

Children's Mercy Kansas City

SHARE @ Children's Mercy

Manuscripts, Articles, Book Chapters and Other Papers

1-2020

Retroperitoneal Hematoma

Christopher Mondie

Rebecca M. Rentea

Children's Mercy Hospital

Let us know how access to this publication benefits you

Follow this and additional works at: <https://scholarlyexchange.childrensmercy.org/papers>



Part of the [Surgery Commons](#)

Recommended Citation

Mondie C, Maguire NJ, Rentea RM. Retroperitoneal Hematoma. In: StatPearls. Treasure Island (FL): StatPearls Publishing; July 26, 2021.

This Article is brought to you for free and open access by SHARE @ Children's Mercy. It has been accepted for inclusion in Manuscripts, Articles, Book Chapters and Other Papers by an authorized administrator of SHARE @ Children's Mercy. For more information, please contact hlsteel@cmh.edu.

NCBI Bookshelf. A service of the National Library of Medicine, National Institutes of Health.

StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan-.

Retroperitoneal Hematoma

Authors

Christopher Mondie¹; Rebecca M. Rentea².

Affiliations

¹ Newark Beth Israel Medical Center

² Children's Mercy

Last Update: June 2, 2020.

Introduction

Retroperitoneal hematoma is defined as bleeding into the retroperitoneal space. This clinical entity is often occult and under-recognized by clinicians and is a cause of significant morbidity and mortality. Often patients do not manifest clinically apparent signs and symptoms until a substantial amount of blood loss has occurred. It is not uncommon for patients to present in frank hemorrhagic shock due to an underlying retroperitoneal hematoma.[1]

The retroperitoneal space lies directly posterior to the peritoneal cavity. An organizational schema dividing the retroperitoneal space into three different “zones” is widely prevalent in the surgical literature. The central-medial zone (Zone I) falls between the two psoas muscles and contains midline structures such as the abdominal aorta, inferior vena cava, pancreas, and duodenum. The perirenal zone (Zone II) begins lateral to the psoas muscles on either side and contains the kidneys, ureters, and portions of the colon. The pelvic zone (Zone III) includes the bladder as well as a multitude of vascular structures, including a robust network for presacral veins. Also, the retroperitoneum contains vital musculoskeletal structures such as the psoas muscles, vertebra, quadratus lumborum, and iliacus muscles. It houses connections to the diaphragm and bony pelvis.[2]

The term “retroperitoneal hematoma” comprises several distinct clinical entities that are best characterized according to their underlying mechanisms. The easiest way to dichotomize this diagnosis is to classify retroperitoneal hematoma as traumatic versus nontraumatic. The traumatic retroperitoneal hematoma heading can be further subdivided into penetrating versus blunt. The nontraumatic retroperitoneal hematoma category can be further broken down into spontaneous and iatrogenic.[3]

The diagnosis of retroperitoneal hematoma requires a high degree of clinical suspicion. In almost all cases, it is reliant upon the use of computed tomography (CT) scanning, which is often useful to confirm the diagnosis as well as identify the underlying cause.

Treatment modalities include observation, interventional radiology coiling/embolization, and operative management for unstable patients.[3][4]

Etiology

Retroperitoneal hematomas are the result of blood loss due to the injury of parenchymal tissue or vascular structures within the retroperitoneal cavity.

Traumatic Retroperitoneal Hematoma

In the setting of traumatic retroperitoneal hematoma, the mechanism of injury can be broken down into blunt or penetrating. Blunt trauma comprises the majority of retroperitoneal hematomas seen in practice and, by definition, is the result of a transfer of energy from an outside source to the victim. The blunt mechanism results in compressive and deceleration forces, which often lead to crushing and shearing injuries to tissues and vascular structures.

Examples of blunt force injuries include perirenal hematomas, pancreatic injuries, pelvic retroperitoneal hematomas as a result of pelvic fractures and disruption of nearby vascular structures, and direct avulsion injuries to blood vessels within the retroperitoneum.

