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DEVELOPMENT OF ADRENAL HEMATOMAS: MANAGEMENT IN TRAUMATIC AND NON-TRAUMATIC PATIENTS

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Abstract:

The primary aim of this investigation is to evaluate the incidence of adrenal gland hematoma arising from both traumatic and non-traumatic aetiologies, while also exploring optimal strategies for their efficacious management. Additionally, this research aims to establish a correlation between the existence of adrenal hematoma and statistical clinical markers indicative of the severity of the injury. Adrenal hematoma is a potentially life-threatening occurrence that can arise from a number of non-traumatic as well as traumatic circumstances. The clinical signs of adrenal hematoma can differ depending on the severity and bleeding, and the area of the adrenal cortex that has been damaged as a result of the hemorrhage. This study is based on the literature review of the previously published articles. All the relevant articles and research papers will be gathered and information will be analyzed to deduce the conclusion.

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INTRODUCTION

The phenomenon of adrenal gland hemorrhage was initially documented by Canton in the year 1863. Subsequent to that period, postmortem examinations have effectively identified instances of adrenal hemorrhage in individuals afflicted with traumatic injuries and acute medical conditions. The occurrence of adrenal hemorrhage in postmortem investigations has exhibited a wide spectrum, with reported frequencies ranging from 0.14% to as high as 25%. With the escalating utilization and enhanced complexity of imaging technology, the incidence of adrenal hemorrhage has witnessed a surge in diagnosis among patients admitted to medical facilities, ranging from 1.5% to 5%.

Adrenal hematoma, colloquially referred to as adrenal hemorrhage, is a pathological state distinguished by the intra-glandular pooling of blood inside the adrenal gland. Adrenal hemorrhage may arise from a multitude of etiological factors, encompassing, but not limited to, trauma, acute stress, anticoagulation medication treatment, coagulopathy, the presence of an underlying tumor, newborn stress, or idiopathic disease. The clinical presentations and symptoms of adrenal hemorrhage often demonstrate a dearth of specificity, in concomitant laboratory abnormalities, if detected, also display a lack of specificity. It is of utmost importance to acknowledge that non-traumatic adrenal hemorrhage is commonly encountered incidentally during the duration of imaging investigations performed to assess other issues. In the infrequent occurrence of bilateral adrenal hemorrhage or hemorrhage in an isolated adrenal gland, there exists the potential for the manifestation of adrenal insufficiency. In the event that these instances persist without appropriate diagnostic measures or encounter a substantial delay in evaluation, the consequences of unaddressed insufficient adrenal function may ultimately culminate in mortality. As a result, a heightened degree of suspicion regarding individuals displaying heightened susceptibility to notable adrenal hemorrhage may facilitate prompt identification and enhance overall survival rates.

The adrenal glands' susceptibility to hemorrhage is attributed to its distinctive vascular supply. The adrenal glands receive vascular supply from approximately 50 to 60 diminutive arterial branches, which emanate from three distinct sources: the inferior phrenic artery, the aorta, and the renal artery. The aforementioned branches intricately supply the adrenal cortex with nourishment, ultimately converging into a subcapsular plexus. The aforementioned extensively vascularized plexus effectively empties into the medullary sinusoids through a limited number of venous channels situated at the corticomedullary junction, consequently establishing a plausible scenario of a "vascular dam". Furthermore, it is worth noting that the adrenal glands are individually drained by a solitary central vein, which is characterized by the presence of robust longitudinal muscle bundles. This anatomical feature serves to augment the impediment to the circulation of blood within these glands. Hemorrhage into the gland may occur as a consequence of elevated adrenal venous pressure or increased arterial perfusion pressure. In instances characterized by hypotension and diminished arterial perfusion, it is noteworthy that capillaries situated at the corticomedullary intersection are susceptible to the occurrence of ischemic necrosis. Upon the restoration of normal arterial perfusion, it is noteworthy that hemorrhage may also manifest as a consequence of reperfusion injury.

