

## REVIEW

# Contemporary diagnosis and management of gallbladder polyps

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**ABSTRACT**

Gallbladder (GB) polyps are present in 5%–10% of the general population and consist of true neoplastic polyps (adenomas) and pseudopolyps (predominantly cholesterol, inflammatory, hyperplastic, focal adenomyomatosis). True polyps, although relatively rare neoplastic lesions (0.5%) are considered an important factor in malignant transformation and cancer development (5%) when their size is  $\geq 1$  cm. Given that it is essential to diagnose GB adenocarcinoma at an early stage to optimize therapeutic management, controversy exists about whether cholecystectomy is always necessary. Their imaging characteristics, size  $\geq 1$  cm, age  $> 50$  years and genetic predisposition determine the indications for immediate cholecystectomy. In younger patients with polyps  $< 1$  cm in size and without a familial history of GB carcinoma, imaging follow-up by ultrasound (US) seems to be a reasonable recommended policy. A scoring system by multivariate analysis (cross-sectional area  $> 123$  mm<sup>2</sup>, positive blood flow signal, age  $> 55.5$  years, alanine aminotransferase (ALT) levels  $> 50$  U/L and an ALT/AST (aspartate aminotransferase) ratio  $> 0.77$ ) can accurately predict true polyps. The widely accepted size threshold for US follow-up is 7 mm, and for intervention, it is 10 mm. Computed tomography or better magnetic resonance imaging can overcome any misdiagnosis of conventional US incidental findings alone that may lead to potentially unnecessary operations. In challenging cases, high-resolution US, novel three-dimensional US, endoscopic US or contrast-enhanced endoscopic US could be helpful. Novel microflow imaging can safely predict polyps. Risk factors for malignancy include age  $> 60$  years, large gallstones, primary sclerosing cholangitis, Asian ethnicity and sessile polyps accompanied by focal gallbladder wall thickening  $> 4$  mm. For polyps sized 6–9 mm, the absence of growth at recommended follow-up (6 months, one year, and two years) indicates treatment discontinuation; however, it is not required for size  $< 5$  mm without risk factors. In addition to laparoscopic cholecystectomy, the standard management, novel interventional modalities preserving the GB in selected cases include per-oral transmural endoscopic resection of GB polyps after a bridge of endoscopic US-guided cholecystostomy or laparoscopic gallbladder-preserving polypectomy. Generally, there are still no precise and strong evidence-based guidelines; thus, the management policy of GB polyps should be individualized in ambiguous cases.

**Key words:** gallbladder diseases, polypoid lesions, adenomas, gallbladder neoplasms, benign biliary tree diseases, true gallbladder polyps

**INTRODUCTION**


Gallbladder (GB) polyps are present in 5%–10% of the general population with different geographical distributions, and they exhibit benign behaviours in most cases and are usually asymptomatic. Thus, they are

diagnosed incidentally and consist of true neoplastic polyps (adenomas) and no neoplastic pseudopolyps, *i.e.*, predominantly cholesterol polyps, which consist of up to 90% of cases, inflammatory polyps, hyperplastic polyps, and focal adenomyomatosis<sup>[1–5]</sup> as shown in Figure 1.

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Risk factors for GB polyps are generally considered to be obesity, metabolic syndrome, and dyslipidemia, and for polyps that are more than 5 mm in size, male sex, age  $\geq 60$  years and decreased HDL cholesterol are risk factors.<sup>[6]</sup> Fatty liver is related to GB polyps and is considered an independent risk factor for their development regardless of visceral obesity or sarcopenia.<sup>[7]</sup>

