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# Cerebellar Syndrome Revealing a Giant Postero Inferior Cerebellar Artery Aneurysm: A Case Report and a Review of Literature

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## Abstract

**Context:** Cerebellar syndrome caused by disturbances of balance and coordination is not an uncommon neurological disorder. It has varied etiologies usually caused by tumor processes or suppurative collections. Vascular causes remain very rare, especially when it is a giant aneurysm of PICA representing 1% of intracranial aneurysms. Treating giant PICA aneurysms is a very difficult task for neurosurgeons because the surgical dissection can lead to severe damage due to the intimate relationship of PICA with the brainstem or nerve structures. We report a case of giant PICA aneurysm responsible for cerebellar syndrome successfully treated with surgery. The objective of this work is to draw the attention of practitioners to this unusual cause which can lead to diagnosis wandering and a lack of planning at the time of management. **Case report:** A 65 years old hypertensive patient was seen for a progressive disturbance of balance and walking disorder, but worsened in the last three months with no notion of fever. On admission, the patient was lucid, oriented in time and space and presented with static and kinetic cerebellar syndrome. Brain CT-scan without and with contrast revealed a tissular mass in the posterior fossa suggesting a tumor process, however, CT angiography showed a giant aneurysm of the PICA after reconstruction. A careful microdissection by a sub-occipital approach was decided. Opening the large cistern made it possible to visualize the aneurysm sack surrounded by a yellowish gliosis. The reclining and microdissection revealed the neck of the aneurysm, which was

clipped to exclude the giant aneurysm in block. Postoperative follow-up was simple with progressive improvement in the cerebellar syndrome and walking over three months. Conclusion: Giant aneurysm of the PICA is rare. The localization in the posterior cerebral fossa can be confusing. Microsurgery gives a good result.

## Keywords

Giant Aneurysm, PICA, Cerebellar Syndrome, CT Angiography

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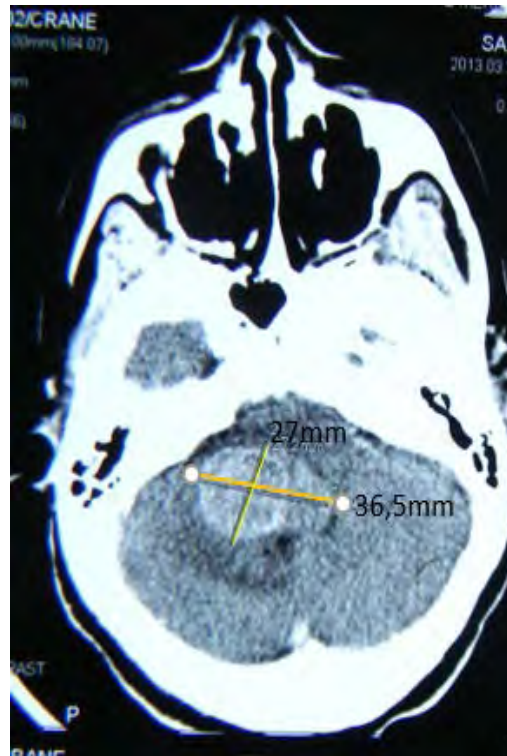
## 1. Introduction

PICA aneurysms represent 1% of all intracranial aneurysms [1] and giant aneurysms defined by their large diameter greater than 25 mm represent 2% to 3% of intracranial aneurysms [2] [3]. The localization at the Ponto-cerebellar angle leading to a cerebellar syndrome (a static and kinetic cerebellar syndrome leading to disturbances in balance and coordination of movements) is a rare clinical representation which can be confusing and whose management remains a challenge [4]. Microdissection clipping can cause serious neurological complications due to the proximity of the aneurysm sack to the brainstem and cranial nerves. We present a case of giant PICA aneurysm that resulted in cerebellar syndrome successfully treated by clipping and a review of the literature.

## 2. Clinical Case

A 65 years old patient with a history of controlled hypertension on amlodipine seen for problem with balance and walking. Medical story was consistent with progressive disabling headaches evolving for three years and complicated by right unilateral perceptual hypoacusis, balance and coordination disorders three months ago. A kinetic and static cerebellar syndrome was shown on physical examination. Brain Ct-scan without and with injection of contrast revealed an expansive process in the posterior cerebral fossa at the level of the Ponto-cerebellar angle with a double central hyperintense component surrounded by a less dense peripheral crown of 36.5 mm by 27 mm, suggesting a tumor or vascular process (**Figure 1**). CT angiography revealed a giant aneurysm of the distal portion of the PICA after reconstruction (**Figure 2**). The patient did not agree with the surgery at the beginning. She left the hospital and returned two weeks later. After the worsening of the neurological signs and the anesthesiology consultation, Clipping surgery was decided for sub-occipital approach. The spinous of the first cervical vertebra was removed and the foramen magnum was exposed and opened completely. The dura mater was cut large and the PICA was observed then a thorough dissection and opening of the large cistern on the right side were performed. A yellowish scarring gliosis was seen serving as a cleavage plane surrounding the non-pulsatile aneurysm sac, indicating a micro-bleeding in the past. The reclining of the bag made it possible to see an anterior collar



