nakai Y, Togawa O, Sasahira N, Kogure H, Sasaki T, Matsubara S, Yamamoto N, Hirano K, Tsujino T, Toda N, Tada M, Omata M, Koike K. Risk factors for pancreatitis following transpapillary self-expandable metal stent placement. *Surg Endosc* 2012; **26**: 771-776 [PMID: 22011943 DOI: 10.1007/s00464-011-1950-4]
23 **Nimura Y**, Kamiya J, Kondo S, Nagino M, Uesaka K, Oda K, Sano T, Yamamoto H, Hayakawa N. Aggressive preoperative management and extended surgery for hilar cholangiocarcinoma: Nagoya experience. *J Hepatobiliary Pancreat Surg* 2000; **7**: 155-162 [PMID: 10982608 DOI: 10.1007/s005340000070155.534]
24 **Rerknimitr R**, Kladcharoen N, Mahachai V, Kullavanijaya P. Result of endoscopic biliary drainage in hilar cholangiocarcinoma. *J Clin Gastroenterol* 2004; **38**: 518-523 [PMID: 15220688 DOI: 10.1097/01.mcg.0000123204.36471.be]
25 **Kawakubo K**, Kawakami H, Toyokawa Y, Otani K, Kuwatani M, Abe Y, Kawahata S, Kubo K, Kubota Y, Sakamoto N. Risk factors for technical failure of endoscopic double self-expandable metallic stent placement by partial stent-in-stent method. *J Hepatobiliary Pancreat Sci* 2015; **22**: 79-85 [PMID: 25308061 DOI: 10.1002/jhbp.170]
26 **Kobayashi N**, Watanabe S, Hosono K, Kubota K, Nakajima A, Kaneko T, Sugimori K, Tokuhisa M, Goto A, Mori R, Taniguchi K, Matsuyama R, Endo I, Maeda S, Ichikawa Y. Endoscopic inside stent placement is suitable as a bridging treatment for preoperative biliary tract cancer. *BMC Gastroenterol* 2015; **15**: 8 [PMID: 25649526 DOI: 10.1186/s12876-015-0233-2]
27 **Fukami Y**, Ebata T, Yokoyama Y, Igami T, Sugawara G, Nagino M. Salvage hepatectomy for perihilar malignancy treated initially with biliary self-expanding metallic stents. *Surgery* 2013; **153**: 627-633 [PMID: 23270971 DOI: 10.1016/j.surg.2012.11.008]

P- Reviewer: Buanes TA, Garg P, Thomopoulos KC
S- Editor: Gong ZM **L- Editor**: A **E- Editor**: Wu HL

World Journal of Gastrointestinal Endoscopy

Submit a Manuscript: http://www.wjgnet.com/esps/
Help Desk: http://www.wjgnet.com/esps/helpdesk.aspx
DOI: 10.4253/wjge.v8.i9.391

World J Gastrointest Endosc 2016 May 10; 8(9): 391-394
ISSN 1948-5190 (online)

CASE REPORT

First report of splenic rupture following deep enteroscopy

Carlo Maria Girelli, Roberta Pometta, Corinna Facciotto, Roberto Mella, Giordano Bernasconi

Carlo Maria Girelli, Giordano Bernasconi, Gastroenterology and Digestive Endoscopy Unit, Hospital of Busto Arsizio, 21052 Busto Arsizio (VA), Italy

Roberta Pometta, Corinna Facciotto, Roberto Mella, Division of Internal Medicine, Hospital of Angera, 21021 Angera (VA), Italy

Author contributions: Girelli CM wrote a section of the manuscript and performed deep enteroscopy; Pometta R wrote a section of the manuscript and performed upper and lower endoscopy; Facciotto C was the referring physician who provided clinical details; Mella R performed capsule endoscopy; Bernasconi G wrote a section of the manuscript; all co-authors read and approved the final version of the manuscript.