True polyps, although relatively rare neoplastic lesions accounting for 0.5% of gallbladder neoplasms and 3.4%–8.9% of all gallbladder polypoid lesions, correlate with size.<sup>[8,9]</sup> They are considered an important factor in malignant transformation and cancer development, which is accompanied by poor prognosis since gallbladder carcinoma has a median 5-year overall survival rate of 5%–8%.<sup>[10]</sup> Their evolutionary natural course is characterized by dysplasia followed by carcinoma *in situ*.<sup>[11]</sup> The latter may occur in 5% of cases when the polyp size is equal to or more than 1 cm and up to 40% when it is 2 cm or more.<sup>[4,8,10,12]</sup> It is well known how imperative an early diagnosis of GB adenocarcinoma is to optimize any treatment chance<sup>[1]</sup> or cost effectiveness.<sup>[13]</sup> However, there is still disagreement regarding whether cholecystectomy is always necessary to achieve the above goal or whether it may be an overtreatment in some cases.<sup>[14]</sup> Despite its dismal prognosis, the GB carcinoma incidence is low and similar among people with or without GB polyps.<sup>[15,16]</sup>

The indications for immediate cholecystectomy without any delay constitute a polyp size equal to or more than 1 cm or other suspicious characteristics on imaging, age more than 50 years and familial predisposing history of GB carcinoma.<sup>[14,15,17,18]</sup> Otherwise, polyps less than 1 cm in size in younger patients without genetic predisposition require ultrasound (US) follow-up.<sup>[4,10,11,19,20]</sup> However, others postulated limited benefits of US surveillance.<sup>[21]</sup> Additionally, the US is not recommended for polyp sizes less than 5 mm but without risk factors.<sup>[14,22–24]</sup>

Diagnosis is based on abdominal US, high-resolution US, endoscopic US, novel three-dimensional US, contrast-enhanced endoscopic US, Computed tomography (CT) and resonance imaging (MRI).<sup>[3,4,10,20,23]</sup> The US accuracy is important and may be increased by the above current modalities.<sup>[25]</sup> On US, the differential diagnosis of true or neoplastic polyps is challenging.<sup>[26–28]</sup>

The prediction of malignant polyps is valuable,<sup>[10,29–31]</sup> and relevant scoring systems have been developed.<sup>[32,33]</sup> Risk factors for malignant transformation as shown in Table 1, include age more than 60 years, large (more than 3 cm) gallstones existing more than 20 years, primary sclerosing cholangitis, Asian and especially Indian ethnicity,<sup>[34]</sup> body mass index  $> 30$  kg/m<sup>2</sup>, *Helicobacter pylori* (*H. pylori*)<sup>[35]</sup> or chronic *Salmonella* infection,<sup>[11]</sup>

Gallbladder polyp types

true neoplastic polyps	non neoplastic pseudopolyps
adenoma	cholesterol
adenocarcinoma	inflammatory
	hyperplastic
	focal adenomyomatosis

Figure 1. Scheme of gallbladder polyp types.

schistosomiasis (bilharziasis),<sup>[36]</sup> size 10 mm or more and sessile polyps accompanied by focal gallbladder wall thickening more than 4 mm and/or disruption of normal layering.<sup>[3,11,20,23,37]</sup> It has been reported that *H. pylori* may not be associated with GB polyp or gallstone formation.<sup>[38]</sup>

Novel microflow imaging can distinguish true polyps from cholesterol pseudopolyps by clearly delineating their vascular morphology and from malignant transformation by revealing their microvessels.<sup>[39–41]</sup>

The perspective of the possible application of artificial intelligence in pancreaticobiliary diseases is essential and could be a helpful diagnostic tool, including for GB polyps.<sup>[42]</sup>

In addition to cholecystectomy, there have been novel interventional modalities preserving the gallbladder, but they are used only in selected cases. They need expertise and long-term evaluation.<sup>[43–45]</sup>

This narrative review evaluates the contemporary knowledge on true or neoplastic polyps (adenomas) of the gallbladder, emphasizing their proper diagnosis and management. This study was based on the data of an extensive literature review from PubMed until August 2023, focusing particularly on full-text papers published only in the English language over the last five years.

