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Portal Hypertensive Gastropathy

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Abstract

Portal hypertensive gastropathy (PHG) and gastric antral vascular ectasia (GAVE), frequently combined, are responsible for acute and chronic bleeding in patients with liver cirrhosis and portal hypertension. Endoscopy is basic for detection of typical features and histological examination can enhance diagnostic accuracy. PHG is frequently responsible for chronic bleeding/anemia and the first treatment option is medical therapy; otherwise, failures can be managed by shunting procedures, such as transjugular intrahepatic portosystemic shunt or surgery. Vasoactive drugs (terlipressin or somatostatin and analogues) can be effectively adopted in less common acute bleeding episodes and additional endoscopic therapy can be performed. Endoscopic hemostatic techniques, like argon plasma coagulation, heater probe and laser, are the first-line treatment for both acute and chronic bleeding from GAVE; preliminary data supported the effectiveness of cryotherapy, radiofrequency and banding ligation as appropriate management options.

Portal hypertensive gastropathy (PHG) can be considered as a portal hypertension-related syndrome which affects patients with liver cirrhosis (32.7%), liver fibrosis (23.4%) or extrahepatic portal obstruction (43%) and is frequently associated with esophageal and/or gastric varices [1]. PHG, uncommon in cirrhotic patients, can however be considered as a predictor of bleeding from esophageal varices when associated with gastric varices [2], and accounts for 8% of obscure non-variceal hemorrhages in chronic liver disease, along with chronic iron deficiency anemia and high blood transfusion, with an overall mortality rate of 12.5% [3].

Pathophysiology. The mechanisms involved in the pathogenesis of PHG have not been fully elucidated, however increased gastric total blood flow, with reduction in the mucosal component and enhancement in the submucosal and muscular layers, has been demonstrated [4]. Moreover, reduction in the mucus secretion, abnormalities in gastric nitric oxide regulation as well as anomalous production of prostaglandins [4, 5], tumor necrosis factor (TNF-α), and epidermal growth factor may be involved [6]. All these elements can explain the high sensitivity of the gastric mucosa to NSAIDs and the likelihood of developing non-*Helicobacter coli*-related peptic disease [7].

Furthermore, esophageal and associated gastric varices, as well as previous endoscopic treatments (sclerotherapy 20.5%, ligation 2.3%), have been recognized as risk factors for the development of PHG [1, 8]. Anyway, the natural history of PHG, precisely defined in two prospective trials (cirrhotic patients followed for 3 years at 6-month intervals) correlates well with the severity and duration of liver disease [9]; PHG affects 80% of patients, with different evolution patterns

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Fig. 1. Fundic 'red point' mild grade PHG (with associated varices). **Fig. 2.** Portal hypertensive colopathy with different enhancement filters (by Pentax EPK-i Processor®). **Fig. 3.** Non-hemorrhagic GAVE.

(worsening 23%, stationary 29%, improvement 23%, variable 25%), with acute (2.5%) or chronic bleeding (10.8%) and a mortality rate of 12.5% [10]; otherwise, both the worsening (9.4 vs. 18%) and bleeding risks can be lower (4.7 vs. 32%) when PHG develops after variceal eradication [11].

Diagnosis can be correctly made by endoscopic examination and severity is usually scored by the presence of typical features such as mosaic-like pattern, red-point lesions, cherry-red and black-brown spots (fig. 1) [12]. Mild lesions are present in 29–57%, while severe stigmata can be detected in 9–46% of patients [13]. Mucosal lesions usually affect fundic and corporal gastric mucosa; however, PHG-like abnormalities can be detected elsewhere in the gastrointestinal tract, from the duodenum toward the colon and rectum [14] (fig. 2).

PHG with Gastric Antral Vascular Ectasia (GAVE). Initially reported by Rider in 1953, GAVE consists of hypertrophic prepyloric antral folds affected by evident tortuous vascular ectasia with a red color very similar to the 'watermelon stomach' (fig. 3). Histological examination shows typical abnormalities such as intramucosal microvascular ectasia, thrombosis, fibromuscular hyperplasia, fibrohyalinosis and spindle cell proliferation detectable in focal as well as diffuse patterns and a diagnostic accuracy of up to 85% [15]. Differential diagnosis with PHG can sometimes be demanding although it may improve by portal hypertension reduction. Moreover, GAVE can be suspected by the predominant gastric location (fundus and corpus), the more severe liver disease, higher frequency of bleeding episodes, hypogastrinemia, and the history of variceal sclerotherapy; similarly, histological evaluation has shown to be accurate in GAVE confirmation by antral microvascular thromboses, fibrohyalinosis and spindle cell proliferation detection [16] (table 1).

