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Mother's Own Milk is Critical to the Health of Preterm Infants

Breast milk is accepted as the normal nutrition for newborns with continued benefits into their second and third years of life. Breast-milk feeding is important for both infant and maternal health. For the breast-fed infant, there is a decreased risk of sudden infant death syndrome (SIDS), childhood leukemia and lymphoma, severe asthma, and GI diseases. The breastfeeding mother experiences substantive benefits such as decreased risk of coronary artery disease, stroke, ovarian and breast cancers, and decreased risk of Type 2 diabetes. Despite knowing this information, many mothers still choose formula feeding. This decision has many competing interests for mothers: time, convenience, insecurities, and lack of social and medical support for breastfeeding. As health care providers, we can change how we support and encourage breastfeeding mothers. The way we talk about breastfeeding in the community and to our patients can shift the focus to how Arkansas can better support breastfeeding – because supporting breastfeeding benefits everyone.

Not only is breast milk beneficial for full-term infants but also avoiding bovine derived formula is important, particularly for premature infants. Premature infants lack the benefit of time in the mother's womb to accomplish very important developmental objectives, especially development of the fetal intestines. After birth, the infant's gut mucosa is the site of a multitude of environmental exposures. The premature intestine is poorly adapted and tends toward pro-inflammatory responses with higher risk for invasion by enteropathogenic organisms. Research demonstrates that in premature infant intestinal epithelial cells, early exposure to bovine or soy-derived formulas causes extensive injury leading to cytotoxic responses and cell death. Similar exposure to breast milk had no such effect and was

even found to reverse cellular damage. Formula exposure also increases the risk of necrotizing enterocolitis, a complication that at its most benign causes longer hospitalization and at its worse leads to death. It is critical that premature infants receive human milk as their only source of nutrition during this important period of gut and immune development.

The initial choice of feeding profoundly impacts the premature infant's long-term outcome. Colostrum provides passive immune protection, helps the newborn's immune system develop non-inflammatory responses to antigens, and protects the infant from pathogenic-invasive organisms. When newborns are fed foods other than mother's colostrum and milk, the development of these intrinsic defense systems is altered, increasing life-long risk of allergic phenotypes, pro-inflammatory responses, and immune dysfunction.

One may ask if donor breast milk has similar benefits for an infant's health. Donor milk holds an important place in the care of premature or sick infants when mother's milk is unavailable, but it does not provide the essential benefits of mother's own milk. Donor milk is most often obtained from mothers of term infants, most frequently beyond the first two months post-partum. Term breast milk is different from premature breast milk in many ways. The most important differences are the presence of immunoprotective enzymes, growth factors, bioactive proteins, and immunoglobulins, which are present in large quantities in the milk of a mother that delivers prematurely. The milk of a term mother in later stages of lactation contains less than one-eighth of the original concentration of protective components in her milk. Further, donor milk is processed by

pasteurization and is then frozen. Pasteurization, while necessary, denatures many of the bioactive proteins that are so important in protecting a newborn. These processes, along with repeated freeze-thaw cycles, further diminish immunoprotective capacity of donor human milk to miniscule proportions. In the end, the benefit associated with donor milk is the ability to provide nutrition for growth without the harmful effects of providing bovine-derived formula.

Health care providers can fill a critical gap in the care of Arkansas's most vulnerable citizens by encouraging and helping mothers provide breastmilk for their babies. Supporting early breastfeeding efforts and providing continued support of breastfeeding mothers after they leave the hospital provides substantial benefits in decreased infant and maternal mortality. For those mothers who deliver prematurely, it is of the utmost importance that we support their efforts to provide their own milk to their infants. This must become a public health priority in Arkansas. Each 1ml/kg/day of mother's milk feedings in the first 14 days of life has an associated cost saving of \$534. At present, the cost of one-gram gold is approximately \$65. Indeed, each drop of a mother's own milk is quite literally worth more than gold.

For more breastfeeding and neonatal care resources, visit ANGELS Guidelines at angelsguidelines.org.

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Is Lumbar Steroid Injection Efficacy Dependent on the Type of Disc Herniation?