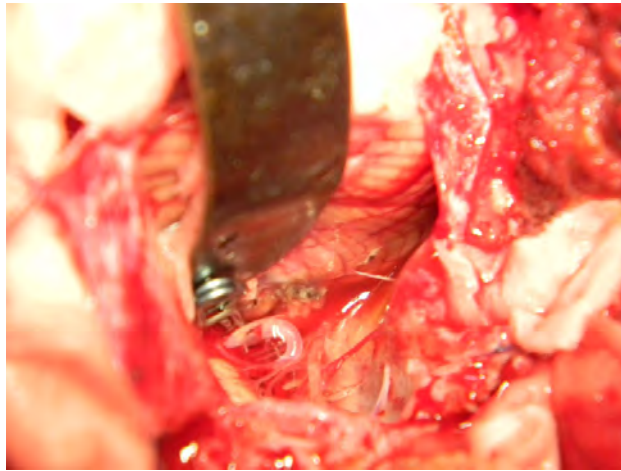


**Figure 1.** Brain CT-scan visualizing the giant aneurysm.



**Figure 2.** CT angiography visualizing the giant PICA aneurysm.

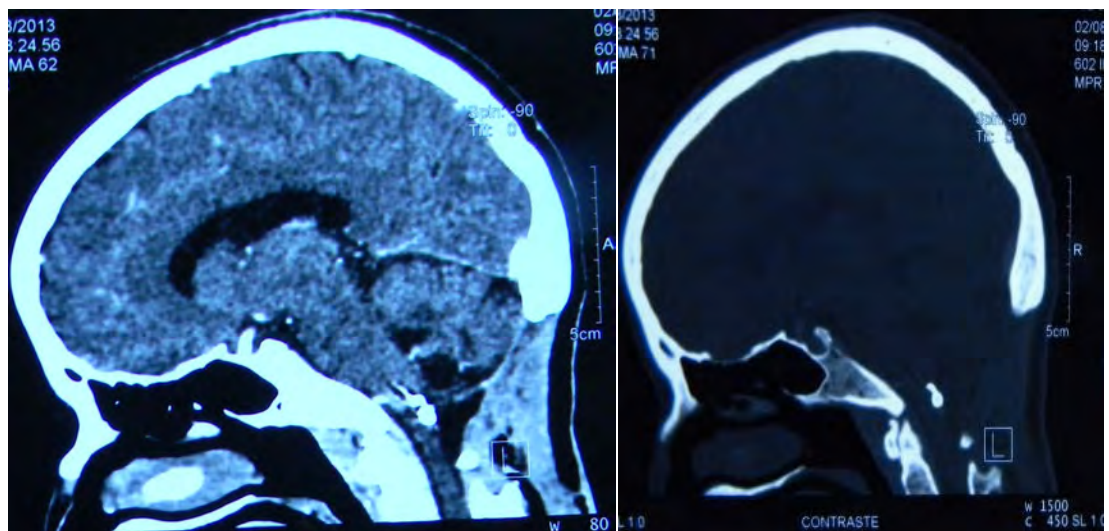
accessible by clipping. The aneurysm was excluded in block without retraction of the nerve structures by placing a medium right yasargil clip (**Figure 3**) and the sack resected in block (**Figure 4**). The postoperative treatment was straightforward, in particular she did not present with any additional neurological deficit or cranial nerve paralysis. The follow up brain scan showed the total exclusion of the aneurysm (**Figure 5**). The patient was put on physical therapy and three months after discharge. After the third month, she had fully recovered and was independent. The patient was programmed for a follow-up with a CT-scan every year.



**Figure 3.** Intraoperative image view after the aneurysm is removed.



**Figure 4.** Photography of the giant aneurysm after surgical removal.



**Figure 5.** Postoperative brain CT-scan showing the total removal of the aneurysm three years after surgery.



### 3. Discussion

The incidence of PICA aneurysms is 0.5% to 3% and giant aneurysms account for 3% to 5% of intracranial aneurysms [2] [3]. About (15%) of these aneurysms are of carotid origin [5]. Localizations of these aneurysms at the level of the PICA in its distal portion are rare and represent 30% of aneurysms in PICA [6]. They can lead to paralysis of the cranial nerves or suffering of the cerebellar tissue [7] as observed in our patient. Slow progression and mass syndrome have been responsible for the coordination impairment. The brain CT-scan made it possible to evoke the diagnosis which was confused with a tumor process brain CT-angiography with the reconstructions visualized the giant aneurysm. Cerebral angiography remains the most important diagnosis tool, “the gold standard” [8], but was not performed in our patient because of its unavailability in the regional health center. The open surgical indication was retained and was the only therapeutic choice due to the unavailability of other methods. The choice of techniques and methods is controversial because each method has its advantages and disadvantages [9]. Several authors believe that surgical clipping brings better results [4] [5] [10] [11] and the sub-occipital route the most used [12]. In our case, this method made it possible to clip the aneurysm and exclude the aneurysmal sac which was compressing the cerebellum. Cranial nerve palsy and cerebellar infection are frequent and usual complications of PICA surgery, it has been reported that 47% of IX and X palsy and 22% of patients will continue to have dysphagia one year after surgery [13]. An understanding of the anatomy of this artery is essential [9] [14]. The mixed nerves were below the giant aneurysm and were not damaged, which explains the absence of aggravation or paralysis of the cranial nerves, postoperatively. Morbidity and mortality associated with microsurgery are relatively high, and endovascular embolization treatment is associated with several complications [4]. Given the complications related to surgery and the limitations of endovascular treatment, it is necessary to consider other methods in the future, such as bypass and new bypass stents such as bypass PICA to PICA, occipital artery to PICA [10] [15] [16].

