

# Nonfluoroscopic endoscopic ultrasound-guided transmural drainage of pancreatic pseudocysts at atypical locations

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## Abstract

**Background:** Pancreatic pseudocysts (PP) at atypical locations are a therapeutic challenge and are usually managed surgically. **Objective:** We evaluated safety and efficacy of nonfluoroscopic endoscopic ultrasound (NF-EUS)-guided transmural drainage in the management of PP at atypical locations. **Patients and Methods:** Retrospective analysis of 11 patients (all males; age range: 28–46 years) with PP at atypical locations who were treated with NF-EUS-guided transmural drainage during the last 18 months was done. **Results:** Four patients had intra/peri-splenic, three patients had mediastinal, three patients had intrahepatic, and one patient had renal PP. Nine patients had chronic pancreatitis whereas two patients had acute pancreatitis. Alcohol was the etiology of pancreatitis in ten patients. The size of PP ranged from 4 to 10 cm. All patients had abdominal pain, and two patients had fever whereas one patient with mediastinal PP also had dysphagia. NF-EUS-guided transmural drainage could be done successfully in all patients. 7 Fr transmural stent (s) was/were placed in six patients whereas single-time complete aspiration of PP was done in five patients. On endoscopic retrograde pancreatography, six patients had partial duct disruption whereas five patients had complete disruption. Bridging transpapillary stent (5 Fr) was placed in all patients with partial disruption. All PP healed in 10/11 (91%) patients within 2–4 weeks, and there has been no recurrence in 9 of these patients during a follow-up period of 4–18 months. One patient with splenic PP needed surgery for gastrointestinal bleed. **Conclusion:** PP at atypical locations can be effectively and safely treated with NF-EUS-guided transmural drainage.

## Key words

Endosonography, pancreatitis, pseudocyst, stent

## Introduction


Pancreatic fluid collections including pseudocysts are a consequence of pancreatic duct (PD) disruption that

can occur due to pancreatitis, trauma, or surgery.<sup>[1]</sup> The pseudocysts are a collection of pancreatic secretions in nonepithelialized fibrous tissue wall with no or minimal necrotic debris.<sup>[1,2]</sup> The pseudocysts are usually located in the peripancreatic area, but occasional reports of distant and atypical locations of pseudocysts such as liver, spleen, mediastinum, neck, pelvis, and kidneys have also been reported in the literature.<sup>[3-9]</sup>

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The pseudocysts have been traditionally treated by surgery or radiologically guided percutaneous drainage. However, in the last two decades, there has been a considerable advancement in gastrointestinal endoscopy and it by virtue of being minimally invasive, relatively safe, and cost-effective, has become the first-line treatment approach for patients with pancreatic pseudocyst (PP).<sup>[10]</sup> The endoscopic drainage can be accomplished using transmural or transpapillary placement of endoprosthesis or both.<sup>[1,2,10]</sup> The previous studies advocated transpapillary drainage for communicating pseudocysts because of lower complication rates, especially in pseudocysts <6 cm in size.<sup>[11]</sup> However, with advancement in endoscopic instruments and advent of endoscopic ultrasound (EUS), endoscopic transmural drainage is now being increasingly preferred for drainage of pseudocysts.<sup>[12]</sup> The creation of wider drainage diameter during transmural drainage leads to quicker resolution of pseudocysts with less chances of getting infected.

Because of being rare, the published experience on the management of pseudocysts at atypical locations is limited. The majority of reported cases have been treated surgically with occasional ones treated radiologically.<sup>[9,13,14]</sup> The experience with endoscopic drainage is limited to case reports and occasional case series with the majority of patients being treated with endoscopic transpapillary drainage. We have previously reported successful resolution of PP at atypical locations including liver, spleen, mediastinum, and kidney using endoscopic transpapillary drainage.<sup>[6]</sup> The transmural drainage has been rarely used to treat PP at atypical locations with only few published case reports.<sup>[15-17]</sup>

In this study, we describe our experience of treating 11 cases of PP at various atypical locations with nonfluoroscopic EUS (NF-EUS)-guided transmural drainage.