Introduction

Injections of steroids are an important adjunct for the management of lumbar radicular pain. More practitioners in Arkansas (anesthesiologists, physiatrists, pain specialists, interventional radiologists, neurosurgeons, CRNAs, and orthopedic surgeons) are currently performing these injections, and with increasing frequency. However, to date, there is no consensus on the most efficacious method of steroid injection to be utilized for a specific lumbar radicular discomfort. When mechanical stress is placed on the lumbar spine, a lumbar disc may bulge or tear. Following a disc injury, the displaced disc may compress a spinal nerve or cause chemical leakage from an injured disc, which may empty prostaglandins, cytokines, chemokines, etc., into the epidural space and can cause inflammatory and radicular pain.¹ For pain reduction, it has been reported that corticosteroids may be administered directly into the epidural, intramuscular spaces, or given orally.²⁻⁶ Epidural steroid injection therapy for lumbar radicular pain reduction may be accomplished by one of three methods: caudal (C), interlaminar (IL), or transforaminal (TF).^{7,8} However, the methods used for epidural injections vary with different practitioners, and no standard for the performance of this procedure has been defined. Unfortunately, some patients will go from one pain treatment center to another and receive multiple steroid injections with only minimal relief. The way to achieve effective epidural steroid injection therapy is to choose the proper epidural steroid technique for the specific discogenic pathology.

Disc herniations are classified according to their nucleus pulposus shape. The disc material, which comes from the pulpous nucleus, is displaced beyond the

intervertebral limits when a herniation occurs. It may take one of three different shapes: protrusion, extrusion, or sequestration. The purpose of this study was to compare the analgesic efficacy of steroid injections in the three different pathologic categories of lumbar disc herniations.

Methods

This investigation, which was done following University Institutional Review Board approval, is a randomized trial of patients between the ages of 21 and 60 with lumbar radicular pain who were treated within seven days of his/her pain onset. Following signed, informed consent, 300 patients were randomly assigned to one of four groups of 25 to receive dexamethasone, 10 mg (1ml) with two ml of normal saline and 1 ml of iohexol contrast as follows: Group I, lumbar epidural steroid injections (LESI); Group II, transforaminal steroid injections (TFESI); Group III, caudal epidural steroid injections; and Group IV, para spinous muscle injections (PMI). The objective of this study was to assess radicular pain relief efficacy following lumbar epidural, caudal, transforaminal, and intramuscular steroid injection therapy in patients with one of three degrees of lumbar disc herniations with single-lower-extremity radiculitis. Each injection was done with fluoroscopic needle guidance using a 22-gauge Tuohy needle. The primary outcome of this study was a statistically significant reduction in a patient's pain intensity using a 10-point (0= no pain and 10 = severe pain) numerical rating scale. Statistical analysis was done with $P \leq 0.05$ necessary to reject the null hypothesis. Patient data were encoded to protect each individual's identity. A P value ≤ 0.05 was considered statistically significant.

Results

A total of 300 patients were enrolled, completed this study, and were analyzed in the groups in which they were allocated. No patient was included in this study who had prior lumbar spine surgery, previous epidural injections, or oral or intramuscular steroid injections. There were no significant demographic differences between the groups of patients. Limitations of this study include the lack of a placebo control group and the absence of a long-term follow-up. The results of this investigation are in Tables 1-3.

Conclusion

The results of this study established that the pathologic grouping of the lumbar disc herniation affected the degree of analgesic efficacy with respect to the manner of the steroid injection administered. In patients with sequestered disc herniations (Table 3), transforaminal steroid injections were more efficacious when compared to intramuscular, caudal, and lumbar epidural steroid injections. Sciatica in patients with disk disease was long ascribed to pressure put on the sciatic nerve root by a herniated disk. However, a role for chemical factors acting in conjunction with a chemical insult is currently suggested by a number of clinical observations.⁹ The intervertebral disk is immunogenic, and mediators for inflammation have been identified within intervertebral disk tissue. A current pathophysiological theory now incriminates proinflammatory substances secreted by the nucleus pulposus as a cause of nerve root pain. Tumor necrosis factor-alpha (TNF-alpha) is the main biochemical potentially responsible for radicular pain. Even after a negative screening, clinicians should maintain a high index of suspicion of CF. The terminology related to CFNBS is confusing and clinicians should work

Table 1: Prolapsed Discs

	(LE) (n=25)	(CE) (n=25)	(TFE) (n=25).	(IM) (n=25)
VAS Initial	9.54 + 4.01	9.17 + 3.31	8.92 + 3.06	9.26 + 2.74
VAS Twelve Weeks	3.12 + 3.21#	3.98 + 4.11#	3.77 + 3.67#	4.01 + 1.92#
BMI	28.72+4.33	29.23 +3.98	30.99 + 3.27	27.98 + 0.86
Age (years)	41.16+11.33	39.99 + 8.82	42.21 + 9.74	37.64 + 7.48
Gender Female (n)	9	7	6	9
Gender Male (n)	16	18	19	16
Pain Relief	n=19/25	n=16 /25	n=17/25	n=16/25
Injections (#)	n= 44/75	n= 49/75	n= 41/75	n=67/75*