DIAGNOSIS

The most widely used diagnostic tool as a first step in day practice is abdominal US,<sup>[25,46–49]</sup> followed by CT<sup>[50–52]</sup> and MRI,<sup>[3,10,20,53,54]</sup> to evaluate GB pathology, particularly for differentiating benign from malignant lesions. CT or better MRI can overcome any misdiagnosis of conventional US incidental findings alone that may lead to potentially unnecessary operations.<sup>[25,55]</sup> In challenging cases high-resolution US, novel three-dimensional US, endoscopic US or contrast-enhanced endoscopic US could be helpful.<sup>[4,10,23]</sup> The used diagnostic tools for gallbladder polyps are shown in Table 2.

**Table 1: Risk factors for malignant transformation of true neoplastic gallbladder polyps**

Factors
Familial predisposing history of GB carcinoma
Age more than 60 years
Large (more than 3 cm) gallstones existing more than 20 years
Primary sclerosing cholangitis
Asian and especially Indian ethnicity
BMI > 30 kg/m <sup>2</sup>
<i>H. pylori</i> or <i>Salmonella</i> chronic infection
Schistosomiasis (bilharziasis)
Polyp size ≥ 10 mm
Sessile polyp
Focal gallbladder wall thickening more > 4 mm
Disruption of normal layering of gallbladder wall
Single polyp than multiples
Cross-sectional area ≥ 85 mm <sup>2</sup>
Broad base
Medium echogenicity

**Table 2: Used diagnostic tools for gallbladder polyps**

Modality
Plain abdominal ultrasound
Contrast enhanced ultrasound
High frequency ultrasound
Doppler ultrasound
High resolution ultrasound
Novel three-dimensional ultrasound
Endoscopic ultrasound
FNA under endoscopic ultrasound guidance
Contrast enhanced endoscopic ultrasound guidance
Computed tomography
Dynamic or triphasic contrast enhanced computed tomography
Dual energy computed tomography
Magnetic resonance imaging
Positron emission tomography-computed tomography for suspicious gallbladder polyp or gallbladder carcinoma staging

Evidence-based recent guidelines recommend routine plain abdominal US as the primary diagnostic investigation and contrast-enhanced or endoscopic US, when they are available. MRI is the imaging method of choice in cases of strong clinical suspicion.<sup>[32,37]</sup>

High-frequency US in combination with color Doppler US is a valuable diagnostic modality since it yields a high diagnostic accuracy and sensitivity of over 90% with a

specificity of 100% in GB polyps.<sup>[56]</sup>

High-resolution US is considered particularly valuable for the evaluation of GB wall layering.<sup>[54]</sup>

Endoscopic US ensures high-resolution images<sup>[57]</sup> and may also be combined with fine needle aspiration to safely diagnose GB malignancy in suspected cases.<sup>[58]</sup>

The growth rate during US follow-up of small GB polyps equal to or greater than 3 mm per year is considered a risk factor for malignancy and indicates immediate cholecystectomy.<sup>[59,60]</sup>

A recent large systematic review and meta-analysis by Foley *et al.* including 67,774 polyps and 889 carcinomas of GB found that the risk of polyp malignancy is low and especially for those less than 1 cm in size.<sup>[61]</sup> Li *et al.*, in a retrospective study including 2,290 GB specimens after cholecystectomy for GB polyps diagnosed by US, found that the risk of GB carcinoma was low (0.4%), and polyps were not detected on histopathology in 73% of cases. Thus, they stressed that plain abdominal preoperative US alone may not be reliable for diagnosing GB polyps.<sup>[62]</sup> Similar allegations for the reliability of US alone have been formulated by Lodhi *et al.*, who recommend following MRI.<sup>[25]</sup>

It has been reported that GB polyps may be detected on US during a second look in cases of fatty liver disease, older age and alcohol consumption, where there are imaging difficulties.<sup>[63]</sup>

It has been postulated that the risk of GB carcinoma is not increased in small polyps incidentally detected by US.<sup>[64]</sup> Subsequently, a rising debate addresses the necessity of frequent and long-term US scheduled follow-up for small polyps.<sup>[65]</sup>

The imaging features as shown in Table 3, included size, single or multiple lesions, sessile or pedunculated shape, base dimpling and wall thickening, smooth or lobulated surface, foci in the lesion, hypo-iso-hyper echo level, and homo/heterogeneous echo pattern. Wall thickening with enhancement and a single, large, sessile polyp support malignancy.<sup>[66,67]</sup>