## Patients and Methods

We performed a retrospective analysis of patients with PP at atypical locations seen at our unit over the last 18 months. Clinical records were reviewed to identify patient symptoms and imaging findings. All patients were symptomatic and had PP in the liver, spleen, kidney, or mediastinum documented on the contrast-enhanced computed tomography (CECT) scan. All patients provided informed consent at the time of endoscopic treatment, and the protocol was approved by our Institutional Ethics Committee.

The pseudocysts and the pancreas were evaluated using linear EUS (EG-3870 UTK Linear Echoendoscope Pentax Inc., Tokyo, Japan, or GF-UCT 180 Linear Echoendoscope; Olympus Pvt. Ltd., Tokyo, Japan). The pseudocysts were carefully evaluated for the presence of any solid necrotic debris to exclude walled-off pancreatic necrosis. The optimal site for drainage was chosen under EUS and color Doppler

guidance. Patients were given intravenous antibiotics before the procedure, and they were continued orally in patients with infected pseudocyst. The procedure was carried out under conscious sedation using intravenous midazolam. The pseudocyst was punctured under EUS guidance with a 19-gauge needle (Echotip; Cook Endoscopy, Winston-Salem, NC, USA). After the withdrawal of the stylet of the needle, the pseudocyst was aspirated to confirm correct position of the needle in the cavity and the aspirated fluid was sent for bacterial culture. Thereafter, a 0.035-inch guide wire was introduced and coiled into the pseudocyst under EUS guidance. Once the guide wire was secured deep into the cavity, the access site was dilated by noncautery method using endoscopic retrograde pancreatography (ERP) cannula or 4 mm biliary balloon dilator. If it was not possible to dilate the tract with the cannula because of a thickened wall, the tract was dilated using electrocautery with a wire-guided needle knife. The tract was further dilated with a wire-guided hydrostatic balloon (Controlled Radial Expansion Balloon; Boston Scientific, Natick, MA, USA) up to 8–12 mm. Following dilatation, one or two 7-Fr double-pigtail stents, 3 or 5 cm in length, were inserted into the pseudocyst.

If the pseudocyst was located >1 cm away from the gastrointestinal tract wall and/or a significant amount of intervening organ parenchyma was present in the needle tract, following needle puncture, no further dilatation was done and the pseudocyst was completely emptied by aspirating and this was followed by transpapillary drainage. Furthermore, patients with splenic pseudocysts seen during first 6 months were first taken up for ERP as a part of previous ongoing study, and EUS-guided transmural drainage was done only in case of nonresponse.

ERP was performed by standard technique using a TJF 160 or TJF-Q180V (Olympus Pvt. Ltd., Tokyo, Japan) side-viewing duodenoscope, and PD disruption was defined by free extravasation of contrast outside pancreatic ductal system after contrast injection. PD disruption was defined as complete when the main duct upstream to disruption was not visualized and as partial when the main duct was visualized upstream. In patients with partial disruption, an attempt was made to bridge disruption and place a 5/7 Fr stent across disruption. No transpapillary stents were placed in patients with complete disruption.

In patients with splenic pseudocyst having partial disruption that was bridged, if there was no response or patient had worsening of abdominal pain or had new onset/persistent fever with leukocytosis, they underwent repeat imaging. The patients with the same or increased size of pseudocyst underwent EUS-guided single-time complete aspiration with a 19-gauge needle or placement of transmural stents as described above. The decision to proceed with either of the drainage methods was based on endoscopist's assessment of the risk of splenic rupture with aspiration only being done if >50% splenic

parenchyma was destroyed. Patients with complete disruption underwent single-time complete aspiration or placement of transmural stents as described above within 2 days of ERP.

All these patients were followed up weekly for: (1) clinical reevaluation and (2) abdominal ultrasound. CECT of the abdomen was repeated when there was complete recovery along with resolution of pseudocysts on ultrasound. The patients who did not respond or had worsening of pain or had new onset/persistent fever with leukocytosis underwent repeat imaging. The patients with the same or increased size of pseudocyst underwent repeat endoscopic transmural drainage under endoscopic and fluoroscopic guidance. The tract was further dilated up to 15 mm and 2–3 10 Fr, 3 or 5 cm in length, double-pigtail stents were placed into pseudocyst. If, again, the pseudocyst persisted with persisting symptoms, a decision for additional transmural drainage by stents or surgery was taken after interdisciplinary consultation with pancreatic surgeons.

