Balloon assisted percutaneal descending litholapaxy - the novel technique for biliary, pancreatic duct and ureteral stone management

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Purpose

The management of blocking stones in CBD, ureter and Wirsung duct represents an important problem of abdominal surgery and urology. The common approach was the surgical removal of the blocking stones. Starting from the eighties of the last century several low-invasive techniques have been implemented in clinical practice for CBD and ureteral stone management - laparascopic surgery, percutaneal lithotripsy (1), stone retrieval under combined endoscopy-fluoroscopy (3; 5) or just endoscopy guidance using retrograde approach, stent placement and Endoscopic Papillary Large Balloon Dilatation for Bile Duct Stone Removal (2; 9). The low-invasive management of Wirsung duct stones suggests the stone removal via papilla, using retrograde approach (4; 8).

It should be mentioned, that the significance of percutaneal drainage, as a low-invasive management option of the complications, caused by presence of blocking stones in CBD, ureter and Wirsung duct (jaundice&cholangitis, hydro&pyonephrosis, pancreatitis) is increasingly growing with the improvement of drainage technique&devices. The percutaneal drainage can easily eliminate the clinical findings of above mentioned complications in few days. The drainage fistula, formed after percutaneal drainage enables to perform any subsequent manipulations on drained duct easily, facilitating the advancement of the needed devices, enabling the drainage catheter easy postprocedure reposition in order to minimize the risk of possible complications.

All above mentioned gave the impulse for seeking of new techniques and possibilities for CBD, ureter and Wirsung duct blocking stone percutanealantegrade management trying to descend the stone down using the fistula of preliminarily performed percutaneal drainage. We failed to find publications on such approach to the problem in ureteral and Wirsung duct stone management; we found 2 publications on CBD stone descending (into the duodenum) removal using the antegrade approach; one paper reports the case of residual CBD stone removal into the duodenum using 5 mm balloon via post-surgery T-tube (7), the second (6) reports bile duct stone evacuation in series of 261 patients with or without preliminary lithotripsy (lithotripsy is applied to the the stones larger than 15 mm) with overall success rate 95.7% and major complication in 6.8%.

The purpose of our paper is to present the novel technique of balloon assisted percutaneal descending litholapaxy to CBD, ureter and Wirsung duct blocking stones.
Methods and Materials

9 patients (CBD stones - 6, Ureteral stones - 2, pancreatic duct stones -1) with blocked duct underwent balloon assisted percutaneal descending litholapaxy (BAPDL). The stone size varied from 5 to 23 mm; all patients were referred for external drainage to treat the complications of bile duct, Wirsung duct or ureter stone induced block - jaundice&cholangitis, pancreatitis, hydro-pyonephrosis. In all cases the percutaneal drainage has been performed and decision to perform BAPDL has been made after the elimination of the clinic of above mentioned complications, which took 1 to 3 weeks. The drainage fistula, formed during this time facilitates the BAPDL procedure, enabling to conduct all devices smoothly and painlessly. BAPDL procedure is performed under the conscious sedation using real-time fluoroscopy guidance. The consequence of actions is as follows - fistulography is performed via the drainage catheter, 0.035 inch diameter guidewire is introduced and catheter is withdrawn; the introducer sheath of appropriate diameter (6 to 11 Fr) is introduced and 5 Fr guiding catheter is advanced in order to manipulate the guidewire down, passing the blocking stone - this is an absolutely obligatory step. When successfully introduced, the guidewire may need the documentation of its adequate position by guiding catheter advancement and contrast injection. After this the heavy duty guidewire is advanced into the duodenum or the bladder via the guiding catheter and the appropriate size balloon device (6 to 20 mm diameter) is introduced into the sphincter (Papilla of Vater or ureteral orifice) according this guidewire - this enables to dilate the sphincter and the duct segment below the stone. After dilation the balloon is deflated and moved up, above the blocking stone, where it's inflated again and multiple pushing actions are applied to the blocking stone having the real-time fluoroscopy control. Use of an introducer sheath and a heavy duty guidewire enables to conduct strong pushing effort, when the balloon strongly pushes and the wire guides the stone down. The contrast injection documents the duct/ureter clearance. By the end of procedure the drainage catheter is repositioned and is kept closed to maintain the access in case of any problem. The drainage catheter is usually withdrawn in a week after the BAPDL.
Urethral stones - arrows

10 mm balloon is inflated in urethral orifice

Fig. 1: Patient A - Urethral BAPDL

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Urethral BAPDL procedure (arrows identify the balloon)

Fig. 2: Patient A - Urethral BAPDL

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Urethral BAPDL procedure (arrow identifies the balloon)

Pushing down action by balloon

Urether is cleared

Fig. 3: Patient A - Urethral BAPDL

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Fig. 4: Patient A - Urethral BAPDL