Three independent factors, including a lower ratio of polyp height to width, detection of vascularity and absence of hyperechoic spots, can safely distinguish true neoplastic polyps from cholesterol pseudopolyps.<sup>[68]</sup>

It has been reported that polyp growth status is not a reliable factor for differentiation between true neoplastic polyps and cholesterol pseudopolyps.<sup>[69]</sup>

Dynamic contrast-enhanced CT can differentiate cholesterol pseudopolyps from true neoplastic polyps by combining the size of the polyp and the ratio of polyp to gallbladder bile enhancement.<sup>[70]</sup> Triphasic dynamic enhanced CT is valuable in distinguishing GB lesions 10–20 mm in size as either true neoplastic polyps or cholesterol pseudopolyps.<sup>[71]</sup>

Dual-energy CT has been advocated in distinguishing true neoplastic polyps 1–2 cm in size from cholesterol

pseudopolyps.<sup>[72]</sup>

Contrast-enhanced US has been shown to be comparable to CT differential diagnosis for GB polyps that are more than 10 mm in size, which can be either true neoplastic polyps or nonneoplastic pseudopolyps.<sup>[73–75]</sup> Conventional US combined with contrast-enhanced US has been used successfully to distinguish true neoplastic polyps from cholesterol pseudopolyps.<sup>[76–80]</sup>

An artificial model based on CT features has been established to differentiate cholesterol pseudopolyps from true neoplastic polyps.<sup>[81]</sup>

Artificial intelligence has been used in differentiating polyps found by endoscopic US, the most reliable diagnostic tool, to overcome its interpretation difficulties.<sup>[82]</sup>

Preoperative US characteristics for polyps sized  $\geq 10$  mm to 15 mm have been proposed in various prediction models to distinguish the risk of neoplastic polyps.<sup>[83–86]</sup> Suspected findings include a single polyp, cross-sectional area  $\geq 85$  mm<sup>2</sup>, broad base, and medium echogenicity.<sup>[87]</sup> Size is the main risk factor, while multiplicity is related to benign disease.<sup>[88]</sup>

Another proposed scoring system can accurately predict true polyps. It includes the following parameters evaluated by multivariate analysis: cross-sectional area more than 123 mm<sup>2</sup>, positive blood flow signal, age more than 55.5 years, alanine aminotransferase (ALT) levels above 50 U/L and an ALT/AST (aspartate aminotransferase) ratio greater than 0.77.<sup>[32]</sup> Likewise, a reliable scoring system using the presence of symptoms, age more than 50 years, single polyp, polyp size more than 12.5 mm, coexisting cholelithiasis and GB wall thickness equal to or more than 4 mm was developed. In scores less than 4, the risk for true neoplastic polyps is 0.6%, while when the score is equal to or more than 4, the risk is 63.2%.<sup>[89]</sup>

Sun *et al.* found that significant factors for GB adenoma polyp size more than 11.5 mm by multivariate analysis were intralesional blood flow and without GB inflammation; by univariate analysis, the above risk factors were found, as well as age more than 49.5 years and asymptomatic polyp.<sup>[90]</sup>

Onda *et al.* in their scoring system, found that significant factors for malignancy by multivariate analysis were age 65 years or more and polyp size 13 mm or more; by univariate analysis, the above risk factors were found, as well as gallstone existence, solitary polyps and sessile polyps.<sup>[91]</sup>

**Table 3: Useful searching imaging features on gallbladder polyp investigation**

Features
Size
Single or multiple lesions
Sessile or pedunculated shape
Base dimpling, wall thickening
Smooth or lobulated surface
Foci in the lesion
Echo level (hypo-iso-hyper)
Echo pattern (homo/hetero-geneous)
Ratio of polyp height to width
Detection of vascularity
Absence of hyperechoic spot

