Background. WGC in ERCP is considered a safe technique, although rare complications can occur. One unique complication of WGC is the perforation of the papilla of Vater by the guidewire. Subjects and Methods. Of 2032 patients who underwent ERCP at our department between January 2010 and December 2014, we selected 208 patients who underwent WGC for a naïve papilla as subjects. A detailed examination of patients in whom a perforation occurred was conducted, and risk factors for perforations were investigated. Results. The perforation was observed in 7 of 208 patients (3.4%). All patients recovered with conservative treatment without the need for surgery. The perforation rate was significantly higher in the patients with juxtapapillary duodenal diverticula than those without diverticula (12.5% versus 0.6%, \( p < 0.001 \)). Cannulation of the bile duct was ultimately achieved in 5 of 7 patients; PSP was performed for 4 of these patients. Conclusion. Caution must be exercised when dealing with patients who have a juxtapapillary duodenal diverticulum because they are at higher risk of perforations. Because these are small perforations made by a wire, most of them heal with conservative treatment. However, perforations can make cannulation difficult, and PSP may be useful for deep cannulation.
3. Results

The success rate of WGC was 86.6% (179/208) and the overall success rate of biliary cannulation was 98.1% (204/208) in this study. A perforation of the papilla of Vater was observed in 7 of 208 patients (3.4%) who underwent WGC. Of these, 4 had intraluminal (intradiverticular) perforations, and 3 had extraluminal perforations (Figures 2 and 3). All patients recovered with conservative treatment without the need for surgery. Prior to changing to WGC, cholangiography was possible in 3 patients but was not possible in the remaining 4 patients. Cases in which a perforation was observed are listed in Table 1. The mean age of 7 patients with perforation was 77 years (65–88), of whom 5 were men and 2 were women. Six had juxtapapillary duodenal diverticula and 1 did not. A 0.035-inch jagwire was used for 4 patients, and 0.025-inch visiglide was used for the other 3. There were no perforations by the cannula itself.

The rates of perforation of the papilla of Vater in each factor were also investigated (Table 2). The perforation rate was significantly higher in the patients with juxtapapillary duodenal diverticula than those without diverticula (12.5% versus 0.6%, \( p < 0.001 \)). No difference in the rate of perforations was observed between 0.035-inch guidewire and 0.025-inch guidewire (3.6% versus 3.1%).

Biliary cannulation was achieved in 5 of 7 patients, and pancreatic sphincter precutting (PSP) was performed for 4 of those patients. Of 2 patients for whom cannulation was not possible, 1 underwent elective surgery (choledocholithotomy), and the other recovered with conservative treatment. Computed tomography scans were taken after 1-2 days in patients with extraluminal perforations, but these revealed no findings such as free air or extravasation of the contrast medium in any patient.

4. Discussion

WGC has come to be widely adopted primarily in Europe and the United States as a cannulation technique for ERCP. This is because several randomized controlled trials and meta-analysis have shown that WGC achieves a higher cannulation rate than normal cannulation methods and leads to a lower incidence of pancreatitis [1–7]. The reason why WGC reduces the incidence of pancreatitis is that pancreatography, which is considered a risk factor for post-ERCP pancreatitis, is avoided [1–7]. However, other randomized controlled trials have also shown that the incidence of pancreatitis and the rate of cannulation do not differ from those of normal cannulation methods [8–10]; therefore, a consensus has not yet been reached. WGC is considered a safe method, but rare complications can occur. One unique complication is the perforation of the papilla of Vater by the guidewire. Complications of portal vein cannulation with WGC have also been reported [11, 12].

Kawakami et al. [10] defined perforations of the ampulla of Vater as perforations caused by the guidewire passing through the posterior wall of the ampulla of Vater, and they report that these perforations occurred in 2% (4/199) of the patients they studied. They also noted that these perforations were minor and resolved without therapy. Adler et al. [13] defined the guidewire perforation as “guidewire passage out of the duodenum but not into either the biliary or pancreatic ducts” and noted that it occurred in 1.3% (11/822) of the patients they studied. Deep cannulation was eventually achieved in 10 of these patients (91%), and all
Figure 2: (a) 74-year-old woman who had juxtapapillary duodenal diverticula underwent ERCP for choledocholithiasis. WGC (C + 0.035-inch straight jagwire) was attempted; however, an intradiverticular perforation by the wire was observed on the endoscope screen (arrow). (b) A small amount of bleeding was observed when the perforation occurred. WGC was repeated, but the guidewire passed through the false lumen created by the perforation, and thus biliary cannulation was not possible. Biliary cannulation was achieved by retracting the scope and applying torque to the left.