Penetrating trauma leading to retroperitoneal hematoma is commonly the result of lower energy mechanisms such as gunshot wounds or stabbings. Injuries associated with penetrating trauma depend on specific organs or vessels affected by the trajectory of the knife or missile. It is important to note that many of these penetrating injuries will have concomitant injuries within the peritoneal cavity as well.[3]

Non-traumatic Retroperitoneal Hematoma

Retroperitoneal hematomas that occur outside the setting of trauma are either spontaneous or iatrogenic in etiology.

Iatrogenic retroperitoneal hematomas are the result of percutaneous interventions (PCI) or endovascular procedures. While the literature demonstrates that this is a rare complication of such procedures, associated morbidity and mortality are high when it does occur. Rates of PCI associated retroperitoneal hematomas are on the decline, with one 2018 study citing an incidence of 0.06%. This low incidence, however, was juxtaposed with a 3.5-fold independent increase in 30-day mortality.[5]

Risk factors for retroperitoneal hematoma following PCI appear to be arterial puncture above the level of the inguinal ligament, female sex, treatment with GPIIb/IIIa inhibitors, and treatment with warfarin.[5][6][7]

Spontaneous retroperitoneal hematoma is a relatively rare clinical entity with a high degree of morbidity and mortality. Much of the literature on the subject is limited to case series and retrospective cohort studies. Trends in the data surrounding spontaneous retroperitoneal hematoma suggest that this diagnosis is more common in the elderly, patients receiving anticoagulation therapy, and those with underlying coagulopathy. While a majority of patients who suffer retroperitoneal hematomas are receiving anticoagulation therapy (oral or parenteral), it is important to note that in one larger cohort, showed that 15% of patients were receiving no blood thinning regimen.[4][8]

Underlying causes of spontaneous retroperitoneal hematoma include rupture of parenchymal lesions such as angiomyolipomas, cysts, and renal carcinomas or underlying vascular malformations such as aneurysm or pseudoaneurysm of any number of retroperitoneal vessels. Vessels implicated in case reports have included a wide range, such as the superior gluteal artery, various lumbar arteries, renal artery, and pancreaticoduodenal artery.[9]

Epidemiology

Traumatic Retroperitoneal Hematoma

The true overall incidence of retroperitoneal hematoma is difficult to ascertain as the label comprises such a heterogeneous group of injuries. Traumatic retroperitoneal hematomas are more commonly the result of blunt injuries (67-80%) versus penetrating (20 to 33%). One retrospective series identified retroperitoneal hematoma in 12% of a population of stable patients with documented abdominal trauma. The majority of these patients suffered from renal injuries as identified on computed tomography (CT) scan. It is estimated that renal injury affects up to 10% of those suffering blunt abdominal trauma.[2]

Large vascular injuries such as direct aortic injuries due to blunt trauma are rare. However, avulsion injuries to smaller aortic branches often occur and can be a cause of centromedial (Zone I) retroperitoneal hematoma.

Pelvic fractures comprise an estimated 2 to 8% of all fractures. Severe fractures often cause excessive bleeding, and extremely high mortality rates are often reported. In one prospective registry study, the mortality rates of those undergoing angioembolization for pelvic hemorrhage were 17.6%. This is in comparison to the group that received no embolization with a mortality rate of 32.6%.[10]

Blunt injuries to other retroperitoneal structures such as the duodenum and pancreas are rare in incidence (0.2% and 5%, respectively) but carry similarly high mortality rates, each cited above 20%.[2]

Non-traumatic Retroperitoneal Hematoma

The etiology of non-traumatic retroperitoneal hematoma can be related to complications of percutaneous procedures or spontaneous in nature.

