

Current application situation of gastrointestinal endoscopy in China

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Abstract

AIM: To study the current application situation of gastrointestinal (GI) endoscopy in mainland China.

METHODS: From 12 August, 2011 to 15 February, 2012, draft questionnaires were sent by e-mail to 289 hospital-based GI endoscopy units, including units with three levels (provincial, prefecture and county level) in mainland China. All the surveyed GI endoscopy units were state-owned and hospital-based. Proportions were compared using χ^2 tests. Comparisons between groups were performed using the Mann-Whitney *U* test. A probability of $P < 0.05$ was considered to represent a statistically significant difference.

RESULTS: Based on satisfactory replies, 169/279 (60.6%) of units were enrolled in the survey, which covered 28 provinces (90.3%, 28/31) in mainland China. Compared with published survey data, the number of GI endoscopes per unit has increased by nearly three times (from 2.9 to 9.3) in the past decade. About

33 of 169 (19.5%) endoscopy units possessed an X-ray machine, which was mainly owned by provincial endoscopy units (43.2%, 19/44). Video capsule endoscopes, which were almost unavailable ten years ago, were owned by 20.7% (35/169) of GI endoscopy units. Endoscopic submucosal dissection could be performed by 36.4% (19/44) of the provincial units, which was significantly higher than the prefecture level (9.9%, $P < 0.01$) and county level (0.0%, $P < 0.01$) units, respectively.

CONCLUSION: Rapid development in GI endoscopy has been made in mainland China, and major diagnostic endoscopes and therapeutic endoscopy procedures are predominantly used in large endoscopy units.

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Key words: Application situation; Gastrointestinal endoscopy; Video capsule endoscopy; Endoscopic submucosal dissection

Core tip: Rapid developments in gastrointestinal (GI) endoscopy have taken place in China in the past decade. Major diagnostic endoscopes and therapeutic endoscopy procedures are predominantly confined to large endoscopy units, whereas small and medium units, often perform fewer endoscopic procedures and have less equipment, and are mostly restricted to diagnostic endoscopy. In addition to improvement in GI endoscopy equipment, standard procedures including the standard reprocessing for endoscopy will be the focus in the future in China.

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INTRODUCTION

Endoscopy is a universally popular, minimally invasive intervention for gastrointestinal (GI) and pancreato-biliary disorders^[1]. It is reported that > 10 million GI endoscopies are performed every year in the United States^[2], and the number of procedures worldwide, although there are no exact figures, is believed to be increasing yearly due to the rapid increase in popularity of GI endoscopy. Although GI endoscopy services have become a routine procedure in western countries^[3], in most developing countries GI endoscopy services are sometimes available in so-called centres of excellence^[4].

In the past decade, the emergence and application of a variety of novel endoscopic techniques and equipment, *e.g.*, video capsule endoscopy (VCE) and double/single balloon enteroscopy (DBE/SBE) have substantially promoted the diagnostic value for GI tract lesions^[5-7]. Additionally, also in the past decade, GI endoscopy has experienced rapid evolution from a diagnostic medical procedure to a minimally invasive therapeutic procedure, *e.g.*, endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD) for removal of mucosal lesions^[8-10]. All these advances in GI endoscopy have ushered in a new era in digestive medicine. However, the systemic data concerning the current status and development of GI endoscopy in China is still lacking. Here, we conducted a survey of GI endoscopy procedures and equipment in hospital-based GI endoscopy units, in order to demonstrate the rapid development of GI endoscopy in mainland China in the past decade.

MATERIALS AND METHODS

Survey design

According to the scale (bed number) and location, hospitals in mainland China are traditionally divided into three levels: provincial (bed numbers > 1000/hospital, usually located in the provincial capital city), prefecture (bed numbers 500-1000/hospital, usually located in the prefecture capital city) and county (bed numbers < 500/hospital, usually located in county city) level; or large scale (*i.e.*, provincial) and small-to-medium scale (*i.e.*, prefecture and county level). The endoscopy units from three levels of hospitals are regarded as provincial, prefecture and county level endoscopy units, respectively.