Treatment success was defined as resolution of symptoms with a resolution of pseudocysts on follow-up CECT with no need of surgery. Following resolution, transpapillary stent was removed and pancreatogram obtained to document healing of disruption, and thereafter, transmural stents were also removed. In patients with complete disruption, transmural stents were removed 8 weeks after documentation of resolution of symptoms and pseudocysts. Patients with complete disruption who underwent single-time aspiration of the pseudocyst underwent weekly ultrasound for the first 2 months to detect recurrence. After 2 months, these patients were regularly followed in our clinic with further investigations being done at the discretion of treating clinician.

## Results

Eleven patients (all males; mean age:  $39.1 \pm 5.9$  years; range: 28–46 years) with PP at atypical locations were studied. Four patients had intra-/peri-splenic, three patients had mediastinal, three had intrahepatic, and one patient had renal pseudocyst. The patient with renal pseudocyst had compromised renal function on Tc99m-diethylenetriaminepentacetate scan

although serum creatinine was normal. Nine patients had chronic pancreatitis whereas two patients had acute pancreatitis. Alcohol was the etiology of pancreatitis in ten patients whereas one patient had idiopathic chronic pancreatitis. The size of the pseudocysts ranged from 4 to 10 cm (mean:  $6.8 \pm 1.8$  cm). All patients had abdominal pain, and two patients had fever whereas one patient with mediastinal pseudocyst also had dysphagia to solids. Four (36%) patients had coexistent abdominal pseudocyst, 5/11 (45%) patients had pleural effusion (3 splenic and 2 mediastinal), and 2 (18%) patient had ascites (splenic) [Table 1].

Two patients with large splenic pseudocyst (9 and 10 cm size) underwent ERP and transpapillary drainage first. In both these patients, a 5 Fr transpapillary stent was placed bridging the partial disruption. However, as these patients continued to be febrile with no relief in pain or decrease in the size of pseudocyst, they subsequently underwent EUS-guided aspiration.

EUS-guided transmural drainage/aspiration was attempted in all the 11 patients and could be done successfully in all of them [Table 2]. 7 Fr transmural stent(s) was/were placed in six patients (two stents in four patients and one stent in two patients) whereas single-time complete aspiration of pseudocysts was done in five patients. The transmural stents were placed in three patients with hepatic [Figure 1], two patients with mediastinal [Figure 2], and one patient with renal pseudocyst. The transesophageal route was used in three patients (two mediastinal and one hepatic pseudocyst) whereas transgastric route was used in remaining three patients (two hepatic and one renal pseudocyst, respectively). Single-time EUS-guided complete aspiration of pseudocyst was done in 5 patients (four splenic and one mediastinal pseudocyst). Transmural drainage with stents could not be done in one patient with mediastinal pseudocyst because of distant location along with the presence of numerous venous collaterals consequent to splenic vein thrombosis. Similarly, it could not be done in four patients with splenic pseudocysts because of the high risk of splenic rupture in two patients and the presence of significant intervening splenic parenchyma in

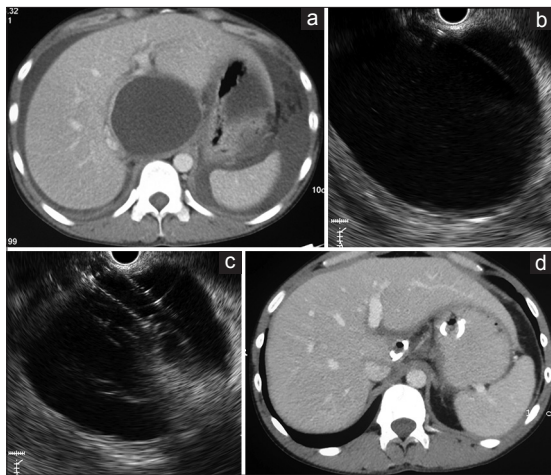
**Table 1: Demographic and clinical profile of patients with pseudocysts at atypical locations**