The natural history of GAVE is still controversial, with significant differences among patients with or without cirrhosis; in such cases it can be detected more frequently in females with autoimmune diseases (62%) (scleroderma) [17] as well as in subjects with chronic renal failure, primary biliary cirrhosis, hypothyroidism and after bone marrow transplantation. In all these cases, GAVE is usually confined to the antral region, while in cirrhotic patients it can affect the entire gastric surface. Anyway, liver dysfunction, more than portal hypertension, can be considered the main cause, as demonstrated by the relative low prevalence in cirrhosis (30–83%) [18] and the poor response after the correction of portal hypertension as well as after liver transplantation [19, 20].

Procedural Aspects

Endoscopic treatment cannot be considered as the first option in case of bleeding from PHG, due to the low entity and the spread source of the hemorrhage. Conversely, when the source of bleeding is active and focal, such as in GAVE-related lesions, endoscopy plays a primary role in bleeding control, by the following techniques: (a) *contact thermal*: heater probe (HP), multipolar electrocoagulation (MPEC), radiofrequency (RF); (b) *non-contact thermal:* argon plasma coagulation (APC), cryotherapy; (c) *photocoagulative:* Nd:YAG laser, and (d) *mechanical:* elastic banding ligation (EBL).

APC, HP and Nd:YAG laser can be effective in bleeding control as well as in focal vascular lesion treatment [21, 22]; more recently, EBL [23, 24] seems to be a promising option for wide vascular ectasia, even recurrent after APC treatment, since the significant lower complication rate. Furthermore, preliminary data from pilot studies with cryotherapy [25–27] and RF are available [28, 29].

Patient Preparation

In cirrhotic patients with portal hypertension, medical therapy (propranolol, somatostatin and octreotide, vasopressin and terlipressin) can be considered the first option in order to decrease portal pressure in PHG; additionally, rebamide, tranexamic acid, steroids, estrogens, progesterone and octreotide are currently adopted in experimental trials for bleeding control in GAVE. Invasive procedures, however, such as antrectomy/gastrectomy for GAVE and shunts (transjugular intrahepatic portosystemic shunt vs. surgical) or liver transplantation sustain a role in the management of patients with PHG. Losartan, talidomide, and steroids in PHG are currently under investigation [16].

Technique and Accessories

In active bleeding, examination should be performed with large channel (≥3.2 mm) scopes, in order to improve visualization of source and type of the lesions.

Thermal hemostatic treatment is based on the effects of high temperature on the tissues (edema, protein denaturation, vascular constriction and subsequent coagulation bond) and can be achieved by direct heating (HP) as well as by electrocautery devices (MPEC, APC).

Heater Probe. HP consists of a Teflon-coated hollow aluminum catheter and an inner-heating coil. A thermocoupling device at the tip of the probe keeps the temperature constant. The mechanism of tissue coagulation is direct heat transfer, but coactive pressure is also used with HP therapy; an irrigation distal port is combined. Preselected quantity of energy deployment to the diode in the probe tip is actionable by foot pedal. Therefore, once the pulse has been initiated the duration of activation is predetermined [30].

Table 1. Differentiation of severe PHG from GAVE in the setting of cirrhosis and portal hypertension [adapted from 39]

	PHG	GAVE	p value
Clinical features			
Child-Pugh score	6.9±1.9	8.6±2.3	<0.05
Blood loss, ml/day	8.9±1.6	21.6±35	<0.05
Previous sclerotherapy	42.8%	0%	<0.02
Hemoglobin level, g/dl	13±3.1	10.8±2.4	<0.05
Histological features (antrum)			
Microvascular thrombi	0%	50%	0.006
Vascular ectasia	64%	100%	0.04
Spindle cell proliferation	29%	86%	<0.01
Fibrohyalinosis	36%	92%	0.004

Multipolar Electrocoagulation. Contact probes provide tissue exsiccation and reduction in electric conductivity, leading to a decrease in the maximal temperature (100°C) and the depth of the effect. The MPEC generator is preset at 20–50 W and a port at the tip delivers water for irrigation, with improvement in visualization.