### 4. Conclusion

The PICA aneurysm is rare, even rarer when it is localized in the posterior cerebral fossa. Surgery prevents re-bleeding by clipping the aneurysm and also relieves the mass syndrome on the nervous structures by excluding the aneurysm.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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# Reducing Hospital Lengths of Stay: A Five-Year Study

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## Abstract

Hospital length of stay reduction is an important mechanism for improving the outcomes and efficiency of care. This study evaluated the impact of length of stay reduction in the hospitals of Syracuse, New York. Between 2015 and 2020, length of stay reduction saved 7106 inpatient days for adult medicine, and 10,605 patient days for adult surgery in the hospitals. At a conservative late stay rate of \$600 per day, \$4,263,600 was eliminated for adult medicine and \$6,363,000 was eliminated for adult surgery between 2015 and 2020. The study data suggested that the numbers of days saved were the greatest for patients with Major and Extreme severity of illness. At the community level, length of stay reduction can support the efforts of health care providers to free inpatient capacity for patients with Coronavirus and other conditions. It can also generate the efficiency needed to reimburse the costs of care.

## Keywords

Hospitals, Hospital Lengths of Stay, Health Care Costs

## 1. Introduction

In recent years, increased attention has focused on the utilization of health care in the United States. This has resulted from the need to accommodate the care of populations in the current system as well as concerns regarding the costs of care [1] [2].

The requirement for health care systems to address population needs has been a focus of efforts to address clinical conditions such as the Coronavirus. The need for hospital bed capacity at the local level has been monitored throughout the nation [3] [4].

It is assumed that inpatient hospitals treat patients within the health care sys-

tem who have the highest severity of illness. Through medical-surgical and intensive care beds, hospitals provide services for a wide range of medical diagnoses and surgical procedures [5].

Hospitals provide these services through acute episodic care. They treat conditions on an inpatient basis and move patients to post discharge services such as self care, home care, and skilled nursing care [5] [6].

The costs of health care have continued to draw attention in the public and private sectors. Government payers and private insurance companies have struggled to address the costs of care for decades. These costs have increased at a faster rate than other components of the cost of living in the United States and elsewhere [7] [8].

Some efforts to improve hospital inpatient care and related costs have focused on reduction of lengths of stay. These stays and related inpatient costs are generated by nursing and other therapies, tests, pharmaceuticals, and other services. Reduction of hospital stays has usually involved limiting costs for these services [7] [8] [9].

Reducing hospital lengths of stay has also involved the movement of patients to post discharge services at the community level. The process is based on transferring patients to less intense and less expensive care [10].

## 2. Population

This study summarized length of stay reduction in recent years in the hospitals of Syracuse, New York. These hospitals included Crouse Hospital (17,204 inpatient discharges excluding well newborns, 2020), St. Joseph's Hospital Health Center (21,328 discharges, 2020), and Upstate University Hospital (30,988 discharges, 2020).

Historically, the Syracuse hospitals have provided a full range of acute care services to an immediate service area with a population of approximately 600,000. They have also provided referral center services to the Central New York Health Service Area with a population of approximately 1,400,000 [11].

The Syracuse hospitals have worked cooperatively to improve utilization and outcomes, including length of stay reduction, in their service area. A number of these efforts have been developed through the Hospital Executive Council [11].

## 3. Method

This study focused on efforts by the Syracuse hospitals to reduce inpatient lengths of stay for adult medicine and adult surgery. These are the two largest acute care services maintained by the hospitals, accounting for 71.1 percent of inpatients excluding well newborns during 2020. For purposes of the study, adult medicine and adult surgery were defined as all inpatients excluding pediatrics, obstetrics, neonates, and mental health services.

The study focused on inpatient hospital lengths of stay between 2015 and 2020, the latest complete twelve-month periods available. The research was



conducted on data for 2015-2020. The years were identified individually so the impact of the coronavirus in 2020 could be separated.

The data were identified for twelve-month periods so that comparisons could be based on similar time periods. For these periods, individual months had the same lengths with the exception of February.

Within these time periods, lengths of stay for the combined hospitals were separated for discharges and lengths of stay by severity of illness. They were identified using the 3M™ All Patients Refined Diagnosis Related Group System.

In the Syracuse hospitals, reduction of inpatient lengths of stay has been developed through a number of programs. Most of these have focused on patients who have remained in hospitals for extended periods of time.

These initiatives have included case management efforts to monitor and manage patients who require long term care services in the community. They have focused on identifying patients who require home health care, skilled nursing care, and other services and providing them on a timely basis. These programs have included development and distribution of information concerning Difficult to Place patients.

Reduction of lengths of stay in the Syracuse hospitals has also included the Subacute and Complex Care programs. These services have focused on moving patients who require extended care for intravenous therapy, extended wound care, and other services, rather than have them remain in acute hospitals.

The first component of this study identified mean lengths of stay and differences between these stays and severity adjusted national averages for adult medicine and adult surgery for the combined Syracuse hospitals by year between 2015 and 2020. Through this analysis, it was possible to quantify numbers of inpatient days saved during each of these twelve-month periods.

The first and second components of the analysis identified indicators associated with length of stay reduction during the period of the data. They included severity of illness and discharge status of the medical-surgical inpatients in the hospitals. These indicators were evaluated through comparison of 2015 and 2020 inpatient data.

## 4. Results

The initial component of this study focused on medical-surgical lengths of stay for the Syracuse hospitals for 2015-2020. Relevant data are summarized in **Table 1**.

This information demonstrated that there were substantial reductions in stays for the combined Syracuse hospitals during this time interval. Based on the differences between mean stays and numbers of discharges, the stay for adult medicine declined by 7106 patient days, while the stay for adult surgery declined by 10,605 patient days. The total length of stay reduction for the two services amounted to an average daily census of 48.5 patients.