Retroperitoneal hematoma related to cardiac catheterization has been decreasing in incidence over the years. While some of this decrease can be related to the rise in radial artery access, it is interesting to note that even in cohorts of radial artery access, a small minority of patients still suffered a retroperitoneal hematoma. A retrospective study from the early 1990s demonstrated an incidence of 0.5% for post-cardiac catheterization retroperitoneal hematomas.[11] A similar study spanning 2007-2014 showed a decline in incidence in retroperitoneal hematoma from 0.09% to 0.03% during the study period, demonstrating that in the modern era, this is an infrequent complication. Patients who do suffer retroperitoneal hematoma, however, are at significantly higher risk for mortality (odds ratio 3.59) and adverse cardiac events (odds ratio 5.76).[5]

Spontaneous retroperitoneal hematoma is a rare occurrence confined mainly to case reports, case series, and small retrospective cohorts. Clearly defined incidence is difficult to ascertain as the disease entity is rare and heterogenous in mechanism and presentation. One single-center retrospective study identified only 89 patients over a seven-year period. The observed mortality of that cohort was 5.6% during the first week and 19.1% at six months. Forty percent of that cohort required ICU monitoring.[4] A similar retrospective study that identified 100 spontaneous retroperitoneal hematoma patients identified a 6% mortality rate directly attributed to retroperitoneal hematoma. The overall mortality rate of that cohort, however, was 20%, suggesting that retroperitoneal hematoma itself was more common in an elderly, moribund population.[8]

History and Physical

Traumatic Retroperitoneal Hematoma

Approach to the patient with traumatic retroperitoneal hematoma begins with the standard history and physical exam used to care for any trauma patient. The practitioner should obtain as much detail as possible regarding the exact mechanism of injury to determine the risk of specific injury patterns. In stable patients able to provide a history, complaints of abdominal, flank, or back pain could be indicative of retroperitoneal hematoma. However, these complaints could also be consistent with intra-abdominal or musculoskeletal injuries as well. The clinician must maintain a high degree of clinical suspicion for retroperitoneal hematoma, as there are no reliable historical features that are helpful in ruling in or out the diagnosis. Most of the presenting signs and symptoms of retroperitoneal hematoma are based upon the specific organs that are injured.

The physical examination should start with the evaluation of the airway, breathing, and circulation in a standard advanced trauma life support fashion. Immediate life threats should be addressed, and primary and secondary surveys completed.

Specific physical exam findings such as an unstable pelvis are suggestive of potential pelvic retroperitoneal hematoma, while penetrating trauma to the back or flank may be suggestive of renal or great vessel injury. The classically taught flank bruising or “Grey-Turner” sign is of little to no clinical use in the acute trauma presentation. [3][12]

Hemorrhage should be suspected as the primary cause of hypotension/shock in the trauma patient. Identification of potential bleeding sources based upon history, mechanism of injury, and the physical exam are helpful to identify potential etiologies. The clinician should consider retroperitoneal bleeding as a source for shock in the trauma patient that has no other clear source for blood loss.

Non-traumatic Retroperitoneal Hematoma

Presenting signs and symptoms of spontaneous retroperitoneal hematomas are often vague and nonspecific. In several retrospective studies, abdominal pain seems to be the most common complaint (46-67.5%). Other complaints include pain in the back, flank, and hip. Nonspecific complaints such as generalized weakness were observed in other cases.

Symptoms of hypovolemia were commonly observed as well, such as syncope, pallor, and dizziness. There are even reports of femoral nerve palsy being a presenting symptom of retroperitoneal hematoma.[13]

A comprehensive physical exam should be conducted in the evaluation of all patients. Findings consistent with hypovolemia/anemia are common in patients with ongoing blood loss from a retroperitoneal hematoma. These can include tachycardia and hypotension/poor peripheral perfusion. Abdominal tenderness may or may not be present. Findings such as flank ecchymosis (Grey-Turner Sign) are of poor sensitivity, present in 6.5% of cases in one cohort, and 1% in another.[4][8]

Findings in patients who suffer retroperitoneal hematoma after undergoing PCI are similar to the above, including abdominal, flank, and back pain. Inguinal tenderness and swelling following the femoral approach are noted as being present in a majority of retroperitoneal hematoma cases in one study. Another common finding reported is that of femoral neuropathy, likely caused by nerve compression due to hematoma formation.[5][7]

