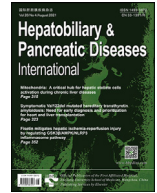




Contents lists available at ScienceDirect

Hepatobiliary & Pancreatic Diseases International

journal homepage: www.elsevier.com/locate/hbpd

Viewpoints

Interventional treatment options for management of delayed arterial hemorrhage after major hepato-pancreatic-biliary surgery

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Hilar cholangiocarcinoma is a biliary malignancy arising from the perihilar biliary tree, which is associated with poor oncological outcomes due to its aggressive biology, chemo-resistance and insidious onset [1].

As stated by Di Martino et al., the standard of care is radical resection, and during the last decades, there have been great efforts to improve survival of potentially resectable hilar cholangiocarcinoma, with surgery being the treatment associated with longer survival [2]. However, radical resection still represents a challenging operation with high risk of intraoperative and postoperative complications.

The report by Wang et al. [3] focuses their analysis on the postoperative delayed arterial hemorrhage that may occur up to several weeks, as opposed to early hemorrhage (defined as an event that may occur within 7 days postoperatively), which is associated with high mortality. It is well known that this complication may occur also in several hepato-pancreatic-biliary (HPB) procedures, most of the time related to fistulas, extended lymphadenectomy and intra-abdominal sepsis [4]. Its early identification and management are challenging and, if not appropriate, the outcome can be fatal.

Therefore, we decided to make some further considerations on delayed arterial hemorrhage in HPB surgery and its interventional endovascular treatment options.

As stated before, instead of starting with treatment, it is important to make some considerations regarding early identification, which is the first attempt to solve this complication. Most of the time its onset is insidious and it might arise from what is called a “pseudoaneurysm”, which is a partial disruption of the arterial wall, secondary to lymphadenectomy and oncological periarial skeletonization, or chemical secondary to a bile/pancreatic leak [5].

Early postoperative hemorrhage is most often a result of technical failure or underlying coagulopathy. On the other side, late hem-

orrhage is usually secondary to pseudoaneurysm formation that occurs as a result of a pancreatic anastomotic leak, and intra-abdominal bleeding is the most common presentation, but frequently it occurs after a moderate previous gastrointestinal bleeding, named “sentinel bleeding”, a warning sign of a potential imminent and massive hemorrhage secondary to its rupture that occurs in 50%-90% of the cases [5,6].

Therefore, we strongly suggest to never underestimate a moderate hemoglobin decrease, melena or a sudden blood drainage color, even if with low flow. This “precursors” signs merit to be further investigated with a contrast enhanced computed tomography (CT) scan with early arterial phase.

Currently, there is still no specific algorithm for patients with postoperative arterial hemorrhage. However, as it is well known, patient hemodynamic is the key point for interventional radiology treatment. It needs a hemodynamically stable setting to be performed, otherwise surgical treatment is deemed to be the best option.

However, there is an intermediate situation called “moderate stability” where an initially hemodynamically unstable patient is moderately stabilized with intravenous fluids and adrenergic drugs. In our opinion, in this situation, interventional radiology is still an important modality. On the other hand, as these patients cannot be moved to another center for an endovascular treatment, this situation may represent an important issue for centers where 24 h interventional radiologist is not available. Surgeons should further reflect upon this situation whenever an HPB surgery is planned.

Most of the time, postoperative delayed arterial hemorrhage occurs in concomitant with some complications after the HPB surgery, such as pancreatic fistula or biliary leak.

We believe that in these cases this strategy may reduce the postoperative morbidity and mortality that are especially high when the localization and ligation of the injured artery are particularly challenging for the surgeon. Subsequent surgery might be technically easier and faster, performed exclusively to treat underlying pathology, like evacuating abscesses, hematomas or to repair

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a pancreatic/biliary anastomosis leakage. This strategy may also reduce the rebleeding incidence that occurs in a high percentage of cases after successful embolization (30%), mainly related to the underlying pathologies.

Since recent improvements, endovascular treatment represents the best option for postoperative delayed arterial hemorrhage [7]. Of note, some bleeding localization might be challenging for interventional radiologists. For instance, a bleeding of the common hepatic artery requires covered stent placement and full anticoagulation with subsequent risk of arterial dissection and/or occlusion of the stent, and rebleeding. In those situations, surgery might be more indicated since arterial repair can be performed with a single stitch on the arterial wall.

However, the most appropriate management of this complication depends on each center expertise. Arterial embolization or stenting remains unclear. Each of these two options entails different advantages and different adverse events.

Arterial embolization has been shown to be an effective treatment for delayed postoperative hemorrhage in multiple studies. However, as stated by Wang et al. [3], this technique is associated to high incidence of rebleeding (25% of cases), especially in the setting of a pseudoaneurysm. Inside this formation, coils have high risk of migration [3]. Therefore, if it is feasible, according to our opinion, to increase the effectivity of the embolization, coils should be placed in the proximal and distal part of the artery which include the pseudoaneurysm. Stenting pseudoaneurysm might also be a feasible alternative offering simultaneously the great advantage to preserve the arterial flow and likely to decrease ischemia. Despite these advantages, stent might not be feasible in case of tortuous or small vessels. In addition, stent occlusion may occur in a long-term period. Current clinical data are still scarce and follow-up periods are too short to strongly declare this option as gold standard [7].

Between stenting or embolization, which is the best treatment remains unclear and, of course, the strategy should be carefully decided on a case-by-case basis, according to involved artery and anatomy and also according to center expertise. Furthermore, we strongly suggest surgeons to assist the endovascular technique as their insight along the procedure can guide the radiologist to choose the best strategy.

In summary, major HPB surgeries are associated with considerable incidence of postoperative delayed arterial hemorrhage, where interventional endovascular radiology has an important and essential role in the management. Surgeon must be aware of the need for permanent availability in the endovascular treatment at their center if any complex HPB surgeries are performed. Further larger experiences are needed to understand whether stent or coils may be effective in managing postoperative delayed arterial hemorrhage.

Acknowledgments

None.

CRediT authorship contribution statement

Benedetto Ielpo: Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Salvatore Alborino:** Conceptualization, Supervision, Writing – review & editing. **Emmanuel Melloul:** Conceptualization, Supervision, Writing – review & editing. **Fabio Salvatori:** Conceptualization, Supervision, Writing – review & editing. **Quirino Lai:** Conceptualization, Supervision, Writing – review & editing. **Massimo Rossi:** Conceptualization, Supervision, Writing – review & editing. **Nicolas Demartines:** Conceptualization, Supervision, Writing – review & editing. **Salomone Di Saverio:** Conceptualization, Supervision, Writing – review & editing.

Funding

None.

Ethical approval

Not needed.

Competing interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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Received 30 September 2022

Accepted 9 February 2023

Available online xxx