Within each of the services, the declines in length of stay between 2015 and 2020 generated reductions in patient days by levels of severity of illness between

**Table 1.** Inpatient Hospital Mean Lengths of Stay by Severity of Illness, Adult Medicine and Adult Surgery, Syracuse Hospitals, 2015-2020.

	Number of Discharges					
	2015	2016	2017	2018	2019	2020
Adult Medicine						
Minor	4236	4686	5018	5243	4915	3641
Moderate	11,887	13,143	13,705	14,561	13,060	10,892
Major	13,036	11,882	12,436	13,347	13,997	12,925
Extreme	4384	3318	3517	4244	5665	6383
Total	33,543	33,029	34,676	37,395	37,637	33,841
	Mean Length of Stay (Days)					
	2015	2016	2017	2018	2019	2020
Minor	2.66	2.60	2.52	2.55	2.55	2.56
Moderate	3.71	3.59	3.52	3.38	3.40	3.37
Major	5.70	5.86	5.76	5.63	5.15	5.09
Extreme	10.75	10.72	10.77	10.27	9.19	9.30
Total	5.27	4.98	4.91	4.85	4.81	5.06
	Patient Days Difference from Severity Adjusted National Average					
	2015	2016	2017	2018	2019	2020
Minor	-127.08	-421.74	-853.06	-734.02	-688.10	-473.33
Moderate	0.00	-1577.16	-2603.95	-4805.13	-4048.60	-3703.28
Major	130.36	2019.94	870.52	-800.82	-7558.38	-7755.00
Extreme	789.12	497.70	703.40	-1273.20	-7817.70	-8106.41
Total	792.40	518.74	-1883.09	-7613.17	-20,112.78	-20,038.02
Adult Surgery						
	Number of Discharges					
	2015	2016	2017	2018	2019	2020
Minor	6652	7784	8201	7473	7184	5246
Moderate	8697	8975	8678	8692	8283	6667
Major	4034	4106	3858	3822	3878	3741
Extreme	1831	1820	1834	1711	2083	2321
Total	21,214	22,685	22,571	21,698	21,428	17,975
	Mean Length of Stay (Days)					
	2015	2016	2017	2018	2019	2020
Minor	2.62	2.67	2.51	2.35	2.24	2.29
Moderate	3.91	4.04	3.99	3.83	3.65	3.69
Major	8.40	8.99	8.71	8.66	8.12	7.53
Extreme	24.50	21.29	19.83	18.86	17.45	15.97
Total	6.25	5.85	5.55	5.36	5.33	5.66
	Patient Days Difference from Severity Adjusted National Average					
	2015	2016	2017	2018	2019	2020
Minor	-2394.72	-2413.04	-3854.47	-4707.99	-5316.16	-3619.74
Moderate	-3478.80	-2423.25	-2776.96	-4172.16	-5466.78	-4133.54
Major	-2311.48	82.12	-1003.08	-1184.82	-3296.30	-5387.04
Extreme	6701.46	819.00	-1852.34	-3387.78	-7061.37	-11,303.27
Total	-1483.54	-3935.17	-9486.85	-13,452.75	-21,140.61	-24,443.59

Source: Hospital Executive Council.

2015 and 2020. The numbers of patient days increased with levels of severity of illness. This suggested that larger amounts of length of stay reduction were associated with higher severity of illness.

In adult medicine, the length of stay decline was produced by all levels of severity. Minor severity patients generated 364.1 patient days. Moderate severity patients produced 3703 patient days. Major severity patients produced 7884 patient days. Extreme severity patients produced 9255 patient days.

In adult surgery, higher severity patients were associated with larger declines in numbers of patient days. Extreme severity patients produced 19,798 patient days. Major severity patients generated 3254 patient days. Moderate severity patients produced 1466 patient days. Minor severity patients generated 1731 patient days.

Reductions in hospital lengths of stay were also associated with differences in adult medicine and adult surgery lengths of stay in the Syracuse hospitals and severity adjusted national averages. These variations were different than those produced by the comparisons of actual discharges and stays in the Syracuse hospitals.

For adult medicine, the reduction in the severity adjusted national average between 2015 and 2020 amounted to 19,245 patient days. The adult surgery length of stay reduction was 25,926 patient days. For the two services combined, the reduction in the average daily census was 123.8 patients.

The second component of the study focused on changes in lengths of stay in the Syracuse hospitals by discharge status. Relevant data are summarized in **Table 2**.

These data demonstrated that the largest numbers of hospital patients by discharge status in the Syracuse hospitals between 2015 and 2020 were those discharged home with self care and home care. At the same time, the longest stays were generated by patients discharged to nursing homes, as well as deaths and transfers.

For adult medicine, the largest reductions in stays in the Syracuse hospitals between 2015 and 2019 were generated by discharges home. These included a decline in patient days of 4741 for discharges home to self care and a decline of 4244 patient days for discharges to home health care. For adult surgery, the declines in stays by discharge status were produced by discharges to self care, 4,706 and deaths/transfers, 3,158. The longest stays were produced by discharges to nursing homes and deaths/transfers.

These data suggest that the largest reductions in hospital stays in Syracuse have involved discharges home. Additional progress could be more challenging, involving post discharge services such as nursing homes and other providers.

## 5. Discussion

Hospital length of stay reduction is an important mechanism for improving health care utilization. Available information suggests that reducing hospital stays can improve the outcomes and efficiency of care.

**Table 2.** Inpatient Hospital Mean Lengths of Stay by Discharge Status, Adult Medicine and Adult Surgery, Syracuse Hospitals, 2015-2020.