Institutional review board statement: This case report was exempt from the Istitutional Review Board standards at Hospital of Busto Arsizio (Italy).

Informed consent statement: The patient involved in this study gave his written informed consent authorizing use and disclosure of his protected health information.

Conflict-of-interest statement: All authors have no conflict of interests to declare.

Correspondence to: Carlo Maria Girelli, MD, Head of the IBD Unit, Gastroenterology and Digestive Endoscopy Unit, Hospital of Busto Arsizio, Via Arnaldo da Brescia, 1, 21052 Busto Arsizio (VA), Italy. cargirel@gmail.com
Telephone: +39-03-31699261
Fax: +39-03-31699265

Received: January 8, 2016
Peer-review started: January 12, 2016
First decision: February 2, 2016
Revised: February 17, 2016
Accepted: March 7, 2016
Article in press: March 9, 2016
Published online: May 10, 2016

Abstract

Splenic rupture is a rare complication of diagnostic and therapeutic gastrointestinal endoscopy procedures. Herein, we report for the first time a case of splenic rupture following therapeutic retrograde double-balloon enteroscopy, which occurred in an 85-year-old man who was treated for recurrent mid-intestinal bleeding that resulted from ileal angioectasia. This patient promptly underwent an operation and eventually recovered.

Key words: Angioectasia; Artero-venous malformation; Capsule endoscopy; Complication; Deep enteroscopy; Device assisted enteroscopy; Double balloon enteroscopy; Mid gastrointestinal bleeding; Obscure gastrointestinal bleeding; Small bowel; Splenic injury; Splenic rupture

Core tip: Splenic rupture is a rare, devastating complication of colonoscopy. For the first time, we report a case of splenic rupture following therapeutic retrograde double-balloon enteroscopy.

Girelli CM, Pometta R, Facciotto C, Mella R, Bernasconi G. First report of splenic rupture following deep enteroscopy. *World J Gastrointest Endosc* 2016; 8(9): 391-394 Available from: URL: http://www.wjgnet.com/1948-5190/full/v8/i9/391.htm DOI: http://dx.doi.org/10.4253/wjge.v8.i9.391

INTRODUCTION

Splenic rupture is a rare complication of gastrointestinal

endoscopy. Although very few cases of splenic injuries have been reported following endoscopic retrograde cholangio pancreatography[1,2], immediate or delayed splenic injury and rupture have mostly been reported following diagnostic and therapeutic colonoscopy. To the best of our knowledge, 102 of such cases have been reported in the English language literature[3]. Deep enteroscopy (DE) is a relatively new endoscopic technique involving approach of the small bowel from an oral (antegrade DE) or aboral (retrograde DE) route. In contrast to small bowel capsule endoscopy (SBCE), DE is invasive, requires sedation and allows for endoscopic interventions (*i.e.*, biopsy, tattooing, hemostasis, or polypectomy). In accordance with the European Society of Gastrointestinal Endoscopy guidelines[4], in the clinical setting of recurrent, overt mid-gastrointestinal bleeding, we perform DE to better characterize and/or treat lesions identified by other less invasive means, such as SBCE and/or cross-sectional imaging. DE can be performed with the aid of an overtube; currently, three different instruments are used: A single-balloon enteroscope, a double-balloon enteroscope (DBE) and a spiral enteroscope. To date, no case of splenic rupture has been reported following DE. Herein, we present the first such case, which occurred after a therapeutic retrograde DBE (R-DBE).

CASE REPORT

An 85-year-old Caucasian man was admitted to hospital in March 2015 because of gastrointestinal bleeding (bright red blood in his stools) and anemia (hemoglobin level of 7.7 g/dL). In 1998, he underwent aortic valve replacement with a mechanical prosthesis, with subsequent long-life warfarin (target INR of 3-4.5). Previously, 5 mo before his current admission, he was admitted because of overt gastrointestinal hemorrhage. Although an upper endoscopy was normal, colonoscopy revealed sigmoid diverticula and active bleeding resulting from a Dieulafoy lesion of the right flexure, which was successfully clipped.