Serial number	Age	Sex	Etiology	Pain	Fever	Pleural effusion	Ascites	Location	Size (cm)	Coexistent abdominal pseudocysts
1	32	Male	Idiopathic	Yes	Yes	Yes	No	Splenic	9	No
2	42	Male	Alcohol	Yes	Yes	Yes	Yes	Splenic	10	No
3	34	Male	Alcohol (acute)	Yes	No	Yes	No	Splenic	6	No
4	46	Male	Alcohol	Yes	No	No	No	Splenic	4	No
5	38	Male	Alcohol	Yes	No	Yes	No	Mediastinal	5	Yes
6	28	Male	Alcohol	Yes	No	No	No	Mediastinal	8	Yes
7	46	Male	Alcohol	Yes	No	Yes	No	Mediastinal	6	Yes
8	42	Male	Alcohol (acute)	Yes	No	No	Yes	Hepatic	8	No
9	36	Male	Alcohol	Yes	No	No	No	Hepatic	6	No
10	42	Male	Alcohol	Yes	No	No	No	Renal	7	No
11	44	Male	Alcohol	Yes	No	No	No	Hepatic	6	Yes

**Table 2: Interventions and outcome in patients with pseudocysts at atypical locations**

Serial number	PD disruption	EUS transmural intervention	Transpapillary intervention	Period of resolution	Surgery	Follow-up (months)
1	Partial, single	Aspiration	5 Fr stent	2 weeks	No	16
2	Partial, single	Aspiration	5 Fr stent	Surgery	Yes	-
3	Complete	Aspiration	None	4 weeks	No	6
4	Partial, single	Aspiration	5 Fr stent	2 weeks	No	11
5	Complete	7 Fr stent	None	4 weeks	No	6
6	Complete	7 Fr Stent	None	3 weeks	No	4
7	Partial, single	Aspiration	5 Fr stent	2 weeks	No	11
8	Complete	7 Fr stent	None	2 weeks	No	8
9	Complete	7 Fr stent	None	3 weeks	No	12
10	Partial, single	7 Fr stent	5 Fr stent	4 weeks	No	11
11	Partial, single	7 Fr stent	5 Fr stent	3 weeks	No	4

PD=Pancreatic duct, EUS=Endoscopic ultrasound

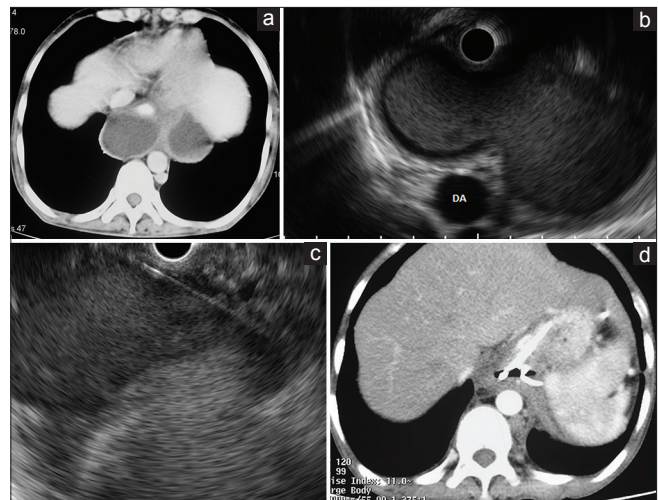


**Figure 1:** (a) Computed tomography: Intrahepatic pseudocyst. Ascites is also noted with minimal intrahepatic biliary dilatation. (b) Endoscopic ultrasound-guided drainage. Guide wire noted in the pseudocyst cavity. (c) Balloon dilatation of the tract under endoscopic ultrasound guidance. (d) Computed tomography at 2 weeks. Complete resolution of pseudocyst as well as ascites with pigtail stent *in situ*

the drainage tract in two patients, respectively. All the patients had marked improvement in their symptoms following the drainage/aspiration.

This was followed by ERP in nine patients who had undergone transmural drainage first. On ERP, four patients had partial disruption (splenic 1, mediastinal 1, renal 1, and hepatic 1) of the PD whereas five patients had complete disruption (hepatic 1, mediastinal 2, and splenic 1). Bridging transpapillary stent (5Fr) was placed in all patients with partial duct disruption. Two patients with partial disruption underwent complete aspiration of the pseudocyst whereas two patients underwent transmural drainage with plastic stents. On the other hand, four patients with complete disruption underwent transmural drainage with stents and only one patient underwent single-time aspiration.