The presence of gallstones, age, CEA, size and sessile polyps have been considered independent predictors of neoplastic potential in a nomogram model.<sup>[92,93]</sup>

Another nomogram established by multivariate regression analysis and based on CT evaluation along with inflammation markers such as neutrophil-lymphocyte ratio and monocyte-lymphocyte ratio has been proposed for discrimination between benign and malignant GB polyps.<sup>[94]</sup>

A survey among fellows of the Society of Radiologists in Ultrasound for the evaluation and management recommendation of GB polyps showed size (100%), wall thickening (76%) and shape (67%) as important parameters. The accepted size threshold for US follow-up was 7 mm and for intervention was 10 mm.<sup>[33]</sup>

The tumor markers CA 19-9, CA 125, CEA, and CA 242 have been found to be elevated in GB carcinoma and could contribute to its early diagnosis. However, they cannot predict survival but only any possible response to treatment in follow-up.<sup>[95]</sup> Polyp size greater than 11 mm with elevated CA 19-9, CA 72-4 and CEA constitute indications of malignant transformation.<sup>[96]</sup>

It has been reported that increased levels of fibrinogen and platelets are related to GB malignancy.<sup>[97]</sup>

Spectroscopy of bile samples using extracellular vesicles, near-infrared spectroscopy or voltage application has been used for the identification of GB carcinoma in cases of polypoid lesions<sup>[98–102]</sup> or GB stones and GB polyps.<sup>[103]</sup>

It has been postulated that there is an association between overgrowth of small intestinal microbial flora detected by a hydrogen-methane simple breath test and

GB polyps; this correlation is stronger in women.<sup>[104]</sup> A similar simple breath test by lactulose has been proposed for the detection of colorectal polyps.<sup>[105]</sup>

The recommended imaging modalities in cases of suspicious GB polyp malignant transformation or for preoperative GB carcinoma staging include CT, MRI and fluorine-18-labeled fluorodeoxyglucose (18F-FDG) PET-CT.<sup>[3]</sup>

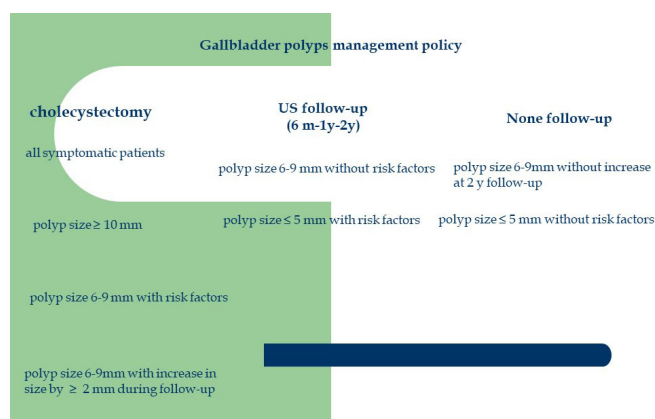
MANAGEMENT

The management of gallbladder polyps is still under debate. However, the evidence-based guidelines established by the European Society of Gastrointestinal and Abdominal Radiology (ESGAR), European Association for Endoscopic Surgery and other Interventional Techniques (EAES), International Society of Digestive Surgery - European Federation (EFISDS) and European Society of Gastrointestinal Endoscopy (ESGE)<sup>[106]</sup> that were updated recently<sup>[20]</sup> recommend management according to the polyp size, growth rate and presence of symptoms with the existing critical analysis.<sup>[37]</sup> Because of the low incidence of GB polyps, there has been a lack of large studies; thus, the existing studies have low quality. Subsequently, any evidence-based recommendations are of low to moderate validity. However, the awareness of current aspects and the updated guidelines for successful management of these patients are valuable.<sup>[37]</sup>

The worldwide clinical practice has been in accordance with the following recommendations based on the above guidelines as shown in Figure 2.