Argon Plasma Coagulation. APC is a non-contact electrocoagulative technique based on high-frequency monopolar current conducted to the tissues through ionized argon gas (argon plasma). Coagulation depth is dependent upon several factors such as generator power setting, gas flow rate, duration of application, and distance of the tissue closest to the electrode allowing for en-face or tangential coagulation (depth and diameter of the coagulation zone increased with duration of application and increase in power settings). The APC unit includes a high-frequency monopolar electrosurgical generator, a source of argon gas and gas flow meter. Disposable probes for endoscopic application consists of a flexible Teflon tube with a tungsten monopolar electrode enclosed in a ceramic nozzle located close to its distal end. APC probes are available in different shapes (linear, radial or spherical) diameters and lengths (2.3 mm OD [220 cm, and 440 cm length], and 3.2 mm OD [220 cm length]).

A foot switch synchronizes argon gas release with the delivery of electrical current. Generators deliver an output voltage of 5,000–6,500 V; the power can be adjusted between 0 and 155 W. Argon gas flow may be adjusted from 0.5 to 7 l/min. In general, low power and low argon flow rates are used for hemostasis of superficial vascular lesions with settings of 40–50 W and 0.8 l/min and the probe tip must be close to the tissue to allow the argon plasma to contact the targeted tissue; conversely, higher output settings are used for the tissue ablation with settings up to 70–90 W and 1 l/min. Very high flow rates may result in prompt gaseous distention and patient discomfort, as well as gas penetration through the wall (pneumatosis) or outside the organ. The operative distance between the probe and tissue ranges from 2 to 8 mm [31]. The surface of the targeted tissue should be free of liquid (including blood), to avoid a coagulated film leaving the tissue surface beneath inadequately treated, reducing efficacy in active hemorrhage. APC is generally performed with applications of 0.5–3 s duration [32] and the probe tip can be directed to 'paint' confluent or near-confluent surface areas, avoiding tissue contact (such as a monopolar fashion).

Nd:YAG Laser. Laser photocoagulation provides light energy of a characteristic wavelength emission and focus into a coherent monochromatic beam, which may result in coagulation or vaporization of the targeted tissue. A flexible optical fiber transmits the laser beam, which can be used in a contact or non-contact fashion. The distal tip (sapphire or ceramic) of the probe must be maintained at 1 cm from targeted area, with a preset power of 40–90 W and 0.5–1 s in duration time application.

Elastic Banding Ligation. Ligation devices consist of a single-use system counting a transparent friction fit adapter (similar to transparent cap) attached to the tip of the scope, preloaded rubber band(s) [1, 4–7, 10] and a release trigger-like mechanism which deploys elastic bands after the tissue is suctioned into the hollow chamber of the adapter. Tissue ligation results in direct hemostatic effect and through necrosis and sloughing [30]. GAVE treatment is generally performed by ligation of the vascular ectasia from the pylorus to the corpus with proximal estension until the normal appearance of gastric tissue with 12.7 bands per session (SD 4.6, range 9–23) (fig. 4).

Cryotherapy. Cryotherapy is a non-contact method for tissue disruption by application of refrigerated gas onto the target mucosa (nitrous oxide, CO_2) and the use in the gastrointestinal tract is still limited, as reported by several pilot studies [33]. Two different methods are suitable for this purpose: one consists of an insulating coated catheter, which releases liquid nitrogen, at –196°C, and the second applies pressurized CO_2 through a 6-french, 200-cm long, single-use catheter. Application is conducted 2–3 cm away from the targeted tissue and the effect is visible after 3–4 s by tissue whitening and ice formation; the procedure can be repeated after 2–3 days to achieve treatment completion [25].

Radiofrequency. RF has recently been applied for GAVE treatment by using the HALO90 (Barrx Medical), consisting of 24 alternate-polarity microelectrodes, which applies energy in up to 3 cm^2 wide areas; the probe, mounted on the distal tip of the scope (in the 12 o'clock position), must be used with 2.8- to 3.4-mm channel instruments. The RF generator is usually preset at 40 W/cm^2 with 12 J/cm^2 of energy density (fig. 5). Treatment consists of four applications for each area, leading ablation uniformly concerning the surface and depth of the effect, which is dependent on the deployed energy density [29].

Personal Experience

Between 2000 and 2008, 43 patients with GAVE were observed at our department. Of these, 21 (48.8%) underwent 54 endoscopic treatments with APC for bleeding. The mean number of therapeutic procedures in each patient was 1.55. More than half of the patients (52.4%) required at least two treatments; in 23.8%, three or more therapeutic endoscopies were needed and 19% of cases were treated 5 times. No patients had more than six examinations. In all cases the endoscopic procedures allowed bleeding control and reduced blood transfusion requirement. Because of the high number of endoscopies needed per patient, in 2009 we introduced EBL in our clinical practice. This initial experience seems to be very effective: we achieved bleeding control in all patients with a single treatment and mucosal healing was faster, reducing the risk of rebleeding from the treated area.