Evaluation

The mainstay of diagnosis for retroperitoneal hematoma is a contrast-enhanced CT-scan. The hallmark feature of retroperitoneal hematomas, both traumatic and nontraumatic, is their occult nature. The physical examination is commonly nondiagnostic at best, and they are not readily detectable on plain film imaging or ultrasonography.[1]

Patients who are victims of significant blunt and penetrating trauma will likely undergo extensive CT scanning as part of their trauma workup. These scans will commonly reveal evidence of retroperitoneal hematoma, with sensitivities reportedly approaching 100%. The bedside focused assessment with sonography in trauma (FAST) exam is notoriously unreliable at detecting presence of a retroperitoneal hematoma.[2][14]

Evaluation of patients with no history of trauma becomes more difficult. As discussed above, history and physical examination is a poor indicator of underlying retroperitoneal hematoma. In these patients, a high degree of clinical suspicion is necessary to cinch the diagnosis. Again, a CT scan is the diagnostic imaging modality of choice.

CT scan serves to identify presence, location, and to guide therapy of retroperitoneal hematoma potentially. The presence of intravenous contrast extravasation has been shown to be an independent predictor of the need for interventional radiology or surgical intervention.[8][9]

The remainder of the evaluation of patients with retroperitoneal hematoma should include a full set of lab work commensurate with the patient's overall presentation including but not limited to: complete blood count to assess for anemia, a metabolic panel to check for renal or electrolyte abnormalities, liver function tests to evaluate for hepatic dysfunction, coagulation studies to determine bleeding risk (especially for those receiving anticoagulation), and a type and screen for transfusion requirements. In trauma patients suffering blunt abdominal injuries, a serum amylase may be elevated in pancreatic injury. Additionally, in symptomatic patients suffering blunt trauma, the presence of hematuria on a urinalysis may indicate underlying kidney injury.[3]

Treatment / Management

The management of retroperitoneal hematoma, regardless of etiology, is multifaceted and requires an interprofessional team approach. Specific therapeutic interventions must be individualized, depending upon the etiology and overall clinical condition of each patient. Treatment modalities include supportive care with close observation for stable patients or angioembolization/surgical exploration for more unstable patients. In all instances, adequate resuscitation with blood products for acute hemorrhage should be undertaken in the usual fashion.

Traumatic Retroperitoneal Hematoma

As with all cases of abdominal trauma, any overt peritonitis, refractory hemodynamic instability, or apparent free fluid in the abdomen necessitates laparotomy. Retroperitoneal injuries are often not isolated and commonly occur in conjunction with intra-abdominal injuries. Patients should be assessed and managed based upon the totality of their injury burden.

For patients presenting with penetrating abdominal trauma, retroperitoneal hematoma develops as a result of direct injury to solid organs, viscera, or vasculature. In the majority of these cases, surgical exploration is recommended to achieve hemostasis.

For patients presenting with blunt abdominal trauma, the decision to proceed with surgical exploration depends on the clinical stability of the patient, and the ability to identify the underlying etiology. Persistent hemodynamic instability, an expanding or pulsatile hematoma, are all indications to move forward with definitive surgical management.[3]

The specific location of retroperitoneal hematoma in the setting of blunt injury is often able to be localized on contrast-enhanced CT scan, and can be utilized to guide management. Centromedial (Zone I) hematomas are commonly explored as the underlying etiology is often attributable to injury to the great vessels or one of their branches. Lateral (Zone II) injuries are largely comprised of renal injuries that are amenable to conservative management in the stable patient with favorable CT findings, however large hematomas which are expanding or show evidence of contrast extravasation may require surgical exploration or angiographic embolization.[15]

Pelvic (Zone III) retroperitoneal hematomas are primarily the result of pelvic fractures and venous bleeding. These injuries are less amenable to surgical management. The initial approach to the patient with presumed blood loss due to pelvic injury is external pelvic fixation/binding, which may help to slow or tamponade the bleeding. Definitive management is by angiographic embolization of the bleeding vessels.[10]

Non-traumatic Retroperitoneal Hematoma

The treatment of non-traumatic retroperitoneal hematoma is mainly based upon the location and characteristics of the bleeding. As noted above, anticoagulation is common in the patient populations who suffer from spontaneous retroperitoneal hematoma, and reversal of the coagulopathy should be undertaken to prevent further bleeding. Additionally, appropriate resuscitation should be undertaken for patients demonstrating hemodynamic instability. Blood transfusion should be ordered for those with signs and symptoms or lab findings of anemia.

