BILINGUAL PUBLISHING CO.
Pioneer of Global Academics Since 1984

Journal of Endocrinology Research
https://ojs.bilpublishing.com/index.php/jer

REVIEW

Early Identification and Diagnosis of Adrenal Crisis after Retroperitoneal Laparoscopic Unilateral Adrenalectomy

Li Wan Yong Wang* Shubin Wang Jingzhao Cao Zhengjin Yi Xiangyu Liu Chuan Xiao Yun Luo Xupan Wei

Department of Urology, Pangang Group General Hospital, Sichuan, 617023, China

ARTICLE INFO

Article history
Received: 31 December 2020
Accepted: 28 January 2021
Published Online: 31 January 2021

Keywords:
Retroperitoneoscope
Unilateral adrenalectomy
Adrenal crisis
Adrenal insufficiency
Shock
Early recognition

ABSTRACT

The occurrence of adrenal crisis after retroperitoneal laparoscopic unilateral adrenalectomy is usually concealed. If not timely diagnosis and treatment, it may cause shock, and even lead to death. It is very difficult to distinguish the clinical manifestations of adrenal crisis from nausea, vomiting, fatigue, gas separation from the lower diaphragm, abdominal pain, hypotension, hypertension, fever and hypothermia after operation. This makes it very difficult to identify and diagnose adrenal crisis early. This article mainly discusses the early recognition, diagnosis and treatment of adrenal crisis after unilateral adrenalectomy by retroperitoneoscope.

1. Introduction

Adrenal crisis (AC) is a serious endocrine crisis caused by adrenocortical insufficiency. AC is a clinical syndrome characterized by weakness, fatigue, anorexia, abdominal pain, weight loss and hypotension [1]. Although the prognosis of patients with AC has been significantly improved since the advent of synthetic glucocorticoids, adrenal crisis is still one of the main causes of death after unilateral adrenalectomy due to atypical symptoms and difficulty in early identification [2,3]. An investigation has shown that the mortality rate of patients with adrenal crisis can reach 0.5%~2% of patients with adrenal cortical dysfunction [4]. So far, the description of AC in the international classification of diseases (ICD10) is only a note of "severe adrenal insufficiency". It does not give any accurate definition of AC symptoms or signs [5]. Therefore, we cannot achieve a unified definition of adrenal crisis. Although Allolio [6] summarized a widely accepted definition in 2015: (1) causing serious damage to health, and having at least two symptoms or signs: hypotension (systolic blood pressure < 100mmhg), nausea or vomiting, severe fatigue, hyponatremia, hypoglycemia, hyperkalemia. (2) After intravenous administration of glucocorticoid preparations, symptoms and signs can be significantly improved. However, the definition does not

**Corresponding Author:*
Yong Wang,
Department of Urology, Pangang Group General Hospital, Sichuan, 617023, China;
Email: 446247758@qq.com

DOI: https://doi.org/10.30564/jer.v2i2.2764

provide a time window for the onset of intravenous glucocorticoid replacement therapy. Through a large number of clinical practices, we found that glucocorticoid can take effect within 1 hour after intravenous drip. However, if it does not work, it indicates that the clinical syndrome of the patient may be combined with other causes, or it is not AC. Although there is no research data to prove the incidence of AC after unilateral adrenalectomy [7], it is undeniable that AC should not be ignored. Most of the clinical manifestations of AC are nonspecific, often manifested as abnormal temperature, abnormal pain, abnormal blood pressure, nausea, fatigue and other atypical symptoms. But after the operation of general anesthesia, nausea, vomiting, fatigue, wound pain, fever, hypothermia and other symptoms often appear. These symptoms superimpose on the fluctuation of normal blood pressure after unilateral adrenalectomy, which makes the diagnosis of AC after unilateral adrenalectomy very difficult. And in the occurrence of AC, it can also cause the adrenal gland to produce aldosterone, which leads to the disorder of water, electrolyte and acid-base balance while blood pressure fluctuates violently [8]. Therefore, in-depth understanding and early identification, timely diagnosis and treatment of AC has very important clinical significance [9].