Outcomes

The main goals of GAVE endoscopic treatment are the prevention and control of bleeding, as well as the reduction in blood transfusion requirement; moreover, the choice of the appropriate technique is strictly dependent upon the confidence with the method itself as well as the local expertise and resource availability.

Argon Plasma Coagulation. The effectiveness of this technique is well demonstrated by the abolition in blood transfusion in 77% of patients [21] with subsequent improvement in portal encephalopathy [34] (fig. 6).

Multipolar Electrocoagulation. The depth of tissue injury is dependent upon the power setting, the duration of the contact and the degree of pressure applied to the targeted area (1 mm in depth for slight pressure of 2 s)

Nd:YAG Laser. The hemostatic effect has been shown to be earlier compared with APC and the long-term results are similar [35]. A thermal effect can reach 4–6 mm in depth on the targeted tissue.

Cryotherapy and RF. These techniques have been demonstrated effective for the treatment of lesions that are large and recurrent after APC [26]. Limited available data reported the absence of active bleeding in 71% of patients after 3.6 sessions, with a significant reduction for the need of blood transfusion and an increase in hemoglobin and hematocrit levels, without hematemesis; furthermore, both healing of erosive lesions and complete epithelial restoration were found at 2–4 weeks and 3 months respectively [27, 29].

Radiofrequency. Standardized RF (4 applications at 14 J/cm^2) has shown to be effective in ablating the superficial part of the submucosal layer (1,000 μm), as reported in 6 patients (66.6% APC-resistant) treated with 10 ablative sessions (33 applications for each session; electrode cleaning up to 2.5 times/session; mean duration time 26 min) with technical success in 83.3% [29].

Elastic Banding Ligation. As demonstrated for esophageal varices and compared with thermal treatment, ligation provides vascular ectasia interruption in GAVE, with a significant reduction in the number of blood units transfused (0.9 ± 2.0 vs. 5.7 ± 13.7), the number of hospital admissions for bleeding (0.1 ± 0.3 vs. 1.2 ± 1.7), the number of sessions required for treatment (1.9 ± 0.6, range 1–3 vs. 4.7 ± 4.7, range 1–14), the need for rebleeding prevention after treatment (33 ± 50 vs. 82 ± 41) and, finally, the number of overall blood transfusions after therapy (0.89 ± 2.03 vs. 6.45 ± 14.87) [23]. The mean healing time was about 4 weeks, with mild persistent lesions. The superiority of EBL seems to be related to the higher efficacy in the obliteration of vascular abnormalities affecting mucosal and submucosal layers, as confirmed by results in patients refractory to thermal treatments [24, 36].

Need for retreatment (4–6 weeks later) is based on technical success (efficacy in bleeding control), clinical outcome (recurrent bleeding episodes, hemodynamic instability, blood transfusion requirement) and endoscopic features. Total costs for endoscopic therapy have been demonstrated to be lower for APC compared with Nd:YAG laser; no data about the cost-effectiveness of APC, HP, Nd:YAG laser and cryotherapy are currently available.

Limitations and Complications

The depth of the thermal effect and coagulation are the main predictors of complications, such as perforations and strictures, and dependent upon the technique (lower with APC, mild with MPEC, higher with laser) and the power settings applied; nevertheless, all these methods equally predispose to bleeding and perforation through ulcer and scar formation on the gastric surface as result of treatment.

HP is limited by the small areas treatable in one single session, with a perforation rate of 1.8–3% and intraprocedural bleeding in 5% [37]. APC demonstrated a wide range of complication rates (0–24%), including pneumoperitoneum, pneumomediastinum, visceral perforation,

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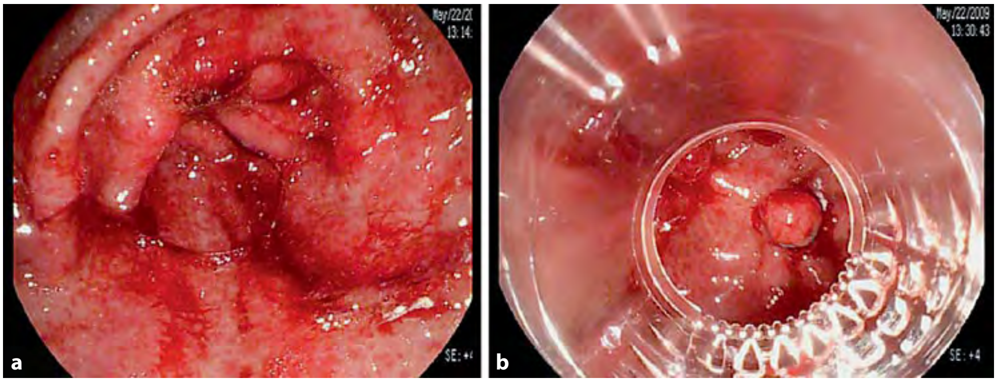