Specific therapeutic modalities will depend upon the location and extent of bleeding and whether or not there is evidence of contrast extravasation on contrast-enhanced CT scan. Several retrospective cohort studies have shown that a majority of patients with spontaneous retroperitoneal hematoma and even those with post-procedural retroperitoneal hematoma do well with supportive care and blood transfusion alone. In one series, 24.7% of patients underwent an embolization procedure, and 6.7% underwent a surgical procedure. Seventy-five percent of the cohort received a blood transfusion.[4] In another series of 100 patients with retroperitoneal hematoma, the rate of invasive management (IR intervention or surgery) was only 16%. One of the greatest predictors of the need for invasive therapy was contrast extravasation on CT scan.[8]

Differential Diagnosis

Traumatic Retroperitoneal Hematoma

- Acute abdomen
- Perforated viscus
- Solid organ injury
- Vascular injury
- Pelvic fracture
- Abdominal compartment syndrome

Non-traumatic Retroperitoneal Hematoma

- GI bleeding

- Musculoskeletal pain
- Appendicitis
- Cholecystitis
- Diverticulitis
- Abdominal aortic aneurysm
- Pancreatitis
- Pyelonephritis

Prognosis

Traumatic Retroperitoneal Hematoma

Prognosis depends upon the extent and type of injury sustained. Aortic injuries carry significantly higher morbidity and mortality than isolated kidney injuries causing a retroperitoneal hematoma. In one cohort of primarily blunt trauma-related retroperitoneal hematoma, mortality was 6.5% in the overall sample, with approximately 77% undergoing surgical management.[15] In a cohort dominated by penetrating trauma victims, mortality was noted to be 18%.[12]

Non-traumatic Retroperitoneal Hematoma

Prognosis of spontaneous retroperitoneal hematoma is poor overall. This may reflect the fact that elderly patients with multiple comorbidities make up the majority of patients diagnosed with spontaneous retroperitoneal hematoma. One retrospective study found a mortality of 10% at 30 days. Forty percent of those studied required ICU care, suggesting that nearly half of the cases are critical.[4]

Complications

Complications of retroperitoneal hematoma include:

- Infection/sepsis
- Symptomatic anemia
- Exsanguination
- Abdominal compartment syndrome

Deterrence and Patient Education

Retroperitoneal hematomas are often the result of traumatic injuries such as motor vehicle collisions, falls, shootings, and stabbings. As with most trauma, there should be a focus on injury prevention, which may include modalities such as enhanced health policy and public health services.

Pearls and Other Issues

The retroperitoneum represents a potential anatomic space that is immediately posterior to the abdominal cavity. Retroperitoneal injury is often seen in conjunction with other injuries in both blunt and penetrating trauma.

The retroperitoneum is divided into 3 anatomic regions that are utilized to guide therapy and describe the location of the retroperitoneal hematomas.

Zone 1: The central retroperitoneum from the diaphragm superiorly to the bifurcation of the aorta inferiorly. It contains the inferior vena cava, origins of the major renal visceral vessels, duodenum, and pancreas.

Zone 2: Includes both lateral perinephric areas of the upper retroperitoneum from the renal vessels medially to the lateral reflection of the posterior parietal peritoneum of the abdomen (from the diaphragm superiorly to the level of aortic bifurcation inferiorly). Organs contained include adrenal glands, kidneys, renal vessels, ureter, and ascending and descending colon.

Zone 3: Is inferior to the aortic bifurcation and includes the right and left internal and external iliac arteries and veins, distal ureter, and distal sigmoid colon and rectum.