All the pseudocysts healed in 10/11 (91%) patients within 2–4 weeks. One patient with splenic pseudocyst had a massive



**Figure 2:** (a) Computed tomography: Large mediastinal pseudocyst. (b) Endoscopic ultrasound: Large lobulated mediastinal pseudocyst. DA = Descending aorta. (c) Endoscopic ultrasound-guided drainage. Guide wire noted in the pseudocyst cavity. (d) Computed tomography at 3 weeks. Complete resolution of pseudocyst with pigtail stents *in situ*

gastrointestinal bleed on the 7<sup>th</sup> day of endoscopic transmural aspiration, and computed tomographic (CT) angiography revealed a 2.3 cm splenic artery pseudoaneurysm. As the patient had a hemodynamic compromise, emergency surgery was performed, and the patient had an uneventful postoperative course. The other ten patients who underwent successful endoscopic drainage of the pseudocysts were subsequently followed up.

On follow-up, the ERP revealed healing of ductal disruption in all five patients with partial duct disruption, and thereafter, all the stents were removed. There has been no recurrence of symptoms or pseudocyst in any of these five successfully treated patients over a follow-up period of 4–18 months. All the four patients with complete duct disruption and transmural stents were regularly followed up in the clinic, and the stents were removed 8 weeks after successful drainage. There has been no recurrence of symptoms or pseudocyst in any of these four successfully treated patients over a follow-up

period of 2–14 months. Remaining one patient with splenic pseudocyst and complete duct disruption, who had undergone single-time aspiration, remained asymptomatic for 4 weeks but had a recurrence of pain subsequently. CT revealed two pseudocysts, with one being in the spleen (4 cm) and other one adjacent to the pancreatic tail (6 cm). He underwent single-time EUS-guided aspiration of the splenic pseudocyst and EUS-guided transmural drainage of the pseudocyst located at the tail end with a 7 Fr pigtail stent. The pseudocysts resolved at 2 weeks; the transmural stent was left in place, and thereafter, he has been asymptomatic over a follow-up period of 4 months.

## Discussion

With the availability of endosonography, EUS-guided transmural drainage is being increasingly preferred as the minimally invasive endoscopic modality of choice for treating patients with PP with success rates approaching 90%.<sup>[18]</sup> EUS guidance enables the drainage of pseudocysts that do not have gastroduodenal impression as well as decreases the risk of bleeding and perforation by allowing the drainage procedure to be done under real-time guidance as well as avoiding intervening vessels.<sup>[18,19]</sup> The EUS-guided drainage procedure can also be done without the use of fluoroscopy, and we have previously reported the techniques as well as excellent results of NF-EUS-guided drainage of various types of pancreatic fluid collections.<sup>[19,20]</sup>

Pseudocysts at atypical locations such as liver, spleen, kidneys, mediastinum, and neck are very rarely encountered. They pose a difficult therapeutic challenge and have been usually treated surgically or by percutaneous drainage.<sup>[9,13,14]</sup> With the advent of endoscopic drainage, there have been attempts to treat these pseudocysts at atypical locations endoscopically. However, as these pseudocysts are located in the parenchyma of other organs distant from the gastroduodenal lumen with no endoscopic bulge, they have been previously treated with endoscopic transpapillary drainage alone.<sup>[6]</sup> We have previously reported successful resolution of PP at atypical locations with endoscopic transpapillary drainage alone using nasopancreatic drain (NPD).<sup>[6]</sup> However, risk of infection, prolonged resolution period, risk of accidentally pulling out NPD, and discomfort are important limitations of transpapillary drainage using NPD.

EUS guidance can help in draining these pseudocysts transmurally even in the absence of endoscopic bulge. The published experience with endoscopic transmural drainage of PP at atypical locations is scanty and is limited to only few published case reports.<sup>[15-17]</sup> In the current study, we have shown that the PP at atypical locations (liver, spleen, kidney, and mediastinum) can be safely and effectively treated by NF-EUS-guided transmural drainage. As anticipated because of wider drainage diameter, the period of resolution in the current study was also shorter than the

period of resolution reported by us in our previous study using transpapillary drainage alone (mean of 2.9 weeks vs. 6.5 weeks, respectively).