	Number of Discharges					
	2015	2016	2017	2018	2019	2020
<b>Adult Medicine</b>						
Self Care	18,404	17,567	18,267	19,801	19,438	16,931
Home Care	6178	6540	7325	7998	7742	7447
Nursing Home	5588	5428	5509	5907	6502	5267
Deaths/Transfers	3347	3474	3564	3689	3955	4196
Total	33,517	33,009	34,665	37,395	37,637	33,841
<b>Mean Length of Stay (Days)</b>						
Self Care	3.76	3.60	3.48	3.48	3.44	3.52
Home Care	6.27	5.81	5.61	5.67	5.41	5.70
Nursing Home	8.19	7.79	7.94	7.61	7.45	7.91
Deaths/Transfers	6.82	5.96	6.16	6.04	6.05	6.57
Total	5.27	4.98	4.91	4.85	4.81	5.06
<b>Patient Days Difference from Severity Adjusted National Average</b>						
Self Care	-12,984.9	-11,347.8	-13,762.4	-16,136.3	-20,447.6	-20,175.0
Home Care	3488.6	2611.6	1183.8	1108.1	-3606.0	-4028.3
Nursing Home	11,759.1	11,201.6	11,885.0	10,182.8	7610.4	7819.2
Deaths/Transfers	-956.2	-2415.8	-1644.7	-3116.3	-3992.3	-3800.1
Total	712.8	605.4	-1650.4	-7458.8	-19,862.6	-19,918.7
<b>Adult Surgery</b>						
Self Care	11,430	12,443	12,775	13,290	13,437	10,945
Home Care	4992	5434	5152	4201	3712	3485
Nursing Home	3446	3376	3212	2945	3040	2286
Deaths/Transfers	1346	1432	1432	1262	1239	1258
Total	21,214	22,685	22,571	21,698	21,428	17,974
<b>Mean Length of Stay (Days)</b>						
Self Care	3.57	3.40	3.27	3.08	2.96	3.14
Home Care	6.87	6.53	6.20	6.56	7.02	7.47
Nursing Home	11.16	10.88	10.42	10.62	10.86	11.73
Deaths/Transfers	14.12	12.66	12.52	13.06	12.37	11.61
Total	6.25	5.85	5.55	5.36	5.33	5.66
<b>Patient Days Difference from Severity Adjusted National Average</b>						
Self Care	-10,604.0	-12,103.9	-13,033.8	-16,462.8	-20,300.4	-18,871.7
Home Care	1127.1	380.4	-2082.2	-1826.0	-1806.1	-3205.2
Nursing Home	9209.5	8704.2	7000.1	6119.7	4674.2	3360.6
Deaths/Transfers	925.2	-1161.0	-1272.1	-406.6	-2235.6	-4358.1
Total	-1499.5	-3954.7	-9479.8	-13,516.0	-21,263.0	-23,149.3

Source: Hospital Executive Council.

For health care outcomes, shorter stays can help patients go home sooner, reducing the risk of hospital acquired infections and other adverse outcomes. They can also free up additional inpatient bed capacity for Coronavirus patients and others who may require inpatient admission.

For health care efficiency, shorter stays can reduce patient days and related costs for labor, pharmaceuticals, and tests. This can generate substantial savings for providers and consumers of care.

The study was limited to inpatient discharges and patient days during the five-year period. For these indicators, it focused on inpatient severity of illness and inpatient discharge status.

In this study, length of stay reduction in the combined Syracuse hospitals, saved 7106 - 19,245 inpatient days for adult medicine and 10,605 - 25,926 inpatient days for adult surgery between 2015-2020 depending on the method of calculation. A late stay rate of \$600 per day would avoid costs such as intensive care and surgery that would not be eliminated. Using this rate, with the conservative numbers of days avoided, \$4,263,600 was eliminated for adult medicine and \$6,363,000 was eliminated for adult surgery between 2015 and 2020.

The study data suggested that levels of length of stay reduction were the greatest for patients with the highest severity of illness. Between 2015 and 2020, those with Major and Extreme severity of illness saved 17,139 patient days for adult medicine and 23,052 patient days for adult surgery.

This study suggested that hospital length of stay reduction at the community level is an important opportunity for improving health care outcomes and efficiency. Because hospitals provide episodic care, the expeditious movement of inpatients is essential to their ability to provide effective inpatient acute care services.

As populations continue to age, the need for efficient hospital lengths of stay will continue to be important for health care providers and payers. Both of them will have to maintain operational efficiency in an environment of limited resources.

In this study, the experiences of the Syracuse hospitals demonstrated that length of stay reduction can be implemented at the community level. These providers were able to reduce stays for patients with a wide range of severity of illness. It was notable that the largest numbers of patient days reduced were those associated with patients with the highest severity of illness.

These experiences indicate that a wide range of health care professionals, including clinicians, administrators, financial professionals, and long term care staff can have roles in length of stay reduction and share in its benefits. With the pressures that are currently challenging health care at the community level, this is an interesting and exciting opportunity.

## **Conflicts of Interest**

The authors declare no conflicts of interest regarding the publication of this paper.