From 12 August, 2011 to 15 February, 2012, 289 GI endoscopy units, which are official members of the Chinese Society of Digestive Endoscopy, were included in the present study. All the surveyed GI endoscopy units were state-owned and hospital-based. They were required to fill in a questionnaire. The questionnaires were sent by e-mail to the physician in charge of the unit, and if an e-mail address was unavailable or invalid, a phone call was made to complete the questionnaire. The draft comprised 21 questions about the endoscopy equipment and procedures performed in the units. The queries pertained to: the number of GI endoscopy procedures performed per year; the number and brands of all kinds of GI endo-

scopes; the number of separate purpose-designed rooms for endoscopy procedures; the number of the full-time GI endoscopy physicians and nurses; the major auxiliary endoscopy equipment (*e.g.*, X-ray machine); which endoscopy procedure they could perform [*e.g.*, endoscopic retrograde cholangiopancreatography (ERCP), EMR and ESD].

Ethical considerations

The study was approved by the Ethics Committee of Chinese PLA General Hospital.

Statistical analysis

Proportions were compared using χ^2 tests. Comparisons between groups were performed using the Mann-Whitney *U* test. A probability of $P < 0.05$ was considered to represent a statistically significant difference. Statistical analysis was performed using SPSS version 13.0 (Chicago, IL, United States).

RESULTS

Responding GI endoscopy units and their locations

Based on provision of a satisfactory reply, 169/289 (58.5%) GI endoscopy units from three levels of hospital were enrolled in our study, which covered 28 provinces (90.3%, 28/31) in mainland China. Of these, 44 (26.0%, 44/169) units were from provincial hospitals, 91 (53.8%, 91/169) from prefecture level hospitals, and 34 (20.1%, 34/169) from county level hospitals.

Number of endoscopy procedures per year

All 44 provincial endoscopy units performed ≥ 5000 procedures, which was significantly higher than the prefecture-level (16.5%, $P < 0.05$) and county-level (0.0%, $P < 0.05$) endoscopy units (Table 1).

Number of endoscopes per unit

The average number of gastrointestinal endoscopes (including all types of GI endoscope) for the 169 endoscopy units was 9.3/unit (1568/169). The average number of endoscopes in the provincial endoscopy units was 22.4 ± 5.5 , which was significantly higher than that in the prefecture level (5.4 ± 1.4 , $P < 0.05$) and county level (2.7 ± 1.2 , $P < 0.05$) units. Moreover, 59.1% (26/44) of the provincial endoscopy units had at least 10 endoscopes, which was also significantly higher than that of the prefecture level (6.6%, $P < 0.05$) and county level (0.0%, $P < 0.05$) units (Table 1).

All of the 169 endoscopy units possessed gastroscopies. The possession rate of colonoscopies in provincial and prefecture level units was 100% and 97.8%, respectively, which was significantly higher than that of county level units (88.2%, $P < 0.05$). Enteroscopies (DBE/SBE) were available only in provincial units (40.9%, 18/44) and a VCE was possessed by 20.7% (35/169) of all GI units (Table 1).

Endoscope manufacturers

The most frequently used GI endoscopes were manufac-

Table 1 Comparison of endoscopy items at three levels of endoscopy units *n* (%)/(mean \pm SD)