During this present instance of hospital admission, two units of packed red blood cells were administered. Urgent esophagogastroduodenoscopy and colonoscopy were performed without evidence of active bleeding. Therefore, the patient underwent SBCE (Pillcam SB3, Covidien, Ireland). At 3 h 30 min after capsule ingestion (81% of the small bowel transit time from the first duodenal image), the capsule showed active ileal oozing and bleeding from an otherwise normal mucosa (Figure 1). With the aim of stopping the bleeding, we performed an R-DBE (instrument: Fuji EN450T5; working length: 2000 mm, and distal end diameter: 9.4 mm) under conscious sedation (pethidine 50 mg, midazolam 5 mg, *i.v.*) up to 180 cm from the ileocecal valve, which we calculated using the May method[5] without experiencing any technical difficulty. A 5 mm, branched angioectasia (type 1b of the Yano-Yamamoto classification[6]) was identified that was 150

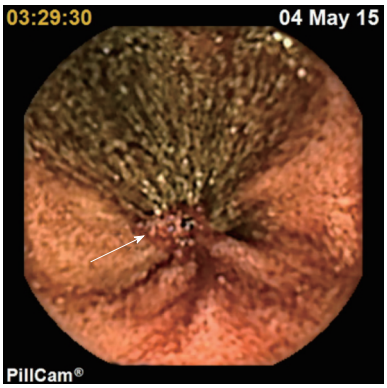

Figure 1 Capsule endoscopy showing ileal luminal blood (arrow).

cm proximal to the ileocecal valve (Figure 2A), which we treated by argon plasma coagulation (low power, 10 Watt) and then tattooed (Figure 2B). No other lesion was identified. At the end of the procedure (total procedural time: 74 min), the patient was asymptomatic and his vital parameters were stable. Then, 12 h later, he reported a dull, ill-defined abdominal pain and a physical examination was unremarkable. However, laboratory tests showed a decrease of 2 g/dL in the hemoglobin concentration in the absence of overt hematochezia. An urgent contrast enhanced computerized tomography (CT) scan revealed a grade Ⅳ splenic injury with active bleeding (Figure 3), according to the American Association for the Surgery of Trauma classification[7]. Because of the high injury severity score, operative management was performed[8]. Hemoperitoneum and splenic capsular laceration was confirmed during surgery, and splenectomy and segmental ileal resection of the tattooed ileal region was carried out. The choice to make an ileal resection was dictated based on the high re-bleeding rate after endoscopic thermo-ablation of angioectasia[9]. The patient was discharged 14 d later in good health and was administered oral warfarin. Then, two months later, he returned to the hospital because of further gastrointestinal bleeding and anemia. Colonoscopy confirmed red blood in the colonic lumen, without any evidence of active bleeding; an upper endoscopy was normal. He was transfused and treated with somatostatin infusion. After confirming that the bleeding had stopped, he was discharged and prescribed subcutaneous long-acting octreotide (20 mg, monthly). No additional transfusions were required during the six-month follow-up period.

DISCUSSION

To date, no case of splenic rupture after DE has been reported in the English language literature. The rate of occurrence of splenic injury following colonoscopy is very low, but it may be underestimated because of a reluctance to report unfavorable outcomes[10]. In a population-based study, Cooper *et al*[11] reported 12 splenic injuries among 165527 procedures. However,