The adrenal medulla is responsible for the synthesis and secretion of catecholamines, which play a crucial role in various physiological processes. These bioactive compounds exert their effects by promoting platelet aggregation, a process that leads to the formation of blood clots, and inducing vasoconstriction, which involves the narrowing of blood vessels. In instances characterized by heightened psychological or physiological stress, it is observed that the adrenal vein exhibits elevated levels of catecholamines. The aforementioned condition has the potential to induce constriction within the adrenal vein, thereby leading to a subsequent elevation in venous pressure. As previously delineated, the aforementioned elevation in venous pressure has the potential to precipitate hemorrhagic events. Furthermore, existing data indicates a potential inclination of the adrenal vein towards the formation of platelet thrombi in regions characterized by turbulent flow and localized stagnation, primarily attributed to the release of catecholamines. The phenomenon of adrenal vein thrombosis has been postulated to induce obstruction of venous outflow, thereby precipitating adrenal hemorrhage.

The historical documentation reveals that a case of adrenal gland hemorrhage was first reported in the year 1670 by Griselius, a renowned medical practitioner from Vienna, as documented by Sevitt. The phenomenon of trauma-induced adrenal hemorrhage was first documented in the year 1863. Since then, adrenal hematoma has been recognized as a relatively uncommon injury that is typically linked to instances of blunt abdominal trauma. The usage of CT in the identification of adrenal hematoma and its

distinction from other adrenal masses has been well-documented. Despite the prevalence of adrenal injuries observed in approximately 28% of individuals during postmortem examinations after experiencing significant trauma, there is limited research available regarding the detection rate of these injuries using computed tomography (CT). Only one study has reported the rate of identifying adrenal injuries through CT imaging. In the course of the aforementioned investigation, it was observed that a notable proportion of patients, specifically 2%, who had experienced blunt trauma, exhibited the presence of adrenal hematomas.

Adrenal Hemorrhage due to Trauma

While it is well-established that trauma happens to be one of the most common causes in approximately 80% of adrenal hemorrhage cases, it is important to note that the occurrence of adrenal gland trauma is comparatively infrequent. The prevalence of adrenal gland hemorrhage due to trauma in the existing body of literature spans a spectrum of 0.03% to 4.95%. The infrequency of this particular injury can be attributed to the gland's anatomical positioning, which is situated in a relatively sheltered area amidst the inferior rib cage as well as the musculature of the back.

The identification of adrenal hemorrhage during trauma assessment has been correlated with heightened severity of injury. Additionally, it is frequently observed that concomitant injuries to the liver, ribs, kidney, or spleen occur in conjunction with adrenal hemorrhage. Historically, the identification of adrenal hematomas resulting from traumatic incidents necessitated the utilization of exploratory laparotomy, primarily conducted to assess and address concurrent injuries. Nevertheless, there is an increasing trend wherein the diagnosis of these conditions is being facilitated through the utilization of imaging techniques during the comprehensive assessment of trauma patients. Traumatic adrenal hemorrhage exhibits a higher incidence on the right side, with bilateral occurrences being exceedingly rare.

The potential mechanisms underlying damage due to trauma to the adrenal glands encompass two primary factors. Firstly, direct compression of the adrenal gland may occur as a result of the anatomical positioning between the spinal column and the spleen or liver. Secondly, a sudden elevation in pressure in intra-adrenal veins can transpire due to the compression of the major vein draining in the inferior vena cava.

The subsequent observation would elucidate the prevalence of right-sided manifestation, as the adrenal vein on the right side directly drains into the inferior vena cava (IVC), while the left adrenal vein drains into the left renal vein. Adrenal hemorrhage, in an alternative scenario, may potentially arise as a secondary consequence of deceleration force. This force induces shearing of the small vessels that penetrate the adrenal capsule.

Non Traumatic Causes of Adrenal Hemorrhage

Nontraumatic adrenal hemorrhage exhibits a strong association primarily with the utilization of an anticoagulant substance namely heparin. The potential of heparin to induce adrenal hemorrhage has been observed through the identification of two distinct mechanisms. Heparin, a commonly utilized anticoagulant, has been predominantly recognized for its ability to impede blood clotting. However, it is important to note that the administration of heparin during the progression of a serious medical condition may augment the vulnerability to bleeding. This heightened susceptibility can subsequently lead to the manifestation of adrenal hemorrhage. Furthermore, a number of cases have been documented wherein bilateral extensive hemorrhaging of the adrenal glands has occurred concomitantly with heparin-induced thrombocytopenia (HIT). Heparin-induced thrombocytopenia (HIT) is characterized by the stimulation of heparin platelet factor 4 (PF4) antibodies, leading to the aggregation and subsequent activation of platelets along with the presence of heparin. This phenomenon gives rise to the development of thrombocytopenia, a condition characterized by a decrease in platelet count, and an intriguingly counterintuitive heightened susceptibility to thromboembolism, a potentially life-threatening condition involving the formation of blood clots that obstruct blood vessels. Heparin-induced thrombocytopenia (HIT) may consequently lead to the occurrence of thrombosis within the central adrenal vein, subsequently causing adrenal hematoma.