Endoscopy unit	Provincial (<i>n</i> = 44)	Prefecture-level (<i>n</i> = 91)	County-level (<i>n</i> = 34)	Total (<i>n</i> = 169)
Procedures per year				
> 5000	44 (100.0)	15 (16.5)	0 (0.0)	59 (34.9)
3000-5000	0 (0.0)	65 (71.4)	3 (8.8)	69 (40.2)
< 3000	0 (0.0)	11 (12.1)	31 (91.2)	42 (24.9)
Average number of endoscopes	22.4 \pm 5.5 ^a	5.4 \pm 1.4	2.7 \pm 1.2	9.3 \pm 3.2
≥ 10	26 (59.1) ^a	6 (6.6)	0 (0.0)	32 (18.9)
endoscopes/unit				
Gastroscope	44 (100.0)	91 (100.0)	34 (100.0)	169 (100.0)
Colonoscope	44 (100.0) ^a	89 (97.8) ^c	30 (88.2)	163 (96.4)
DBE/SBE	18 (40.9) ^a	0 (0.0)	0 (0.0)	18 (10.7)
EUS	31 (70.5) ^a	7 (7.7)	0 (0.0)	38 (22.5)
VCE	28 (63.6) ^a	7 (7.7)	0 (0.0)	35 (20.7)
Average number of procedure rooms	4.9 \pm 1.4 ^a	2.6 \pm 1.3 ^c	1.6 \pm 0.8	3.6 \pm 1.8
Average number of full-time physicians	3.0 \pm 1.3 ^a	1.6 \pm 1.2	1.2 \pm 0.9	1.9 \pm 1.4
Average number of full-time nurses	5.4 \pm 1.3 ^a	2.2 \pm 1.1	1.3 \pm 0.8	2.8 \pm 1.3
X-ray machine	19 (43.2) ^a	14 (15.4) ^c	0 (0.0)	33 (19.5)
Polypectomy	44 (100.0) ^a	71 (78.0) ^c	14 (41.2)	129 (76.3)
ERCP	34 (77.3) ^a	39 (42.9) ^c	4 (11.8)	77 (45.6)
EMR	30 (68.2) ^a	20 (22.0) ^c	2 (5.9)	52 (30.8)
ESD	16 (36.4) ^a	9 (9.9)	0 (0.0)	25 (14.8)
EVS/EVL	33 (75.0) ^a	37 (40.7) ^c	3 (8.8)	73 (43.2)

^a*P* < 0.05 *vs* prefecture-level or county-level endoscopy units; ^c*P* < 0.05 *vs* county-level endoscopy units. EUS: Endoscopic ultrasonography; VCE: Video capsule endoscope; DBE/SBE: Double balloon/single balloon enteroscopy; ERCP: Endoscopic retrograde cholangiopancreatography; EMR: Endoscopic mucosal resection; ESD: Endoscopic submucosal dissection; EVS: Endoscopic variceal sclerotherapy; EVL: Endoscopic variceal ligation.

tured by Olympus (140/169, 82.8%), followed by Fujinon (52/169, 30.8%) and Pentax (28/169, 16.6%).

Number of full-time staff in GI endoscopy units

The average number of full-time physicians in each provincial endoscopy unit was 3.0 ± 1.3 , which was significantly higher than that in prefecture level (1.6 ± 1.2 , *P* < 0.05) and county level (1.2 ± 0.9 , *P* < 0.05) endoscopy units. A similar trend was found for the numbers of full-time nurses in these three levels of endoscopy units (Table 1).

Possession of X-ray machine in GI endoscopy units

Thirty three of the 169 (19.5%, 33/169) endoscopy units possessed an X-ray machine. Furthermore, 43.2% of the provincial endoscopy units owned an X-ray machine, which was significantly higher than that of prefecture level (15.4%, *P* < 0.01) and county level (0.0%, *P* < 0.01) endoscopy units (Table 1).

Endoscopy procedures performed

Polypectomy could be performed by all the provincial units (100%), 78.0% of the prefecture level units and 41.2% of county level units. ERCP could be performed by 77.3% of the provincial units, which was significantly higher than

Table 2 Comparison of main endoscopy items in three independent surveys

Endoscopy items	Shanghai survey (2001)	Qinghai survey (2003)	Present survey (2011)
Number of units	138.0	37.0	169.0
Average number of endoscopes/unit	3.3	1.4	9.3
Possession rate			
Gastroscope	100.00%	100.00%	100%
Colonoscopy	70.30%	-	97.60%
Enteroscopy	4.30%	0.00%	10.60%
EUS	7.20%	0.00%	22.50%
VCE	-	2.70%	20.70%
X-ray machine	5.70%	-	19.50%
Procedures			
Polypectomy	54.30%	-	76.30%
EVS/EVL	40.20%	-	43.20%
ERCP	38.40%	-	45.60%

EUS: Endoscopic ultrasonography; VCE: Video capsule endoscope; ERCP: Endoscopic retrograde cholangiopancreatography; EVS: Endoscopic variceal sclerotherapy; EVL: Endoscopic variceal ligation.

in the prefecture level (42.9%, *P* < 0.05) and county level (11.7%, *P* < 0.01) units. A similar trend was also found for EMR, ESD and endoscopic variceal sclerotherapy (EVS)/endoscopic variceal ligation (EVL) (Table 1).