2. Clinical Manifestations of Adrenal Crisis

Different patients may have different clinical manifestations of adrenal crisis, but there will be multiple system abnormalities. The clinical manifestations of AC are lack of specificity. In the early stage, only abnormal changes of blood pressure (decreased or increased), halophilic, anorexia, or pain (abdominal pain, muscle pain, joint pain) [10,11]. Some patients may have high fever (body temperature > 38 ℃ , the temperature of some patients can be as high as 40 ℃), while the other may show hypothermia (body temperature < 34 ℃ , or even lower than 24.6 ℃). However, surgical procedures, anesthetic drugs, absorption of bad dead objects, incision infection and adrenal crisis itself may cause changes in body temperature and blood pressure [12]]. Some patients will also appear dry skin mucosa, poor elasticity and other dehydration performance and fatigue. The above symptoms can worsen rapidly in tens of minutes or several days, and even life-threatening [13]. The main clinical manifestations of each system are as follows.

2.1 Circulation System

Due to the deficiency of glucocorticoid, the permissive effect of catecholamine is weakened, and the balance of water and sodium is disordered, which changes the effective circulating blood volume. Therefore, the fluctuation of blood pressure, the weakness of pulse, the dampness and coldness of skin, arrhythmia and other symptoms, and even shock [14].

2.2 Digestive System

Anorexia, abdominal distension, nausea, vomiting, diarrhea, abdominal pain, and even total abdominal colic [15] may occur, which is easy to be misdiagnosed as acute abdomen or gastrointestinal perforation.

2.3 Nervous System

In the early stage, they may only be depressed, but with the fluctuation of blood pressure, they may become restless, drowsy, delirium, delirium, and even coma. If accompanied by hypoglycemia, patients may soon appear sweating, blurred vision, diplopia and even coma [16].

2.4 Other Performance

In addition, oliguria, hypercalcemia, hyponatremia can occur, and blood potassium can be low or high. If not timely rescue, it can be fatal. It can also be manifested as pigmentation, which is mainly located in exposed and easily rubbed parts (buccal, dorsum of foot, palmar surface, etc.), and can also appear in non-exposed positions, such as fold of hands and buccal mucosa [17].

The symptoms of nausea, vomiting, fatigue, wound pain, absorption heat, hypothermia may occur after general anesthesia, and the blood pressure fluctuation after unilateral adrenalectomy makes the diagnosis of adrenal crisis after unilateral adrenalectomy extremely difficult. Therefore, patients with atypical symptoms such as excessive fatigue, fatigue, nausea, vomiting, dizziness, skin pigmentation, abdominal pain, blood pressure fluctuation, body temperature fluctuation or electrolyte disorder should exclude AC, especially those with autoimmune diseases and related family history [18].

3. Early Recognition of Adrenal crisis

Studies have shown that about 8% of patients with adrenal gland surgery may have adrenal crisis [19], and patients with history of adrenal crisis attack are more likely to relapse [20]. When patients with recurrent adrenal crisis attack, the mortality rate can be as high as 40%-50% [19]. Therefore, early identification of adrenal crisis is very important.

75.8% of AC patients are diagnosed with Cushing syndrome before operation [6]. However, for patients without cortisol, such as primary aldosteronism, because of the ACTH promoting the secretion of cortisol and increase

 DOI: https://doi.org/10.30564/jer.v2i2.2764

the secretion of cortisol during stress, will make the diagnosis of adrenal crisis more difficult. Due to the lack of specificity in clinical manifestations of adrenal crisis, it is very important to inquire about the relevant family history, autoimmune disease history, and glucocorticoid, left thyroid hormone and rifampicin related drug history. Above all, the laboratory diagnosis of AC should be carried out with the following two parts: (1) confirm that the cortisol level is lower than the lower limit of reference value, but there is no unified reference value lower limit due to the increase of cortisol secretion during surgical stress. According to the endocrine society, the early morning plasma cortisol level ≤ 82.8 nmol/L is likely to indicate AC, and the determination every 6-12 hours is more helpful for the diagnosis [21]. (2) To confirm whether cortisol deficiency is ACTH dependent. If ACTH > 22 pmol/L, primary AC should be considered. If the plasma ACTH and cortisol levels are lower than the lower limit of the reference value, the secondary AC should be considered. For the patients with cortisol > 82.8 nmol/L, 250 μg ticotitide stimulation test is feasible. This test has high sensitivity and specificity (97% and 95%), but the patients with recent pituitary stroke or pituitary surgery are not available. Of course, the positive feedback effect of ACTH on adrenal gland is enhanced due to surgical stress, thus, the original reference value may have some errors [22,23]. Our analyzation needs to be in detail.

Because of the lackage of safety test in clinical trials, insulin hypoglycemia test is not recommended as the gold standard for evaluating the integrity of the hypothalamus-pituitary-adrenal axis. The corticotropin releasing hormone (CRH) and methylprednisolone stimulation test are also not recommended because of their potential risk for adrenal crisis. The thyroid function, thyroid antibody, 21-hydroxylase antigen and 17-hydroxylase antigen are detected. If necessary, MRI is performed to determine whether there is tumor, tuberculosis, fungal infection, etc.