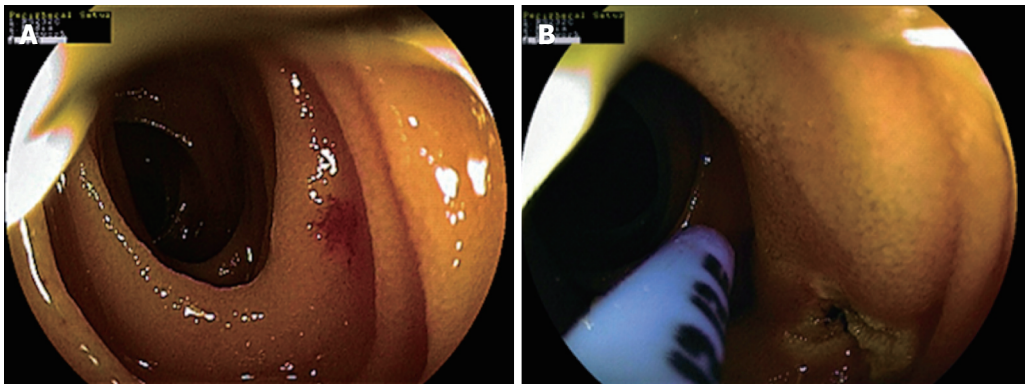

Figure 2 Retrograde double-balloon enteroscopy showing an ileal type 1b lesion before (A) and after (B) thermo-ablative therapy.

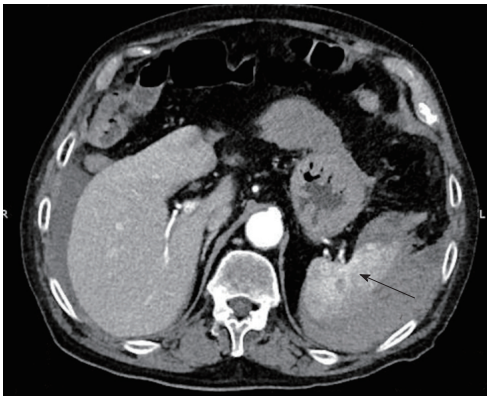

Figure 3 Contrast enhanced abdominal computerized tomography showing peritoneal blood and active bleeding from a ruptured spleen (arrow).

the complication rate with any endoscopic procedure is generally low, so a large number of DE need to be performed to determine the complication rate of such a relatively new invasive procedure. It is conceivable that R-DBE, which is a more invasive and less frequently performed procedure than colonoscopy, may carry a higher risk of splenic injury.

In our unit, beginning in 2006, we have performed a mean of 22 DBE/year, mostly by an antegrade approach; however, a single operator (CMG) recently performed 15 consecutive therapeutic R-DBE procedures without any complications. Although a learning curve has not yet been established for R-DBE, Mehdizadeh *et al*[12] suggest a minimum of 20 procedures to learn to maintain ileal access through the ileocecal valve and reduce procedure times.

Splenic injury complicating gastrointestinal endoscopy may result from either direct trauma or excessive traction on the splenocolic ligament that occurs during the maneuvers required for instrument advancement. Several risk factors have been postulated and categorized as endoscopist-dependent (scope straightening, hooking the splenic flexure, alpha maneuver, and excessive hurry) or patient-dependent (female gender, smoking, anticoagulation, splenomegaly, pre-existing spleen disease, and adhesions)[13-15].

Interestingly, the most predictive diagnostic indicator of splenic injury was found to be an unexplained decrease in hemoglobin greater than 3 g/dL after endoscopy rather than procedural difficulties[3]. Deep sedation may be related to a delayed diagnosis of this complication[11]. Nearly all colonoscopic splenic injuries require surgical intervention, with a mortality rate of 5%[13]. With regard to DBE, two retrospective series of 40 and 41 patients older than 70 and 65 years, respectively, did not show a complication rate that was higher than that seen in younger patients[16,17]. In our present case, chronic oral anticoagulation, several colonoscopies performed before R-DBE, and mild splenomegaly (resulting from subclinical prosthesis-related mechanical hemolysis) likely contributed to the pathogenesis of this complication.

In conclusion, we have reported the first case of splenic rupture after therapeutic R-DBE. Careful clinical observation after such procedures is strongly advisable to promptly recognize and treat this rare but dreadful endoscopic complication.