For polyp sizes greater than 10 mm, the presence of symptoms regardless of size or growth greater than 2 mm in two years regardless of size, cholecystectomy is





**Figure 2.** Scheme of gallbladder polyp management policies.

strongly recommended; for smaller lesions with or without risk factors, monitoring is recommended.<sup>[20,37,106]</sup> These risk factors for malignancy include age greater than 60 years, primary sclerosing cholangitis, Asian ethnicity and sessile polypoid lesions, including focal gallbladder wall thickening > 4 mm. Defining risk factors is a multidisciplinary task.<sup>[20,37,106]</sup>

It has been postulated by Liu *et al.* that the abovementioned threshold for polyp size of 10 mm is considered inadequate as an indication for cholecystectomy, and they proposed a new threshold of 12 mm.<sup>[107]</sup>

For polyps 6–9 mm in size, the absence of growth or an increase of less than 2 mm at the recommended two-year follow-up (6 months, one year, and two years) indicates termination.<sup>[4,12,20,37,106]</sup> However, when polyps 6–9 mm are initially diagnosed, if any risk factor for malignancy is present, cholecystectomy will be recommended in fit patients for surgery after reassuring them and obtaining their consent.<sup>[4,10,20,37,106]</sup>

For polyps 5 mm or less in size, follow-up is not required when there are no risk factors; otherwise, a two-year follow-up is indicated as described above.<sup>[3,14,20,24,106]</sup> These small polyps had a low risk of size increase, and none developed malignant transformation in long-term (up to 10 years) US follow-up.<sup>[108]</sup> Valibouze *et al.* advocated in the latter case, *i.e.*, with risk factor existence, abdominal US surveillance lasting at least 5 years and when an increase by 2 mm in polyp diameter is detected, cholecystectomy will be necessary.<sup>[109]</sup> Wu *et al.* raised this limit of increase for cholecystectomy indication to 3–4 mm but within a six-month follow-up period.<sup>[110]</sup>

It is well known that solitary polyps are related to a greater risk of malignant transformation than multiple polyps, but no difference was found between them in growth rate. It is important that they remain stable

during follow-up with growth less than 2 mm in 92% of cases,<sup>[111,112]</sup> although an opposite argument in favor of a higher growth rate as part of their natural history has been raised.<sup>[15,113]</sup> A surveillance program found that initial pathology yielded a premalignant or malignant pathology in 1.97% of patients, with a 1.2% annual addition.<sup>[13]</sup>

Laparoscopic cholecystectomy is currently the gold standard for the management of GB polyps.<sup>[4,10,20,114]</sup>

It should be stressed that in the case of a GB polyp size of 2 cm or more without any evidence or even indication of malignancy, a surgical plan similar to that of GB carcinoma is required.<sup>[115]</sup> This means that laparoscopic cholecystectomy is not indicated because of strong suspicion of malignancy.<sup>[116]</sup> Subsequently, an open operation must be performed preferably by an experienced hepatobiliary surgeon considering the carcinoma management strategy as described below.

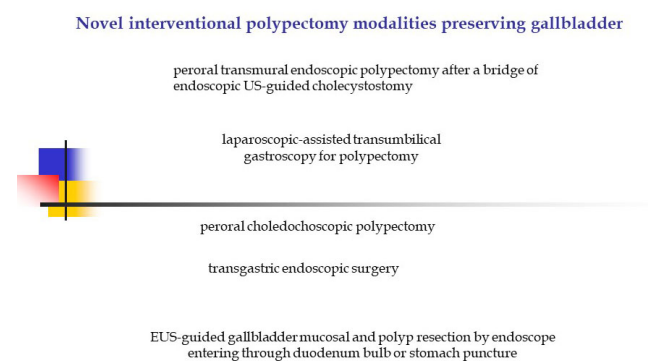
For GB polyps 10–15 mm in size or GB wall thickening without any evidence or even indication of malignancy, an experienced general surgeon can safely perform laparoscopic cholecystectomy, but GB perforation should be avoided in all cases to prevent possible intraabdominal dissemination of cancer cells in cases of initially occult malignancy but that are found finally on biopsy. This obligation may require conversion to open surgery without hesitation in potentially difficult cases.<sup>[109,117]</sup> However, in cases where the specimen biopsy shows GB adenocarcinoma T1b or beyond, an expert hepatobiliary surgeon must perform adequate hepatic resection of the gallbladder bed without delay or even in more advanced stage hepatic trisegmentectomy, both accompanied by resection of the extrahepatic biliary tree with total lymph node clearance and hepaticojejunostomy Roux-Y.<sup>[118]</sup>