In addition to laboratory examination, the patients after unilateral adrenalectomy have the following conditions, which need to be suspected of adrenal crisis: (1) dehydration, blood pressure fluctuations, body temperature fluctuations, shock and other manifestations that cannot be explained by the current state. (2) On the basis of unexplained changes in fatigue, nausea and mental state, abdominal pain and other symptoms similar to acute abdomen or gastrointestinal perforation occur, without obvious or matching abdominal pain, muscle tension and other peritoneal irritation signs. (3) Unexplained hypoglycemia. (4) Unexplained skin flush or new pigmentation. (5) Hyponatremia, hyperkalemia or hypokalemia. (6) Other biochemical indicators are abnormal, including azotemia, hypercalcemia and hypoproteinemia [24,25].

4. Treatment of Adrenal Crisis

Once suspected for adrenal crisis attack, it is necessary to immediately take blood for ACTH, and cortisol. In addition, 300 mg hydrocortisone will be given intravenously within 1 hour, which made the plasma cortisol concentration reach the level of normal people under severe stress [26]. After that, intravenous drip of 100 to 200 mg of hydrocortisone is going to be continued for 6 to 8 hours. On the second and third day, it can be reduced to 100mg twice or three times per day. If the patient's condition improves, continue to reduce the intravenous hydrocortisone to 200mg/day and the next day to 100mg/day. After the patient stopped vomiting and resumed eating, prednisone acetate 10mg daily is taken orally [27]. Active treatment of infection, trauma, cold, psychological stress and other incentives, the use of necessary vasoactive drugs and albumin supplement to maintain blood pressure, and timely correction of hypoglycemia, maintain water and electrolyte balance is also very important.

Before the advent of glucocorticoid replacement therapy, the mortality rate of AC is more than one third [28]. With the emergence of hormone replacement therapy, the prognosis of patients with AC identified in time is good [29]. However, some patients do not follow the principle of long-term adherence or not adjust the dose in time, resulting in life-threatening adrenal crisis [30]. Therefore, early and accurate identification and scientific treatment of AC after unilateral adrenalectomy are very important. It is generally believed that a daily dose of hydrocortisone in excess of 50 mg is sufficient for mineralocorticoid receptor action, so there is no need for additional corticosteroids. However, if the symptoms of AC can't be effectively controlled after using more than 1000 mg hydrocortisone, or the AC attacks repeatedly and frequently, it is necessary to consider whether 50 to 200 μg of fludrocortisone (25 times of hydrocortisone activity) should be supplemented daily [31].

5. Prevention of Adrenal Crisis

For patients with AC, glucocorticoid replacement therapy can only be evaluated by clinical symptoms and signs. There is no objective evaluation index [32]. However, patients with AC who are not treated properly in time will soon suffer from hypovolemic shock, unconsciousness and even life-threatening [33]. Attention should be paid to the prevention of infection, cold stimulation, massive bleeding, vomiting, diarrhea, water loss and other stress situations [34]. Hydrocortisone 200 mg can be given imme-

DOI: https://doi.org/10.30564/jer.v2i2.2764

diately after adrenalectomy, and then again within 6 hours after surgery [35]. According to the prospective study of Hahner et al. [16], 184 patients (184/423 cases, 43.50%) developed adrenal crisis during the 2-year follow-up period after adrenalectomy. Because of timely identification and intervention, only 4 patients died of adrenal crisis. The cause of their death is related to the sudden withdrawal of prednisone acetate during long-term regular oral administration [36].

Although the occurrence of adrenal crisis after retroperitoneal laparoscopic unilateral adrenalectomy is relatively hidden, and if not treated in time, it may cause shock and even lead to death. However, if doctors can early and accurate identification, and timely use of hydrocortisone intervention, the prognosis of patients with AC is generally good.