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# Treatment of Cannabinoid Hyperemesis Syndrome-Associated Nausea with Haloperidol: A Case Report

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## Abstract

**Introduction:** Because of the rising prevalence of cannabis abuse, cannabinoid hyperemesis syndrome (CHS) was recognized as a new medical diagnosis in 2004. Despite the syndrome's growing prevalence, many providers are unfamiliar with its diagnosis and treatment, and there is little data to back up clinical knowledge and treatment recommendations. For many years, haloperidol has been widely used as an antiemetic, despite a lack of evidence-based clinical data on efficacy and side effects. We present the case of a female who presented to the emergency room with suspected CHS and was treated with haloperidol. **Case:** A 34-year-old African-American woman with diabetes and a history of marijuana use presented to the emergency department with refractory nausea and vomiting. Her urine drug screen came back positive for THC, but she denied using marijuana prior to this admission. She stated that she was following her current medication regimen. She denied drinking alcohol and smoking cigarettes. Multiple doses of ondansetron, promethazine, scopolamine, and metoclopramide had no effect on the patient. After two days of treatment with haloperidol 5 mg by mouth every 8 hours, nausea and vomiting subsided. **Discussion:** Haloperidol was able to control nausea and vomiting in six previous case reports of CHS. However, haloperidol was administered intravenously in five of the reports, and the route of administration was not specified in the sixth. To the best of our knowledge, we are the first to demonstrate the benefit of oral haloperidol for CHS. **Conclusion:** Although cessation of marijuana use is required for long-term resolution of CHS, our case and six others show the benefit of using IV haloperidol for acute management and oral for relapse prevention. More extensive clinical trials are needed to confirm haloperidol's therapeutic role in patients presenting with CHS symptoms.

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## Keywords

Cannabinoid, Hyperemesis, Haloperidol, Marijuana, Case Report

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## 1. Introduction

Cannabinoid hyperemesis syndrome (CHS) is associated with cannabinoid overuse. According to the United Nations, in 2017, an estimated 238 million people used cannabis in 2017, 22% percent of that total are users in North America, making it the most widely used drug globally [1]. Cannabis-induced adverse drug effects increased with its increased access [2] and in 2004, CHS was recognized as a new medical diagnosis [3].

CHS is characterized by chronic cannabis use, cyclic episodes of nausea and vomiting, and the learned behavior of hot bathing to relieve symptoms [4]. The clinical characteristics and appearance can be divided into three phases: the prodromal phase, the hyper-emetic phase, and the recovery phase [5]. The prodromal phase can last months to years with recurrent symptoms of early morning nausea, fear of vomiting, and abdominal discomfort [6]. This phase also includes a normal eating pattern with increased use of cannabis to alleviate nausea. The hyper-emetic phase consists of persistent vomiting that could be debilitating with weight loss of up to 14 kilograms and compulsive warm bathing to relieve symptoms of nausea and cannabis vomiting. The recovery phase follows a complete halt to use, with a total resolution of symptoms within 12 hours to 3 weeks, a return of normal eating pattern, weight gain, and recurrent hot bathing habits [6].

The only definitive treatment identified for CHS is the cessation of marijuana [3] [5] [7] [8] [9]. Pharmacological treatment of CHS can be divided into two phases: therapy for the hyperemetic phase and relapse prevention. Patients may require hospitalization during the hyperemetic phase secondary to abdominal pain, dehydration, as well as severe nausea and vomiting. Supportive therapy serves as the mainstay of treatment during this phase [10]. There is limited literature available on haloperidol as the standard of care in CHS. However, haloperidol has been widely used as an antiemetic for many years and has been described to provide symptom relief in some patients with CHS [11]. This article presents the findings from a literature review on CHS. It discusses a female patient who was successfully treated for CHS with haloperidol given by mouth.

## 2. Case Report

A 34-year-old African American female presented to the emergency department with complaints of recurrent nausea and vomiting. Three days before admission, the patient reported having nausea and vomiting after smoking marijuana and was unable to keep any food down. The patient has had two previous admissions for the same symptoms. During those admissions, the patient was given on-

dansetron, metoclopramide, erythromycin, and promethazine with no relief of symptoms. The patient's past medical history included Type 1 diabetes mellitus, gastroparesis, and hypertension. Her social history was significant for daily marijuana use, but she denied alcohol and tobacco.

## 2.1. Clinical Findings

Upon the current admission, the patient denied chest pain, headaches, shortness of breath, back pain, and diarrhea. The patient also stated that nothing aggravated or relieved the symptoms. Vitals were as follows: Blood pressure 153/110 mmHg, Pulse 95 beats/min, temperature 98.9°F, respiratory rate 15 breaths/min, and SpO<sub>2</sub> 100% on room air. A physical exam revealed an alert, awake, and oriented female with dry mucus membranes, diffuse abdominal pain, and bilateral mild tingling sensation in lower extremities. Her vomiting was bilious and sometimes mixed with blood. Cardiac and lung examinations were unremarkable. The patient's social history, clinical presentation, vital signs, and labs at admission supported the diagnosis of CHS and are depicted in **Table 1**.

## 2.2. Therapeutic Intervention

**Table 2** shows that the patient was unresponsive to promethazine 12.5 mg intramuscularly (IM) every 6 hours as needed and metoclopramide 10 mg IV × 1 dose during the hospital course. When given haloperidol 5 mg IM on hospital day #2, the vomiting subsided, but she was still nauseous. During the third day of therapy, the patient was given haloperidol 5 mg orally and felt better.