### **Novel interventional techniques for removing GB polyps**

The GB preservation has gained recently an increasing attention removing only the polyps. The novel interventional modalities preserving the GB are shown in Figure 3. They include the following.

a. Per-oral transmural endoscopic resection of GB polyps after a bridge of endoscopic US-guided cholecystostomy. Under ultrasound guidance, the endoscopic placement of a lumen-apposing metal stent creates initially a cholecystogastrostomy or cholecystoduodenostomy. In second stage after some days, a gastroscope is inserted through the cholecystostomy into the GB for resection of polyps.<sup>[43,119]</sup>

b. Laparoscopic-assisted transumbilical gastroscopy for gallbladder-preserving polypectomy. It is achieved by the



**Figure 3.** Scheme of novel interventional polypectomy modalities preserving gallbladder.

cooperation of a laparoscopic surgeon and an GI endoscopist. Under general anaesthesia, a small incision is performed laparoscopically in gallbladder wall and a gastroscope entering through the umbilical trocar is inserted into the GB to perform the polypectomy.<sup>[44,120,121]</sup>

c. Peroral choledochoscopic gallbladder-preserving polypectomy. A novel choledochoscope entering the gallbladder through the cystic duct can resect polyps.<sup>[122]</sup> An adjusted probe of confocal laser endomicroscopy or otherwise called optical biopsy, is a novel endoscopic imaging tool that through the choledochoscope can detect malignant transformation of a polyp.<sup>[45]</sup>

d. Transgastric endoscopic gallbladder preserving surgery. After incision on the antrum, the gastroscope is entered into the peritoneal cavity finding the GB and then through an incision on its wall, it is inserted into its cavity to remove the polyp.<sup>[123]</sup>

EUS-guided gallbladder mucosal and polyp resection is faster and less traumatic with fast recovery and fewer complications than the other abovementioned interventional techniques. The endoscope is guided into the GB cavity under ultrasound guidance through either the bulb of the duodenum or stomach puncture.<sup>[124]</sup>

However, it should be stressed that all the abovementioned interventions need further evaluation and long-term outcomes. On the other hand, in coexistence of polyp with symptomatic cholelithiasis, a laparoscopic cholecystectomy is necessary to avoid stone recurrence. Nevertheless, they open new horizons in the management options.

## CONCLUSION

True or neoplastic GB polyps have a low incidence and

risk of malignancy. They usually do not cause any symptoms and are detected incidentally by ultrasound. Current imaging modalities can distinguish neoplastic from nonneoplastic polyps mainly from the most frequent cholesterol pseudo-polyp. Additionally, they can evaluate suspicious cases of malignant transformation by detecting malignancy earlier or the stage of an existing GB carcinoma preoperatively. The management policy based on current guidelines depends on the polyp size, growth rate and symptoms. Cholecystectomy is strongly recommended for all cases with a lesion size of 10 mm or more, when an increased risk of malignancy exists in lesions that are sized 6-9 mm, in all symptomatic patients with or without gallstones and in cases with an increasing lesion size of 2 mm or more during regular two-year US follow-up. In small polyps that are sized 5 mm or less without risk factors, no follow-up is needed. Generally, there are still no precise evidence-based strong guidelines; thus, the management policy of GB polyps should be individualized in ambiguous cases.

## DECLARATIONS

### Author contributions

Pavlidis TE designed research, contributed new analytic tools, analyzed data and review; Galanis IN analyzed data and review; Pavlidis ET performed research, analyzed data, review and wrote the paper.

### Ethics approval

Not applicable.

### Source of funding

None.

### Conflicts of interest

The authors declared no potential conflicts of interest.

### Data sharing statement

No additional data is available.

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