References

[1] You BR. Emergency management of acute adrenocortical insufficiency (adrenal crisis) in British adults[J]. Fujian Med J, 2017, 39(3): 24-25. https://kns.cnki.net/KXReader/Detail?TIMESTAMP=63745028996142914 1&DBCODE=CJFD&TABLEName=CJFDLAST2017&FileName=FJYY201703005&RESULT=1&SIGN=G%2b9qZNWRXipytQciOq9Is7%2fG3fg%3d

[2] Smans LC, Van der Valk ES, Hermus AR, et al. Incidence of adrenal crisis in patients with adrenal insufficiency[J]. Clin Endocrinol, 2016, 84(1): 17-22.
DOI: 10.1111/cen.12865

[3] Hahner S, Mbleicken L. Epidemiology of adrenal crisis in chronic adrenal insufficiency: the need for new prevention strategies[J]. Eur J Endocrinol, 2010, 162(3): 597-602.
DOI: 10.1530/EJE-09-0884

[4] MEYER G, BADENHOOP K, LINDER R. Addison's disease with phlyglandular autoimmunity carries a more than 2.5-foid risk for adrenal crises:-German Health insurance data 2010-2013[J]. Clin Endocrinol(Oxf), 2016, 85(3): 347-353.
DOI: 10.1111/cen.13043

[5] Organization WH. ICD-10. International Statistical Classification of Diseases and Related Health Problems[J]. Acta Chir Iugoslavica, 2009, 56(3): 65-69.
DOI: 10.2298/ACI0903065V

[6] Allolio B. Extensive expertise in endocrinology. Adrenal crisis[J]. Eur J Endocrind, 2015, 172(3): 115-124.
DOI: 10.1530/eje-14-0824

[7] Anand G, Beuschlein F. Management of Endocrine Disease: Fertility, pregnancy and lactation in women with adrenal insufficiency[J]. Eur J Endocrinol, 2018, 178(2): 45-53.
DOI: 10.1530/EJE-17-0975

[8] Li XX, Liu J, Chen YL, et al. Atypical Presentation of Adrenocortical Insufficiency with Anorexia and Jaundice[J]. Am J Case Rep, 2018, 19: 705-709.
DOI: 10.12659/AJCR.909190

[9] Bergthorsdottir R, Leonssonzachrisson M, Oden A, et al. Premature mortality in patients with Addison's disease: a population-based study[J]. J Clin Endocrinol Metab, 2006, 91(12): 4849-4853.
DOI: 10.1210/jc.2006-0076

[10] Wang L, Li Q. Evaluation of adrenal function and hormone replacement in patients with pituitary adenoma after operation[J]. Clin Med China, 2016, 32(8): 757-760+761.
DOI: 10.3760/cma.j.issn.1008-6315.2016.08.025

[11] Jin L, Liu JF. Septic shock complicated with adrenocortical crisis after gastric perforation: a case report[J]. Zhejiang J Traum Surg, 2017, 22(2): 399-400.
DOI: 10.3969/j.issn.1009-7147.2017.02.092

[12] Grossmann M, Topliss DJ. A cool case: hypothermia and adrenal failure[J]. Lancet, 2006, 368(9553): 2184.
DOI: 10.1016/S0140-6736(06)69866-8

[13] MEYER G, BADENHOOP K, LINDER R. Addison's disease with phlyglandular autoimmunity carries a more than 2.5-foid risk for adrenal crises: German Health insurance data 2010-2013[J]. Clin Endocrinol (Oxf), 2016, 85(3): 347-353.
DOI: 10.1111/cen.13043

[14] Hahner Stefanie, Spinnler Christina, Fassnacht Martin, et al. High incidence of adrenal crisis in educated patients with chronic adrenal insufficiency: a prospective study[J]. J Clin Endocrinol Metab, 2015, 100(2): 407-16.
DOI: 10.1210/jc.2014-3191

[15] Yang Ys, Luo by. Adrenal crisis[J]. Int J Endocrinol metab, 2005, 25(3): 214-215.
DOI: 10.1007/s00390-005-0546-4

[16] Hahner S, Loeffler M, Bleicken B, et al. Epidemiology of adrenal crisis in chronic adrenal insufficiency: the need for new prevention strategies[J]. Eur J Endocrinol, 2010, 162(3): 597-602.
DOI: 10.1530/EJE-09-0884

[17] White K, Arlt W. Adrenal crisis in treated Addison's disease:a pre-dictable but under-managed event[J]. Eur J Endocrinol, 2010, 162(1): 115-120.
DOI: 10.1530/EJE-09-0559

[18] Mastorakos G, lias I. Maternal and fetal hypothalamic-pituitaryadrenal axes during pregnancy and

postpartum[J]. Ann N Y Acad Sci, 2010, 997(1): 136-149.
DOI: 10.1196/annals.1290.016

[19] White K, Arlt W. Adrenal crisis in treated Addison's disease: a predictable but under-managed event[J]. Euro J Endocrinol, 2010, 162(1): 115.
DOI: 10.1530/EJE-09-0559