Comparisons of gastrointestinal endoscopy between current survey and previously published data

From January 2000 to November 2010, only two regional endoscopy surveys (*i.e.*, Shanghai survey in 2001 and Qinghai provincial survey in 2003) in mainland China were available by searching the Chinese national (Wanfang bases) and international databases (Medline), and they were both published in Chinese^[11,12]. The major GI endoscopy items mentioned by these two regional surveys were compared with the current survey results, and a rapid development of GI endoscopy items, including the average number of GI endoscopes per unit, was shown in Table 2.

DISCUSSION

In 1973, GI endoscopy was first introduced from Japan into China. Since then, much progress in GI endoscopy has been made by Chinese endoscopists, and the efforts and achievements of Chinese endoscopists in GI endoscopy have gradually gained international recognition^[13-16]. For example, with regard to the latest endoscopy techniques, EUS, ERCP, VCE and DBE have been the focus for Chinese endoscopists, and they have accounted for 66% of all the international publications^[17].

Although the Shanghai survey in 2001 and the Qinghai provincial survey in 2003 were from single and different areas in China, which means lower comparability with the present survey here we use them to demonstrate the progress of GI endoscopy facilities in the past decade in mainland China because these are the only journal publications available^[11,12].

The total number of GI endoscopes per unit is an important and determinant factor for what kinds of and how many endoscopy procedures they can perform. In the present survey, the average number of GI endoscopes per unit increased nearly threefold (9.3/unit) compared with that of previously published data ten years ago (the average number for Shanghai and Qinghai surveys was 2.9/unit). This is major progress in mainland China in the past decade.

VCE was first reported in 2000 by an Israeli company, Given Imaging^[5], and it is predicted that major developments in endoscopy over the next 10-20 years will centre on this technique^[18]. In the past eight years, the possession rate of VCE has markedly increased from 2.7% (Qinghai survey, 2003) to 20.7% in the present survey.

EUS and small-intestine enteroscopy have been used in clinical practice for many years^[19,20], but in the past decade, these two types of endoscopy have developed rapidly. For example, DBE, which has evolved from conventional push enteroscopy, was first introduced into clinical practice in 2001 by Yamamoto *et al*^[21]. DBE is a completely new technique that allows complete visualization, biopsy and treatment of small-bowel diseases. In the Shanghai survey, the rates for EUS and push-type enteroscopy were 4.3% and 7.2%, respectively, but in the present survey, the possession rates had increased to 10.6% and 22.4%, respectively. However, these two types of endoscope were still mainly owned by provincial hospitals in mainland China, which was largely due to their high cost and fewer indications for such procedures in small-to-medium endoscopy units (*i.e.*, prefecture and county level units).

Another important piece of endoscopy equipment, especially for large scale units, is a dedicated X-ray machine, which is necessary for a variety of GI interventions, including ERCP, percutaneous trans-hepatic catheter drainage, luminal stent placements and dilation^[22]. In the Shanghai survey, the rate of possession of a dedicated X-ray machine (not mentioned in the Qinghai survey) was 5.7% (8/138), and the rate has increased to 19.5% in the present survey. Our data also demonstrated that Olympus was the leading manufacturer of GI endoscopes in mainland China, which is in accordance with the fact that Tokyo-based Olympus is the world's largest manufacturer and provider of conventional endoscopes^[23].

Staffing requirements for GI procedures should be based on what is needed to ensure safe and proficient performance of the individual procedure^[24]. As the number of procedures carried out and the complexity of the procedures and equipment have increased, the need for specialised staff has become apparent. Our survey indicated that most full-time endoscopy staff were found in provincial hospitals in mainland China.