Splenic pseudocysts are rare complications of both acute and chronic pancreatitis and have been usually treated by surgery in the form of splenectomy with or without distal pancreatectomy, cyst resection, or percutaneous drainage under radiological guidance.<sup>[21]</sup> These have also been occasionally treated endoscopically using transpapillary drainage.<sup>[6,22]</sup> In the current study, we have reported four patients with splenic pseudocysts that were treated with either combined transmural aspiration and transpapillary drainage ( $n = 3$ ; partial duct disruption) or transmural aspiration alone ( $n = 1$ ; complete duct disruption). In none of the patients, transmural stents could be placed because of concern of splenic rupture as a consequence of tract dilatation. The patient with complete duct disruption had a recurrence of pseudocyst and required re-endoscopic intervention whereas two-third patients with partial disruption had an uneventful recovery. One patient required surgery because of massive gastrointestinal bleed associated with hemodynamic compromise. The inability to place transmural stents in splenic pseudocysts was a major limitation of transmural drainage in this study, and therefore, aspiration of pseudocysts needed to be complemented with transpapillary drainage. If transpapillary drainage was not possible, as in complete duct disruption, simple aspiration led on to recurrence as the underlying ductal abnormality remains uncorrected.<sup>[23]</sup>

Intrahepatic pseudocysts are also very rare, and the occasional reported cases have been treated by surgery or percutaneous drainage with limited experience with endoscopic drainage.<sup>[3,6,8]</sup> As with splenic pseudocysts, the reported cases have been treated with transpapillary drainage with no published experience with transmural drainage. In the current study, all the three patients with intrahepatic pseudocysts could be successfully treated with endoscopic transmural drainage through the esophagus as well as stomach using 7 Fr stents.

Mediastinal pseudocysts, although rare, have been reported frequently in the literature with the majority of cases being treated surgically.<sup>[4,6,7]</sup> Transpapillary as well as EUS-guided transmural drainage has been reported to be successfully used for the treatment of mediastinal pseudocysts.<sup>[4,6,7,15-17]</sup> In the current study, we also have shown that all the three patients with mediastinal pseudocysts could be successfully treated with endoscopic transmural drainage.

Renal pseudocysts are extremely rare with the left kidney being commonly involved than the right kidney because of proximity to the pancreas. As with pseudocysts at other atypical locations, the majority of the renal pseudocysts have also been treated by surgery or percutaneous drainage with limited experience with endoscopic drainage.<sup>[5,15,24]</sup> Occasional

cases of renal pseudocyst have been successfully treated with endoscopic transpapillary drainage.<sup>[6]</sup> In the current study, we have reported one case of renal pseudocyst that was successfully treated with combined endoscopic transpapillary and transmural drainage.

There is a concern of leaving stents for a longer time in organs that move considerably with respiration such as liver and spleen. However, none of our patients with hepatic as well as renal pseudocysts with indwelling stents had complications because of leaving transmural stents for up to 8 weeks. Although it is current practice to leave transmural stents indefinitely in patients with complete duct disruption,<sup>[24-27]</sup> because of concerns of leaving stents indefinitely in the parenchyma of solid organ, we removed stents after 8 weeks, and none of the patients had a recurrence of fluid collection during the follow-up period of 4–12 months.

In the current study, we used EUS to characterize the pancreatic fluid collection and thus studied patients with only pseudocysts that had no significant solid debris on EUS. Moreover, complete drainage of pseudocysts at atypical locations could be achieved under EUS guidance only, and this observation is in accordance with our previous results.<sup>[19,20]</sup> The puncture of the pseudocyst as well as the coiling of the guide wire can be effectively seen under EUS guidance, and therefore, the need for fluoroscopy can be obviated. Deployment of stents without fluoroscopy is difficult, and there is also risk of losing the guide wire. In the current study, we used double-pigtail stents with black markers to correctly deploy the stents, and in none of the patients, the guide wire was lost while deploying stents. Small sample size and retrospective design are the limitations of the current study.

## Conclusion

PP at atypical locations can be effectively and safely treated with NF-EUS-guided transmural drainage. Best results are obtained if transmural stents can be placed into the pseudocysts and complete aspiration of the pseudocyst alone is not effective.

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## Conflicts of interest

There are no conflicts of interest.

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