Figure 3: (a) An 80-year-old man with no juxtapapillary duodenal diverticula underwent ERCP for obstructive jaundice that was induced by cancer of the head of the pancreas. Because of the invasion of pancreatic head cancer to duodenum, having a front view of a papilla of Vater is difficult. (b, c) WGC (S + 0.025-inch angle visiglide) was performed, but the wire made an extraluminal perforation, and extravasation of the contrast medium was observed during fluoroscopy (arrow). After PSP was performed with a pancreatic duct guidewire, deep cannulation of the bile duct and biliary drainage were achieved.
| Case  | Age  | Sex | Indication for ERCP  | Duodenal diverticulum | Device          | Site of perforation | Deep cannulation | Precut | CT findings                      |
|-------|------|-----|----------------------|-----------------------|------------------|--------------------|-------------------|--------|----------------------------------|
| Case 1| 76   | F   | CBD stone            | Yes                   | C + 0.025-inch guidewire | Intraluminal      | Success           | PSP    | Not performed                    |
| Case 2| 86   | M   | Obstructive jaundice | Yes                   | C + 0.025-inch guidewire | Extraluminal      | Unsuccess         | None   | No free air, no extravasation    |
| Case 3| 88   | M   | CBD stone            | Yes                   | C + 0.025-inch guidewire | Extraluminal      | Unsuccess         | None   | No free air, no extravasation    |
| Case 4| 80   | M   | Pancreatic cancer    | None                  | S + 0.025-inch guidewire | Extraluminal      | Success           | PSP    | No free air, no extravasation    |
| Case 5| 74   | F   | CBD stone            | Yes                   | C + 0.035-inch guidewire | Intraluminal      | Success           | None   | Not performed                    |
| Case 6| 65   | M   | CBD stone            | Yes                   | C + 0.035-inch guidewire | Intraluminal      | Success           | PSP    | Not performed                    |
| Case 7| 72   | M   | CBD stone            | Yes                   | C + 0.025-inch guidewire | Intraluminal      | Success           | PSP    | Not performed                    |
Perforations of the papilla of Vater can be classified into 2 categories. The first is intraluminal (intradiverticular) perforations, and the second is extraluminal perforations. Risks of panperitonitis and inflammation of the retroperitoneum are low with intraluminal perforations. When extraluminal perforation occurs, gastrointestinal fluids (including bile and pancreatic juice) may leak outside of the lumen; therefore, the patient must be monitored for panperitonitis and inflammation of the retroperitoneum. When possible, drainage of the perforated bile duct or the pancreatic duct should be performed. However, drainage was only possible for 1 of our 3 patients with extraluminal perforations. Drainage was not possible for the remaining 2 patients, but they recovered with conservative treatment. Such perforations are very small, which is likely why most of them can be treated conservatively.

With both intraluminal and extraluminal perforations, a false lumen is formed, and papillary edema develops. This phenomenon can make cannulation difficult. Four of 5 patients for whom biliary cannulation was finally achieved underwent PSP, indicating that PSP may be useful for deep cannulation. PSP is a method established as a precut technique [18] for patients for whom cannulation is difficult and can open a path from the false lumen to the true bile duct. Some disadvantages of this method include the fact that it cannot be performed when the guidewire cannot be inserted into the pancreatic duct. Therefore, in such instances, compared to the case when WGC is performed from the beginning, it is possible that perforation tends to occur.

5. Conclusion

The perforation of the papilla of Vater is a rare complication associated with WGC that sometimes occurs. Caution must be exercised when dealing with patients who have a juxtapapillary duodenal diverticulum because they are at higher risk of perforations. Perforations are classified as intraluminal or extraluminal based on the site of the perforation. Because they are small perforations made by a wire, most of them can be treated conservatively. However, biliary cannulation can be difficult after perforation occurs; thus, different cannulation strategies are required. PSP may be useful for this purpose.

Competing Interests

The authors declare that they have no competing interests.

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