Compared with the Shanghai survey in 2001, easily performed therapeutic procedures, such as polypectomy, have become more popular in the past 10 years; even in small-to-medium endoscopy units in China. Another conventional procedure is ERCP, which was first performed

in 1968 and is usually regarded as the representative endoscopic intervention in pancreaticobiliary disorders^[25]. In 1973, ERCP was introduced to China, and since then it has been extensively used. It is estimated that Chinese physicians perform nearly 60000 ERCP procedures annually, including therapeutic ERCP^[17]. Our survey showed that, in China, ERCP (diagnostic and/or therapeutic) was a frequently performed procedure not only in provincial hospitals (77.3%), but also in prefecture level hospitals (42.9%). In the Shanghai survey in 2001, the overall rate of capability of performing ERCP was 38.4%, but now the nationwide rate has increased to 45.6%.

EVS or EVL is an effective endoscopic procedure for treatment of oesophageal varices^[26], and it has been frequently performed in China because of the large number of patients with oesophagogastric variceal bleeding^[27]. The Shanghai survey showed that 40.2% of the surveyed endoscopy units can perform an EVS procedure. According to the present survey, EVS/EVL is now frequently carried out in provincial (75.0%) and prefecture level (40.7%) units (Table 2); but in county level units (9.0%), there is still room to increase the popularity of this procedure, with regard to its simple operation without special devices. EMR and ESD were developed in the past decade as a novel therapeutic endoscopic procedure to remove the mucosal lesions, including early malignant lesion^[8,9]. Our survey demonstrated that EMR or ESD is also predominantly confined to the large units (provincial level) in mainland China, which may be due to the shortage of special devices in small-to-medium endoscopy units, and the procedure itself is technically demanding.

In conclusion, rapid developments have taken place in GI endoscopy in China in the past decade. Major diagnostic endoscopes and therapeutic endoscopy procedures are predominantly confined to large endoscopy units (*i.e.*, provincial hospitals), whereas small-to-medium units, often perform fewer endoscopic procedures and have less equipment, and are mostly restricted to diagnostic endoscopy. In addition to improvements in GI endoscopy equipment, standard procedures including the standard reprocessing for endoscopy will be the focus in the future in China^[28]. Therefore, there is still much room for improvement in GI endoscopy in China, and our results may provide crucial information needed for the national level GI endoscopy planning.

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COMMENTS

Background

Endoscopy is a universally popular, minimally invasive intervention for gastrointestinal (GI) and pancreatico-biliary disorders. Although GI endoscopy services have become a routine procedure in western countries, in most developing countries GI endoscopy services are sometimes available in so-called centres of excellence.

Research frontiers

In the past decade, the emergence of a variety of novel endoscopic equipment and techniques, *e.g.*, video capsule endoscopy (VCE), double/single balloon enteroscopy, endoscopic mucosal resection and endoscopic submucosal dissection (ESD) have substantially promoted the application value for GI tract lesions worldwide. GI endoscopy is experiencing rapid evolution from a diagnostic medical procedure to a minimally invasive therapeutic procedure.

Innovations and breakthroughs

The authors conducted a survey of GI endoscopy procedures and equipment in hospital-based GI endoscopy units, in order to demonstrate the current status of GI endoscopy in mainland China in the past decade. Based on provision of a satisfactory reply, 169/289 (58.5%) GI endoscopy units from three levels of hospital were enrolled in their study, which covered 28 provinces (90.3%, 28/31) in mainland China.

Applications

The authors found that the number of GI endoscopes per unit increased by nearly three times (from 2.9 to 9.3) in the past decade. The VCE, which was almost completely unavailable ten years ago, was possessed by 20.7% (35/169) of GI endoscopy units. ESD could be performed by 36.4% (19/44) of the provincial units, which was significantly higher than the prefecture level (9.9%) and county level (0.0%) units, respectively.

Terminology

The survey of GI endoscopy included equipment and procedures performed in each GI endoscopy unit. The questionnaires comprised 21 questions which were sent by e-mail to the physician in charge of the unit.

Peer review

This is a very important survey reflecting the development of GI endoscopy in mainland China in the past decade.

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