In a study conducted by Kovacs et al., it was observed that patients who were subjected to heparin administration for a duration of 4 to 6 days and for more than 6 days exhibited a significantly higher likelihood, roughly 17 and 34 times respectively, of developing bilateral massive adrenal hemorrhage compared to individuals who had not been exposed to heparin. A significantly elevated risk for hemorrhage, estimated to be 15 times greater, was observed among patients who presented with thrombocytopenia.

Adrenal hemorrhage has been found to exhibit a significant correlation with stressors stemming from a variety of sources, including but not limited to, the presence of overwhelming sepsis, burns, surgical procedures, hypotensive conditions, pregnancy, as well as the administration of synthetic steroids or ACTH. In instances characterized by heightened psychological or physiological strain, the pituitary gland exhibits the release of adrenocorticotropic hormone (ACTH). Elevated concentrations of adrenocorticotropic hormone (ACTH) elicit the release of catecholamines, which subsequently augment the perfusion of the adrenal gland, leading to an upsurge in the secretion of glucocorticoids. Elevated arterial blood flow, in conjunction with the vasoconstrictive effects induced by catecholamines on the adrenal vein during periods of stress, culminate in heightened intra-adrenal pressure, potentially precipitating hemorrhagic events.

Adrenal hemorrhage, in its classical presentation, has been historically linked to fulminant meningococcemia, commonly referred to as Waterhouse-Friderichsen syndrome. However, it is important to note that instances of adrenal hemorrhage have also been documented in the context of Pseudomonas infection, Klebsiella species, Staphylococcus aureus, E coli, and Proteus bacteremia. In the comprehensive analysis conducted by Kovacs et al., it was observed that the presence of sepsis significantly amplified the susceptibility of patients to adrenal hemorrhage, resulting in a six-fold escalation in risk. Septicemia, a severe bloodstream infection, can potentially result in the development of low blood pressure or DIC, thereby exacerbating the susceptibility to hemorrhage. These aforementioned mechanisms play a significant role in this heightened risk. In these instances, individuals commonly exhibit severe illness resulting from the primary infection, and the identification of adrenal hemorrhage is infrequently established prior to death.

The prevalence of adrenal hemorrhage in the pediatric cohort is estimated to vary between 1% and 2% among neonates classified as being in a state of optimal well-being. The etiology of adrenal hemorrhage often remains uncertain; nevertheless, it is frequently noted that prolonged labor, breech delivery, birth trauma, infection, high birth weight, or anoxia are commonly observed as concurrent factors. A compelling association has been identified in the context of Beckwith-Wiedemann syndrome. Neonatal adrenal hemorrhage possesses the inherent capacity for incidental identification through the utilization of ultrasound (US) or may become evident through the manifestation of various symptoms, including anemia, shock, inexplicable jaundice, the emergence of a scrotal hematoma, the presence of an abdominal mass, thereby or in severe cases, postmortem examination may unveil its existence.

The identification of lupus anticoagulant or antiphospholipid antibodies within an individual's biological system represents a significant and noteworthy risk factor for the occurrence of adrenal hemorrhage. Individuals diagnosed with lupus anticoagulants exhibit a heightened susceptibility to recurrent episodes of thrombosis, as well as an increased risk of experiencing fetal loss. The underlying pathological mechanism associated with adrenal involvement remains inadequately elucidated. It is postulated that these individuals exhibit a predisposition towards the occurrence of adrenal vein thrombosis, subsequently culminating in the development of hemorrhagic infarction within the adrenal gland. Individuals with lupus anticoagulants are susceptible to experiencing notable bilateral adrenal hemorrhage subsequent to major surgical procedures, infections, traumatic events, heightened stress levels, or administration of anticoagulation therapy for the purpose of managing recurrent thromboembolism. These individuals are deemed to possess a heightened susceptibility to adrenal insufficiency, a condition that may potentially present itself as the initial clinical indication of antiphospholipid syndrome.