Retroperitoneal injury can be due to blunt or penetrating trauma. Blunt trauma is caused by direct energy transfer. A penetrating injury is an injury that directly violates tissue planes.

Management of retroperitoneal injuries can range from observation to immediate operative exploration, depending on the mechanism, affected zone of injury, and organ injury severity.

For Penetrating Injury

- Zone 1 – Explore as this is likely a major vascular injury.
- Zone 2 – Selectively explore the kidney for active hemorrhage or an expanding hematoma. Mobilize the colon to rule out retroperitoneal colon injury and explore the ureters if in proximity to the wound.
- Zone 3 – Explore as this is likely a major vascular injury.

For Blunt Injury

- Zone 1 – Explore as this is likely a major vascular injury.
- Zone 2 – Explore for an expanding hematoma or one that has failed alternative methods of hemorrhage control (angioembolization). Do not explore a contained, nonexpanding hematoma.
- Zone 3 – Do not explore and utilize a method for hemorrhage control, such as intraoperative preperitoneal packing or angioembolization.

Enhancing Healthcare Team Outcomes

Retroperitoneal hematoma is a heterogeneous entity caused by a variety of etiologies, as noted above. Regardless of the cause, retroperitoneal hematomas must be evaluated and managed aggressively as they are associated with high morbidity and mortality.

Management of retroperitoneal hematoma does not come in a “one size fits all” approach. Therefore, an interprofessional approach to these patients is paramount in providing adequate care. Coordinating and mobilizing multiple specialties and resources is vital to provide life-saving treatments.[16]

In the case of the trauma patient, the diagnosis of retroperitoneal hematoma by the radiologist should trigger a cascade of events that goes on to involve multiple specialties. Trauma or general surgery, interventional radiology, orthopedics, and blood bank all may need to be involved acutely in the management of the patient. Constant communication between specialties may be necessary to determine the adequate plan of care (i.e., between diagnostic radiology, surgery, and interventional radiology).[3]

Similarly, in non-traumatic retroperitoneal hematoma, interprofessional team care and coordination are essential. By definition, these patients have no history of trauma and are often medical admissions being managed by medical clinicians. Recognition of retroperitoneal hematoma based upon CT scan imaging should trigger the same cascade as above. The clinician should involve surgery and interventional radiology as well as diagnostic radiology to have a collaboration regarding the most appropriate treatment course.[8]

For all of the above reasons, it is imperative that there be a team-centered working relationship between all parties. This relationship should be fostered on a regular basis and not just at a time of emergency. By having an amicable

relationship between specialties on a daily basis, there is a greater chance for effective and unhindered teamwork when a critical patient or crisis arises. [Level 3]

Questions

To access free multiple choice questions on this topic, [click here](#).