**Table 1.** Admission Laboratory Tests.

Serum Test	Value	Serum Test	Value
Sodium	138 mEq/l	Hemoglobin	10.5 g/dl
Potassium	3.3 mEq/l	Hematocrit	22 %
Chloride	108 mEq/l	WBC	$9.4 \times 10^9$ per liter
Bicarbonate	26 mEq/l	Platelets	$259 \times 10^9$ per liter
BUN	14 mg/dl	A1C	10.49%
Creatine	0.9 mg/dl		
Glucose	174 mg/dl		

**Table 2.** Cannabinoid hyperemesis syndrome treatment.

Hospital Day	Treatment	Outcome
#1	Promethazine 12.5 mg IV @ 2202 Metoclopramide 10 mg IV @ 2310	Emesis × 2
#2	Haloperidol 5 mg IM @ 1156 Haloperidol 5 mg IM @ 2018	↓ vomiting but still nauseous
#3	Haloperidol 5 mg PO @ 0900	Patient felt better and requested to leave against medical advice

### 2.3. Follow-Up and Outcomes

The patient left the hospital against medical advice and was discharged on haloperidol 5 mg by mouth every 8 hours. The patient was given instructions regarding the diagnosis, expectations, follow-up, and return precautions. Unfortunately, despite counseling, the patient was not amenable to cannabis cessation at that time. She was also counseled on the importance of therapy adherence and following up with her primary care physician.

### 3. Discussion

Reports of CHS in patients have increased over the years, despite the syndrome's increasing prevalence, many physicians are unfamiliar with its diagnosis and treatment [6]. This under-recognition may be due to the paradoxical use for the treatment of nausea and vomiting, the stigma associated with cannabis use, and the illegal status of cannabis in some areas leading to under-reporting of use. The frequency of emergency department visits and high hospital admission rates for CHS exemplify the difficulty in symptom management [4]. The lack of knowledge and treatment recommendations regarding CHS compounds this issue.

We report the first case of recurrent acute cannabinoid hyperemesis syndrome successfully treated with haloperidol given both intramuscularly and orally. The Naranjo adverse drug reaction probability scale was utilized to assess the probability that the hyperemesis was related to cannabinoid use, and a total score of 6 (probable) was obtained (Table 3) [12].

Diagnosis is determined through receiving a detailed medication history and a

**Table 3.** Naranjo adverse drug reaction probability scale.

Question	Answer	Score
1. Are there previous <i>conclusive</i> reports on this reaction?	Yes	+1
2. Did the adverse event occur after the suspected drug was administered?	Yes	+2
3. Did the adverse reaction improve when the drug was discontinued, or a <i>specific</i> antagonist was administered?	Yes	+1
4. Did the adverse reaction reappear when the drug was readministered?	Yes	+2
5. Are there alternative causes (other than the drug) that could have on their own caused the reaction?	Yes	-1
6. Did the reaction reappear when a placebo was given?	Do not know/ not done	-1
7. Was the blood detected in the blood (or other fluids) in concentrations known to be toxic?	No	0
8. Was the reaction more severe when the dose was increased or less severe when the dose was decreased?	Do not know/ not done	0
9. Did the patient have a similar reaction to the same or similar drugs in <i>any</i> previous exposure?	Yes	+1
10. Was the adverse event confirmed by any objective evidence?	Yes	+1
<b>Total Score</b>		<b>6</b>



comprehensive physical examination. In a recent systematic review conducted by Sorensen and colleagues, the following diagnostic characteristics and frequency of each were found: history of regular cannabis use for over one year (74.8%), severe nausea and vomiting (100%), vomiting that recurs in a cyclic pattern over months (100%), resolution of symptoms after stopping cannabis (96.8%), compulsive hot baths/showers with symptom relief (92.3%), male predominance (72.9%), abdominal pain (85.1%), at least weekly cannabis use (97.4%), history of daily cannabis use (76.6%), and age less than 50 at time of evaluation (100%) [10]. With >10 years of self-reported cannabis use, our patient experienced the following symptoms: severe nausea and vomiting that has recurred over many months in a cyclic pattern.

Haloperidol is a drug primarily used for sedation, behavioral agitation, and as an antipsychotic. However, haloperidol has been used as an antiemetic for years, particularly in the anesthesia, general surgery, and oncology literature [13]. Haloperidol is a butyrophenone antipsychotic that non-selectively blocks postsynaptic dopaminergic D2 receptors in the chemoreceptor trigger zone (CTZ) [13] [14]. The CTZ is located in the medulla oblongata and is exposed to toxins in the bloodstream, which triggers vomiting. The mechanism of action of haloperidol's antiemetic effects in CHS is unknown. The medication may decrease nausea and vomiting by blocking the dopamine receptors in the CTZ, thus reducing input to the medullary vomiting center. Early administration of haloperidol in acute episodes of CHS may reduce symptoms, minimize the time in the emergency room, and reduce the rate of hospital admissions [15].

There are six case reports using haloperidol as treatment for CHS. These reported cases have been summarized in **Table 4**. In 5 out of the 6 reported cases, haloperidol was given intramuscularly only [16] [17], and in one case, the route of administration was not provided [18]. Also, interestingly only one of the cases was a woman [18] and our case makes two. In a recent analysis synthesizing findings from case reports found that men were overwhelmingly more likely to be diagnosed with CHS relative to women (72.9% vs 27.1%) [4]. However, this sex discrepancy may reflect heavier cannabis use reported among men relative to women, rather than a sex-specific sensitivity to this adverse effect of cannabis [19]. More studies are warranted to research these findings.

The main point from these six cases was that patients continued to have refractory nausea and vomiting with standard antiemetics. However, once given doses of haloperidol, the patients experienced a clinically significant improvement in their symptoms. And like the other cases, our patient received a multitude of other antiemetics without the relief of symptoms and it was only when she was treated with IV haloperidol followed by oral did her symptoms subside.