In individuals presenting with adrenal gland hemorrhage in the absence of apparent risk variables, it is imperative to contemplate the possibility of an undiagnosed cyst or cancer as the etiology of the hemorrhagic event. Benign lesions, including adrenal cysts, pseudocysts, myelolipomas, and hemangiomas exceeding a size threshold of 10 cm, have been observed to exhibit spontaneous hemorrhage within the adrenal gland or retroperitoneum. Pheochromocytoma, a primary adrenal tumor, is identified as the prevailing etiology for extensive hemorrhaging. This condition carries a potentially fatal outcome, with mortality rates reaching as high as 50%. Adrenocortical carcinomas of considerable size, measuring greater than 6 cm, frequently exhibit regions characterized by hemorrhage and necrosis. These pathological features may potentially lead to misinterpretation, as they bear resemblance to benign adrenal hemorrhages. Adrenocortical adenomas, while prevalent, exhibit a low incidence of hemorrhage. Adrenal metastases represent a frequently encountered pathology affecting the adrenal gland, with a low incidence of hemorrhagic complications. The utilization of radiographic imaging has emerged as a pivotal modality in the

identification and assessment of underlying neoplasms amidst cases of adrenal hemorrhage.

Clinical and Imaging Findings

The clinical manifestation of adrenal hemorrhage exhibits variability, encompassing a range of symptoms. These symptoms may encompass the sudden emergence of pain in the abdomen, flank pain, vomiting, changes in blood pressure (both hypotension and hypertension), the presence of a detectable flank mass, heightened agitation, alterations in mental status, and a mild elevation in body temperature. In the context of a patient experiencing clinical illness, it is not uncommon for the manifestation of these symptoms to be erroneously attributed to sepsis. The laboratory assessment can exhibit either normal findings or indicate a notable decrease in hemoglobin levels, alongside alterations in electrolyte composition, which are observed in the context of adrenal insufficiency.

A multitude of imaging techniques can be effectively employed in the diagnostic assessment of adrenal hemorrhage. Computed tomography (CT) is widely regarded as the prevailing imaging modality employed for the diagnosis and evaluation of adrenal hemorrhage, which is a condition characterized by bleeding within the adrenal glands. Adrenal hemorrhage is frequently encountered as an inadvertent discovery during computed tomography (CT) scans conducted for trauma-related purposes or other medically justified indications. The morphological characteristics of adrenal hematoma may exhibit considerable variability contingent upon the chronological age of the patient and the temporal age of the hematoma.

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Various imaging modalities can be proficiently utilized in the diagnostic evaluation of adrenal hemorrhage. CT scan is universally acknowledged as the predominant imaging modality utilized for the diagnosis and assessment of adrenal hemorrhage, a pathological state distinguished by the presence of hemorrhage within the adrenal glands. The incidental identification of adrenal hemorrhage is a common occurrence during CT scans performed for trauma-related reasons or other medically warranted indications. Considerable variations in the morphological features of adrenal hematoma can be observed, depending on the age at the time of the individual as well as the relative age of the hematoma.

MANAGEMENT OF ADRENAL HEMATOMA

Adrenal hemorrhage was typically diagnosed only after death when cross-sectional imaging became standard practice. Severe sepsis, like in Waterhouse-Friderichsen syndrome, multiple organ trauma commonly accompanies the aforementioned traumas. Due to the widespread availability of CT scanning technology, the diagnosis of adrenal hemorrhage has increased dramatically. The existing body of literature pertaining to the treatment of adrenal hemorrhage predominantly comprises case reports that primarily focus on instances of adrenal gland trauma.