COMMENTS

Case characteristic

An 85-year-old man on chronic warfarin underwent successful retrograde double-balloon enteroscopy for bleeding control of an ileal angioectasia, diagnosed on a previous capsule endoscopy. Twelve hours following the procedure, the patient complained abdominal pain.

Clinical diagnosis

Acute abdomen following deep enteroscopy (DE).

Differential diagnosis

Intestinal perforation *vs* splenic injury.

Laboratory diagnosis

Decrease of 2 g/dL of blood hemoglobin level.

Imaging diagnosis

Hemoperitoneum and grade IV splenic injury on contrast enhanced computerized tomography.

Pathological diagnosis

Splenic capsular laceration and rupture of the spleen.

Treatment
Urgent splenectomy and ileal resection.

Related reports
Splenic rupture is a rare devastating complication of gastrointestinal endoscopy. Immediate or delayed splenic injury and rupture have mostly been reported following diagnostic and therapeutic colonoscopy. This is the first reported case of splenic rupture following retrograde DE.

Term explanation
Vascular lesions of the small bowel are classified by the Yano-Yamamoto classification. Type 1a: Punctulate erythema with or without oozing; type 1b: Patchy erythema with or without oozing; type 2a: Punctulate erythema with pulsatile bleeding; type 2b: Pulsatile red protrusion without surrounding venous dilatation; type 3: Pulsatile red protrusion with surrounding venous dilatation; type 4: Other lesions not classified into any of the above categories.

Experiences and lessons
Retrograde double-balloon enteroscopy can cause delayed splenic rupture. Careful clinical patient observation is recommended after this procedure. Abdominal pain along with hemoglobin decrease $\geqslant$ 2 g/dL following the procedure mandate urgent contrast enhanced abdominal computerized tomography.

Peer-review
The authors report a case of spleen injury after DE for the first time and underscore the importance of careful clinical observation for a patient, especially complaining of abdominal pain, after endoscopic examination in order to recognize and treat this potentially life-threatening complication as soon as possible. Thus, this report is very unique and instructive for many kinds of clinicians including endoscopists.

REFERENCES

1 **Zyromski NJ**, Camp CM. Splenic injury: a rare complication of endoscopic retrograde cholangiopancreatography. *Am Surg* 2004; **70**: 737-739 [PMID: 15328812]

2 **Aubrey-Bassler FK**, Sowers N. 613 cases of splenic rupture without risk factors or previously diagnosed disease: a systematic review. *BMC Emerg Med* 2012; **12**: 11 [PMID: 22889306 DOI: 10.1186/1471-227X-12-11]

3 **Singla S**, Keller D, Thirunavukarasu P, Tamandl D, Gupta S, Gaughan J, Dempsey D. Splenic injury during colonoscopy--a complication that warrants urgent attention. *J Gastrointest Surg* 2012; **16**: 1225-1234 [PMID: 22450952 DOI: 10.1007/s11605-012-1871-0]

4 **Pennazio M**, Spada C, Eliakim R, Keuchel M, May A, Mulder CJ, Rondonotti E, Adler SN, Albert J, Baltes P, Barbaro F, Cellier C, Charton JP, Delvaux M, Despott EJ, Domagk D, Klein A, McAlindon M, Rosa B, Rowse G, Sanders DS, Saurin JC, Sidhu R, Dumonceau JM, Hassan C, Gralnek IM. Small-bowel capsule endoscopy and device-assisted enteroscopy for diagnosis and treatment of small-bowel disorders: European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline. *Endoscopy* 2015; **47**: 352-376 [PMID: 25826168 DOI: 10.1055/s-0034-1391855]

5 **May A**, Nachbar L, Schneider M, Neumann M, Ell C. Push-and-pull enteroscopy using the double-balloon technique: method of assessing depth of insertion and training of the enteroscopy technique using the Erlangen Endo-Trainer. *Endoscopy* 2005; **37**: 66-70 [PMID: 15657861]