References

1. Kasotakis G. Retroperitoneal and rectus sheath hematomas. *Surg. Clin. North Am.* 2014 Feb;94(1):71-6. [PubMed: 24267499]
2. Daly KP, Ho CP, Persson DL, Gay SB. Traumatic Retroperitoneal Injuries: Review of Multidetector CT Findings. *Radiographics.* 2008 Oct;28(6):1571-90. [PubMed: 18936022]
3. Feliciano DV. Management of traumatic retroperitoneal hematoma. *Ann. Surg.* 1990 Feb;211(2):109-23. [PMC free article: PMC1357953] [PubMed: 2405790]
4. Sunga KL, Bellolio MF, Gilmore RM, Cabrera D. Spontaneous retroperitoneal hematoma: etiology, characteristics, management, and outcome. *J Emerg Med.* 2012 Aug;43(2):e157-61. [PubMed: 21911282]
5. Kwok CS, Kontopantelis E, Kinnaird T, Potts J, Rashid M, Shoaib A, Nolan J, Bagur R, de Belder MA, Ludman P, Mamas MA., British Cardiovascular Intervention Society (BCIS) and National Institute of Cardiovascular Outcomes Research (NICOR). Retroperitoneal Hemorrhage After Percutaneous Coronary Intervention: Incidence, Determinants, and Outcomes as Recorded by the British Cardiovascular Intervention Society. *Circ Cardiovasc Interv.* 2018 Feb;11(2):e005866. [PubMed: 29445000]
6. Maluenda G, Mitulescu L, Ben-Dor I, A Gaglia M, Weissman G, Torguson R, F Satler L, Pichard AD, Bernardo NL, Waksman R. Retroperitoneal hemorrhage after percutaneous coronary intervention in the current practice era: clinical outcomes and prognostic value of abdominal/pelvic computed tomography. *Catheter Cardiovasc Interv.* 2012 Jul 01;80(1):29-36. [PubMed: 21735521]
7. Farouque HM, Tremmel JA, Raissi Shabari F, Aggarwal M, Fearon WF, Ng MK, Rezaee M, Yeung AC, Lee DP. Risk factors for the development of retroperitoneal hematoma after percutaneous coronary intervention in the era of glycoprotein IIb/IIIa inhibitors and vascular closure devices. *J. Am. Coll. Cardiol.* 2005 Feb 01;45(3):363-8. [PubMed: 15680713]
8. Baekgaard JS, Eskesen TG, Lee JM, Yeh DD, Kaafarani HMA, Fagenholz PJ, Avery L, Saillant N, King DR, Velmahos GC. Spontaneous Retroperitoneal and Rectus Sheath Hemorrhage-Management, Risk Factors and Outcomes. *World J Surg.* 2019 Aug;43(8):1890-1897. [PubMed: 30963204]
9. Caleo O, Bocchini G, Paoletta S, Ierardi AM, Scionti A, Tonerini M, Guida F, Sica G, Perillo A, Carrafiello G, Scaglione M. Spontaneous non-aortic retroperitoneal hemorrhage: etiology, imaging characterization and impact of MDCT on management. A multicentric study. *Radiol Med.* 2015 Jan;120(1):133-48. [PubMed: 25572538]
10. Hauschild O, Aghayev E, von Heyden J, Strohm PC, Culemann U, Pohlemann T, Suedkamp NP, Schmal H. Angioembolization for pelvic hemorrhage control: results from the German pelvic injury register. *J Trauma Acute Care Surg.* 2012 Sep;73(3):679-84. [PubMed: 22710767]
11. Kent KC, Moscucci M, Mansour KA, DiMattia S, Gallagher S, Kuntz R, Skillman JJ. Retroperitoneal hematoma after cardiac catheterization: prevalence, risk factors, and optimal management. *J. Vasc. Surg.* 1994 Dec;20(6):905-10; discussion 910-3. [PubMed: 7990185]
12. Manzini N, Madiba TE. The management of retroperitoneal haematoma discovered at laparotomy for trauma. *Injury.* 2014 Sep;45(9):1378-83. [PubMed: 24606980]
13. Parmer SS, Carpenter JP, Fairman RM, Velazquez OC, Mitchell ME. Femoral neuropathy following retroperitoneal hemorrhage: case series and review of the literature. *Ann Vasc Surg.* 2006 Jul;20(4):536-40. [PubMed: 16741653]
14. Richards JR, McGahan JP. Focused Assessment with Sonography in Trauma (FAST) in 2017: What Radiologists Can Learn. *Radiology.* 2017 Apr;283(1):30-48. [PubMed: 28318439]
15. Wang F, Wang F. The diagnosis and treatment of traumatic retroperitoneal hematoma. *Pak J Med Sci.* 2013 Apr;29(2):573-6. [PMC free article: PMC3809226] [PubMed: 24353579]

16. Sahu KK, Mishra AK, George SV, Siddiqui AD. Managing retroperitoneal hematoma: Associated complexities and it challenges. Am J Emerg Med. 2020 Feb 05; [PubMed: 32057530]

Copyright © 2020, StatPearls Publishing LLC.

This book is distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, duplication, adaptation, distribution, and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, a link is provided to the Creative Commons license, and any changes made are indicated.

Bookshelf ID: NBK558928 PMID: 32644354