Our report wasn't without limitations. During this admission the patient received only one dose of metoclopramide. The attending physician made this decision based on the fact that the first dose didn't relieve the patient's symptoms and in previous admissions for gastroparesis but before the CHS diagnosis

**Table 4.** Summary of case reports using haloperidol to treat cannabinoid hyperemesis syndrome<sup>a</sup>.

Patient and Presentation (Reference number)	Cannabinoid Use	Labs and Diagnostics	Intervention	Patient Outcome
34-year-old man with epigastric pain, nausea, and vomiting for 4 days. History of similar symptoms every 2 to 3 months for approximately 10 years. (Gnanaraj <i>et al.</i> 2011, [8])	Daily cannabis use since 1992, with only short intervals of abstinence resulting in complete resolution of his vomiting.	Unremarkable diagnostic tests: 3 computed tomographic scans, esophagogastroduodenoscopy, and several specialty consults. Vitals: BP: 116/64 mmHg, HR 94 beats/min, RR 20 breaths/min, pulse Oxygen 97% on room air, temperature 98.4°F.	Morphine 4 mg IV, OND 4 mg IV, 1 liter normal saline IV fluid bolus.	The previous therapies did not help symptoms, but when given haloperidol 5 mg IV, symptoms resolved within 1 hour. He exhibited no further vomiting during 8 hours of observation, tolerated oral fluids, and then discharged.
27-year-old man presents with vomiting and abdominal pain for 3 days. Patient reported 15 - 20 episodes of non-bloody, non-projectile, and non-bilious vomiting, which were alleviated partially by taking hot showers. (Inayat <i>et al.</i> 2017, [16])	Smoking at least five joints a day for approximately 10 years.	Normal vital signs. Toxicology screening positive for cannabis. Abdominal examination: soft, non-tender and non-distended abdomen. No rebound or tenderness and normal bowel sounds. Initial laboratory evaluation was unremarkable.	OND, lorazepam and IV fluids.	Severe hyperemesis persisted after 2 days of conventional antiemetic treatment. Given haloperidol 1 mg IV, the patient responded well with clinically significant improvement. His compulsive hot bathing and GI symptoms began to diminish following next two dosages of 2 mg IV haloperidol.
18-year-old woman with emesis consistently non-bloody and non-bilious. Symptoms were worse in the morning and relieved only by smoking marijuana. (Jones <i>et al.</i> 2016, [18])	History of smoking using cannabis 2 - 3 times per day for two years and unwilling to quit.	Initial physical exam was unremarkable and vital signs were within normal limits. BMP, LFTs, and CBC were all normal. Tested positive for cannabis while symptomatic.	Haloperidol 5 mg daily for symptom relief.	At the next visit, patient reported complete resolution of previous refractory nausea, vomiting, and abdominal pain within one day of starting treatment.
34-year-old man with previously diagnosed recurrent CHS arrived to the ED with vomiting for 4 days. (Witsil <i>et al.</i> 2017, [17])	Previously admitted to hospital 7 times for same issue.	Unremarkable diagnostic tests and several specialty consults.	Promethazine and OND 4 mg IV and IV fluids.	Given haloperidol 5 mg IV, and within 1 hour, symptoms resolved and was discharged home from the ED.
48-year-old man presented to the ED with vomiting for 2 days. (Witsil <i>et al.</i> 2017, [17])	Chronic cannabis use.	Multiple unremarkable workups over the past year for cyclical vomiting	MET, promethazine, OND 4 mg IV, chlorpromazine and IV fluids with no symptom relief.	Given haloperidol 5 mg IV; within 1 hour, his vomiting resolved and was discharged home within 8 hours.
22-year-old man arrived for treatment of cyclical vomiting (Witsil <i>et al.</i> 2017, [17])	Recurrent CHS diagnosed 2 years ago.	Not reported	MET, OND 4 mg IV, and IV fluids.	Initial ED treatment with OND 4 mg IV and IVF were unsuccessful. He was then given haloperidol 5 mg IV; within 2 hours, his vomiting resolved, and he was discharged home 6 hours later.
28-year-old man (Witsil <i>et al.</i> 2017, [17])	Not reported.	Nondiagnostic workups	OND, MET, chlorpromazine with no symptom relief.	His initial ED treatment included haloperidol 5 mg IV, diphenhydramine 25 mg IV, and IVF. Within 1 hour, improved, had no further episodes of vomiting, and was discharged from our ED 6 hours later.

<sup>a</sup>IV-intravenous, ED-emergency department, IVF-intravenous fluids, OND-ondansetron, MET-metoclopramide.

metoclo-pramide was effective, that this admission her nausea and vomiting were not due to gastroparesis. Another limitation to consider is that the patient had some confounding conditions such as uncontrolled diabetes with her last A1C being 10.5 and associated gastroparesis. Even with these confounders we believe our patient experienced CHS because none of the typical medications used to treat gastroparesis such as metoclopramide or erythromycin eliminated her symptoms.

## 4. Conclusion

Although cessation of marijuana use is required for long-term resolution of CHS, our case and six others show the benefit of using IV haloperidol for acute management and oral for relapse prevention. More extensive clinical trials are needed to confirm haloperidol's therapeutic role in patients presenting with CHS symptoms.

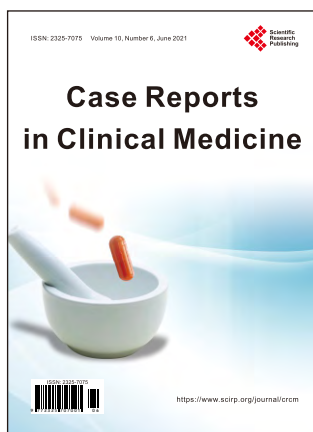
## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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