[20] Hahner S, Spinnler C, Fassnacht M, et al. High incidence of adrenal crisis in educated patients with chronic adrenal insufficiency-a prospective study[J]. J Clin Endocrinol Metab, 2015, 100(2): 407-416.
DOI: 10.1210/jc.2014-3191

[21] Bouillon R. Acute Adrenal Insufficiency[J]. Endocrinol Metab Clin, 2006, 35(4): 767-775.
DOI: 10.1016/j.ecl.2006.09.004

[22] Bornstein SR, Allolio B, Arlt W, et al. Diagnosis and Treatment of Primary Adrenal Insufficiency: An Endocrine Society Clinical Practice Guideline[J]. J Clin Endocrinol Metab, 2016, 101(2): 64-389.
DOI: 10.1210/jc.2015-1710

[23] Nolten WE, Lindheimer MD, Rueckert PA, et al. Diurnal Patterns and Regulation of Cortisol Secretion in Pregnancy[J]. J Clin Endocrinol Metab, 1980, 51(3): 466-472.
DOI: 10.1210/jcem-51-3-466

[24] Smith JS. Acute Adrenal Insufficiency[J]. Comprehensive Therapy, 2006, 35(4): 767-775.
DOI: 10.1016/j.ecl.2006.09.004

[25] Meeking S. Treatment of Acute Adrenal Insufficiency[J]. Clin Tech Small Anim Pract, 2007, 22(1): 36-39.
DOI: 10.1053/j.ctsap.2007.02.006

[26] Husebye ES,Allolio B,Arlt W,et al. Consensus statement on the diagnosis, treatment and follow-up of patients with primary adrenal insufficiency[J]. J Intern Med, 2014, 275(2): 104-115.
DOI: 10.1111/joim.12162

[27] Jung C, Inder WJ. Management of adrenal insufficiency during the stress of medical illness and surgery[J]. Med J Aust, 2008, 188(7): 409-413.
DOI: 10.5694/j.1326-5377.2008.tb02071.x

[28] Brent F. Addison's disease and pregnancy[J]. Am J Surg, 1950, 79(5): 645-652.

[29] Park J, Didi M, Blair J. The diagnosis and treatment of adrenal insufficiency during childhood and adolescence[J]. Arch Dis Child, 2016, 101(9): 860-5.
DOI: 10.1136/archdischild-2015-308799

[30] Kong SM, Luo JM. Clinical characteristics and mutation analysis of NR0B1 and steroid-generating factor-1 gene in 7 children with primary adrenocortical hypofunction[J]. Guangxi Med J, 2017, 39(03): 337-341+349.
DOI: 10.11675/j.issn.0253-4304.2017.03.15

[31] Arlt W. The approach to the adult with newly diagnosed adrenal insufficiency[J]. J Clin Endocrinol Metab, 2009, 94(4): 1059-1067.
DOI: 10.1210/jc.2009-0032

[32] Bhattacharyya A, Macdonald J, Lakhdar AA. Acute adrenocortical crisis: three different presentations[J]. Intern J Clin Pract, 2001, 55(2): 141-144.
https://schlr.cnki.net/Detail/index/SJPD_03/SJPD12090303313868

[33] Streeten DHP, Anderson GH, Bonaventura MM. The potential for serious consequences from misinterpreting nomal responses to the rapid adrenocorticotropin test[J]. J Clin Endocrinol Metab, 1996, 81:285-290.
DOI: 10.1210/jcem.81.1.8550765

[34] Bao WG. Clinical analysis of 20 cases of acute adrenocortical crisis[J]. Chin Mod Med, 2012, 19(28): 27-28.
https://kns.cnki.net/KXReader/Detail?PlatForm=kdoc&TIMESTAMP=637450271831331484&DBCODE=CJFD&TABLEName=CJFD2012&FileName=ZGUD201228017&RESULT=1&SIGN=tduK%2fOH7m00J5Ed7vE3FIbdZXco%3d

[35] Quinkler M, Dahlqvist Pr, Husebye ES, et al. A European Emergency Card for adrenal insufficiency can save lives[J]. Eur J Intern Med, 2015, 26(1): 75-6.
DOI: 10.1016/j.ejim.2014.11.006

[36] Irina B, Stefanie H. Diagnosis and management of adrenal insufficiency[J]. Lancet Diabetes Endocrinol, 2015, 3: 216-226.
DOI: 10.1016/S2213-8587(14)70142-1

DOI: https://doi.org/10.30564/jer.v2i2.2764