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Results

BAPDL enabled to descend the blocking stones in all cases; in the case of wirsungolithiasis 8 of 9 stones were evacuated; we failed to evacuate 1 stone, which was imbedded and non-blocking. In 7 cases (77.8%) stones were pushed down successfully at the first attempt as documented on post-procedure fistulography; in 1 (11.1%) case of multiple CBD stones and the case of multiple wirsungolithiasis (11.1%) two BAPDL procedures were needed to get the positive result; this was the same and only patient, on whom the third procedure was also performed, but it failed to remove the imbedded and non-blocking stone. Mild hematuria was documented in one patient with ureteral stones, no other complications were observed.
79 years old lady in extremely poor general condition due to CBD stone caused obstructive cholangitis underwent simultaneously left side PTC and cholecystostomy (PTC procedure was complicated with liver hematoma formation, treated later by percutaneous drainage). The whole abdominal anatomy is altered due to spine problems.

**Fig. 5:** Patient B - CBD BAPDL

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Biliary drainage catheters and contrast injection via cholangiostomy catheter – CBD blocking stone is revealed (red arrows)

Decision to perform BAPDL procedure has been made

**Fig. 6:** Patient B - CBD BAPDL

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CBD BAPDL (Balloon Assisted Percutaneal Descending Litholapaxy) – fistulography at the beginning (stone is identified by red arrow)

Fig. 7: Patient B - CBD BAPDL

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CBD BAPDL – papilla dilatation by 10 mm balloon (stone – red arrow, balloon – yellow arrow)

**Fig. 8: Patient B - CBD BAPDL**

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CBD BAPDL – first (unsuccessful) attempt to push down the stone (stone – red arrow, balloon – yellow arrow)

Fig. 9: Patient B - CBD BAPDL

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Follow-Up in 4 days (before PTC catheter withdrawal)

Fig. 14: Patient B - CBD BAPDL

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CBD BAPDL – fistulography after PTC catheter reposition. Stone is seen in duodenum

Fig. 13: Patient B - CBD BAPDL

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CBD BAPDL - successful attempt; stone is already in duodenum!

**Fig. 12:** Patient B - CBD BAPDL

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CBD BAPDL - successful attempt (stone – red arrow, balloon – yellow arrow); introducer has been used to inforce the pushing effort

**Fig. 11**: Patient B - CBD BAPDL

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CBD BAPDL - papilla dilatation by 20 mm balloon (stone – red arrow, balloon – yellow arrow)

**Fig. 10:** Patient B - CBD BAPDL

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**Fig. 15:** Patient B - CBD BAPDL

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Conclusion

BAPDL is a friendly technique, easy to perform and easy to tolerate. It should be mentioned, that BAPDL might be easily combined with contact lithotripsy, although we had no need of this in our series. The maximal size of evacuated CBD stone was 23 mm - this shows the high effectiveness of the technique inspite of the small amount of patients in series. The advantage of this technique in biliary or Wirsung duct patients is a lack of need of cutting alteration of Papilla and the possibility to perform the low-invasive stone removal in cases with previously performed gastric resection. BAPDL after preliminarily performed percutaneal drainage is safe and effective and should be routinely used in selected patients as an alternative for stone retrograde evacuation techniques; it should be recommended as a first choice option in patients to whom percutaneal drainage has been already performed.
MRCP – arrows identify defects of filling in the Wirsung duct (stones)

Patient underwent percutaneal wirsung duct drainage procedure under combined US-Fluoroscopy guidance. Clinical&laboratory finding of acute pancreatitis eliminated immediately and decision to perform pancreatic BAPDL (Balloon Assisted Percutaneal Descending Litholapaxy) has been made

Fig. 16: Patient C - Pancreatic BAPDL

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CT after wirsungostomy – the countable stones in distal duct (yellow arrows); stones/calcifications in pancreatic tail (red arrows); opacified Wirsung duct & duodenum (blue arrows) after contrast injection via wirsungostomy catheter

Fig. 17: Patient C - Pancreatic BAPDL

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Pancreatic BAPDL procedure – papilla dilatation

Fig. 18: Patient C - Pancreatic BAPDL

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Fig. 20: Patient C - Pancreatic BAPDL

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CT control after the third BAPDL procedure – one embedded, non blocking stone is still seen (yellow arrow). Pancreatic tail stones/calcifications – red arrows

**Fig. 21:** Patient C - Pancreatic BAPDL

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Fig. 22: Patient C - Pancreatic BAPDL

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Fig. 19: Patient C - Pancreatic BABDL. Video demonstrates the process of stones evacuation into duodenum after papilla dilatation using pushing-down actions by half-inflated balloon

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