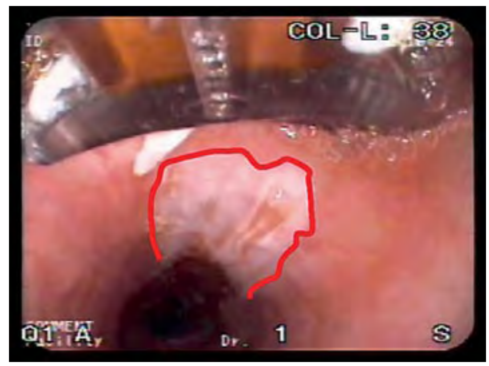

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Fig. 4. **a** Hemorrhagic GAVE. **b** After ligation with 5 bands.

Fig. 5. RF ablation with HALO90 system (ablated area delimited by red line).

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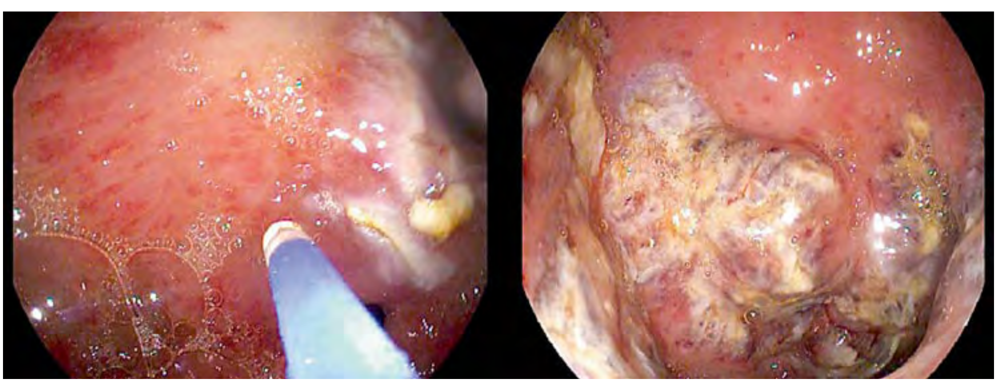

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Fig. 6. Hemorrhagic GAVE treated by the APC-VIO II system (30 W; pulse mode; end-side probe).

Fig. 7. Follow-up endoscopy after APC treatment of hemorrhagic GAVE (1 week later).

subcutaneous emphysema, burning wall syndrome, chronic ulcerations (fig. 7), local pain and bleeding. For analogous power settings, duration and operative distance, APC showed significantly lower perforation rates compared to Nd:YAG laser [32], while the overall number of sessions needed to eradicate lesions is higher. In one single patient, a 74-year-old male, gastric antral stricture has been described after 7 APC sessions [38]. Nd:YAG laser: the risk of perforation (9%) and bleeding (29%) is strictly related to the power adopted; other reported complications include strictures, fistulas, abscesses, fever and pain. Finally, risk for complications seems to be lower with cryotherapy (2.2%) [25], RF (0.25%) and EBL (0%) [23].

Post-Procedure Care Algorithm. Once endoscopic treatment has been considered complete, re examination should be scheduled at 2–4 weeks, at 3 and 6 months interval time.

To summarize: PHG and GAVE can be considered as two different pathological entities, frequently combined, affecting patients with liver cirrhosis and portal hypertension and responsible for acute and chronic bleeding. Differential diagnosis can sometimes be challenging, but endoscopy is basic for the detection of typical features (mosaic-like with or without 'red points' in the proximal stomach versus confluent linear 'red points' with no mosaic-like lesions in the distal stomach) and histological examination can enhance diagnostic accuracy. PHG is frequently responsible for chronic bleeding/anemia and the first treatment option is medical therapy with non-selective β-blockers; failures can be managed by shunting procedures, such as transjugular intrahepatic portosystemic shunt or surgery. Vasoactive drugs, such as terlipressin or somatostatin and analogues, can be effectively adopted in less common acute bleeding episodes; in such cases additional endoscopic therapy can be performed, with a lower successful rate however. Traditional endoscopic hemostatic techniques, like APC, HP and laser are the first-line treatment for both acute and chronic bleeding from GAVE; preliminary data supported the effectiveness of cryotherapy, radiofrequency and banding ligation as appropriate management options.

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