The primary objective of the current investigation is to provide a comprehensive understanding of the focal topic through the utilization of a medical research framework. text will be rewritten in a manner consistent with the style of a medical research writer. No additional information will be added. The present discourse shall endeavor to In the year 1993, a seminal investigation carried out by Gómez et al. unveiled a meticulous examination encompassing 14 occurrences of adrenal hemorrhage precipitated by traumatic incidents. Surgical exploration was performed in 86% of the instances under scrutiny. In the cohort of cases under investigation, it was observed that a significant majority, comprising 58% of the subjects, underwent adrenal restoration as a therapeutic intervention. Conversely, the remaining 42% of cases required adrenalectomy to be a treatment modality. The decision to pursue either removal or restoration was based on a comprehensive assessment of various crucial factors, encompassing the extent of the damage, the ability to survive any residual adrenal tissue, the state of the contralateral adrenal gland, and the general well-being of the patient.

The reparative procedure encompassed the meticulous closure of the adrenal capsule utilizing a continuous suture composed of non-absorbable material. Interrupted mattress sutures had been strategically employed as necessary. The present study documented a noteworthy achievement in the management of patients within the observed cohort. Specifically, a successful therapeutic approach involving diligent monitoring and observation was implemented. This approach yielded positive outcomes in the treatment of the remaining 14% of patients who presented with restricted adrenal damage, unaccompanied by any additional injuries.

Over the course of time, a prevailing inclination has emerged within the realm of trauma literature, wherein there has been a gradual shift towards the adoption of nonoperative management strategies. In light of this prevailing pattern, a notable surge has been observed in the percentage of individuals afflicted with adrenal hemorrhage who have been effectively managed through the method of observation. In the year 2003, Stawicki and colleagues conducted a study wherein they documented an incidence of surgical exploration at a rate of 18%. Additionally, they observed a rate of adrenalectomy at 2.5%. In the year 2007, Mehrazin et al. conducted a study wherein they documented a surgical exploration rate of 3.8%. Within this subset of cases, an adrenalectomy rate of 3.1% was observed. According to the latest findings, it has been widely acknowledged that surgical intervention is not deemed necessary for the management of adrenal hemorrhage. In instances wherein patients were subjected to exploration, surgical intervention was commonly administered to address a concomitant injury that frequently coexists with adrenal trauma.

In the absence of additional indications for investigation in patients of trauma having adrenal damage, it is advised to pursue nonoperative management, provided that there is no ongoing bleeding. The nonoperative management approach encompasses the provision of supportive care, diligent monitoring of consecutive hematocrit levels, and the judicious governance of transfusions of blood as deemed necessary. In numerous reports, the successful utilization of angioembolization for the management of an adrenal hemorrhage has been documented, particularly in cases where bleeding persists. Given the intricate vascular network that supplies the adrenal gland, the occurrence of ipsilateral infarction as a result of the embolization of one of its vessels is highly improbable. Consequently, embolization emerges as an appealing therapeutic approach and a feasible substitute for surgical intervention.

CONCLUSION:

In the absence of additional indications for abdominal investigation in patients of trauma having adrenal damage, it is recommended to pursue nonoperative management, provided that there is no ongoing bleeding. The nonoperative management approach encompasses the provision of supportive care, diligent monitoring of consecutive hematocrit levels, and the judicious governance of transfusions of blood as deemed necessary. In numerous reports, the successful utilization of angioembolization for the management of an adrenal hemorrhage has been documented, particularly in cases where bleeding persists. Given the intricate vascular network that supplies the adrenal gland, the occurrence of ipsilateral infarction as a result of the embolization of one of its vessels is highly improbable. Consequently, embolization emerges as an appealing therapeutic approach and a feasible substitute for surgical intervention. Understanding the etiology of extensive bilateral adrenal hemorrhage and familiarising oneself with the clinical manifestations of adrenal insufficiency may significantly reduce the risk of therapeutic delay, thereby potentially conferring a life-preserving outcome. The management of adrenal hemorrhage typically involves a nonoperative approach in the majority of cases. Nevertheless, it is imperative to acknowledge the potential existence of a possible underlying adrenal neoplasm in instances of adrenal hemorrhage. Serial computed tomography (CT) imaging, also known as sequential CT imaging, is a diagnostic technique that involves the acquisition of multiple CT scans over a period of time. This method allows for The utilization of computed tomography (CT) scans and magnetic resonance imaging (MRI) and has demonstrated significant utility in the differentiation of benign adrenal hemorrhage from malignant aetiologies that require surgical intervention. In instances characterized by the presence of benign adrenal hemorrhage with persistent bleeding, the utilization of angioembolization may present itself as a viable alternative to the conventional approach of surgical exploration.

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