6 **Yano T**, Yamamoto H, Sunada K, Miyata T, Iwamoto M, Hayashi Y, Arashiro M, Sugano K. Endoscopic classification of vascular lesions of the small intestine (with videos). *Gastrointest Endosc* 2008; **67**: 169-172 [PMID: 18155439]

7 **Moore EE**, Shackford SR, Pachter HL, McAninch JW, Browner BD, Champion HR, Flint LM, Gennarelli TA, Malangoni MA, Ramenofsky ML. Organ injury scaling: spleen, liver, and kidney. *J Trauma* 1989; **29**: 1664-1666 [PMID: 2593197]

8 **Siriratsivawong K**, Zenati M, Watson GA, Harbrecht BG. Nonoperative management of blunt splenic trauma in the elderly: does age play a role? *Am Surg* 2007; **73**: 585-589; discussion 590 [PMID: 17658096]

9 **May A**, Friesing-Sosnik T, Manner H, Pohl J, Ell C. Long-term outcome after argon plasma coagulation of small-bowel lesions using double-balloon enteroscopy in patients with mid-gastrointestinal bleeding. *Endoscopy* 2011; **43**: 759-765 [PMID: 21544778 DOI: 10.1055/s-0030-1256388]

10 **Lawton R**, Parker D. Barriers to incident reporting in a healthcare system. *Qual Saf Health Care* 2002; **11**: 15-18 [PMID: 12078362]

11 **Cooper GS**, Kou TD, Rex DK. Complications following colonoscopy with anesthesia assistance: a population-based analysis. *JAMA Intern Med* 2013; **173**: 551-556 [PMID: 23478904 DOI: 10.1001/jamainternmed.2013.2908]

12 **Mehdizadeh S**, Han NJ, Cheng DW, Chen GC, Lo SK. Success rate of retrograde double-balloon enteroscopy. *Gastrointest Endosc* 2007; **65**: 633-639 [PMID: 17383460]

13 **Skipworth JR**, Raptis DA, Rawal JS, Olde Damink S, Shankar A, Malago M, Imber C. Splenic injury following colonoscopy--an underdiagnosed, but soon to increase, phenomenon? *Ann R Coll Surg Engl* 2009; **91**: W6-11 [PMID: 19416579 DOI: 10.1308/147870809X400994]

14 **Lalor PF**, Mann BD. Splenic rupture after colonoscopy. *JSLS* 2007; **11**: 151-156 [PMID: 17651580]

15 **Rao KV**, Beri GD, Sterling MJ, Salen G. Splenic injury as a complication of colonoscopy: a case series. *Am J Gastroenterol* 2009; **104**: 1604-1605 [PMID: 19491881 DOI: 10.1038/ajg.2009.94]

16 **Sidhu R**, Sanders DS. Double-balloon enteroscopy in the elderly with obscure gastrointestinal bleeding: safety and feasibility. *Eur J Gastroenterol Hepatol* 2013; **25**: 1230-1234 [PMID: 23751353 DOI: 10.1097/MEG.0b013e3283630f1b]

17 **Choi DH**, Jeon SR, Kim JO, Kim HG, Lee TH, Lee WC, Kang BS, Cho JH, Jung Y, Kim WJ, Ko BM, Cho JY, Lee JS, Lee MS. Double-balloon enteroscopy in elderly patients: is it safe and useful? *Intest Res* 2014; **12**: 313-319 [PMID: 25374498 DOI: 10.5217/ir.2014.12.4.313]

P- Reviewer: Akyuz F, Ogata H, Soria F, Tsujikawa T, Urbain D
S- Editor: Ji FF **L- Editor**: A **E- Editor**: Wu HL

Published by **Baishideng Publishing Group Inc**
8226 Regency Drive, Pleasanton, CA 94588, USA
Telephone: +1-925-223-8242
Fax: +1-925-223-8243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.wjgnet.com/esps/helpdesk.aspx
http://www.wjgnet.com