Table 2: Extruded Discs

	(LE) (n=25)	(CE) (n=25)	(TFE) (n=25).	(IM) (n=25)
VAS Initial	8.79 + 3.2	8.98 + 2.72	9.05 + 2.98	9.19 + 2.44
VAS Twelve Weeks	4.76 ± 2.76 #	5.17 + 2.32 #	5.54 + 2.64 #	8.27+ 1.86
BMI	28.72+4.33	29.32 +3.98	30.99 + 3.27	27.65 + 2.98
Age (years)	41.16 +11.33	42.21 + 9.74	39.99 + 8.82	35.42 + 5.84
Gender Female (n)	9	7	8	10
Gender Male (n)	16	18	17	15
Pain Relief	n=11/25	n=8/25	n=16/25*	5/25
Injections (#)	n= 53/75	n= 59/75	n= 49/75	n=70/75*

Table 3: Sequestered Discs

	(LE) (n=25)	(CE) (n=25)	(TFE) (n=25).	(IM) (n=25)
VAS Initial	8.54 + 4.01	9.17 + 3.31	8.92 + 3.06	9.21 + 2.31
VAS Twelve Weeks	7.12 + 3.21	8.98 + 4.11	4.77 + 3.67* #	8.99 + 3.11
BMI	28.72+4.33	29.3 +3.98	30.99 + 3.27	3.17 + 3.88
Age (years)	41.16+11.33	39.99 + 8.82	42.21 + 9.74	38.95 + 3.87
Gender Female (n)	9	7	6	7
Gender Male (n)	16	18	19	18
Pain Relief	n=7/25	n=4/25	n=16/25# *	n= 2/25
Injections (#)	n= 51/75	n= 64/75	n= 38/75#*	n=73/75

*P < 0.05 between groups; #P < 0.05 within groups; LE (lumbar epidural steroid); CE (Caudal epidural steroid); TFE (Transforaminal epidural steroid); IM (Intramuscular steroid)

with CF specialists to communicate with their families after positive screening.

It is our hypothesis that the origin of sciatic pain is reported to be multifactorial, involving mechanical stimulation of the nerve ends of the external portion of the fibrous ring, direct compression of the nerve roots (with or without ischemia), and a series of inflammatory phenomena induced by the extruded nucleus. (9,10) The breach of the posterior longitudinal ligament caused by an extruded or sequestered disc herniation exposes the herniated disc to the vascular bed of the epidural space, and inflammatory cells originating from these vessels on the periphery of the herniated disc material may have an important role in irritating the nerve roots and inducing sciatic pain. This study demonstrated that lumbar interlaminar, caudal, transforaminal, and intramuscular epidural injections are all efficacious but are not statistically more efficacious when compared to intramuscular injections in patients with contained disc herniations. On the other hand, in the extruded and sequestered disc herniation groups, direct steroid contact from the transforaminal steroid injections occurs between the injected steroid and the inflamed nerves; this is one reason for the increased efficacy of the transforaminal steroid injections noted in these study results. All interventions and medications come with risks that may be offset by variable levels of analgesic benefit. Since steroids injected into the epidural space are not FDA-approved, clinicians recommending or performing such procedures must carefully outline the risks without minimizing them, especially for vulnerable patients who may otherwise disregard such risks in the presence of unrelenting, intolerable pain. It is our conclusion that lumbar steroid injection therapy success depends not only on the type of disc herniation but also on the proper selection of the method of the epidural steroid delivery.

References

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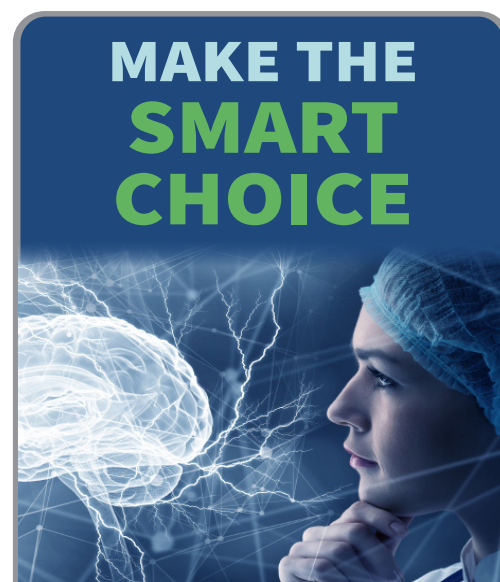
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Handshake Stewardship in an Adult Critical Care Population

Abstract

Handshake stewardship (HS) differs from traditional methods of prospective audit with feedback and antibiotic preauthorization. We describe our experience using HS in an adult critical care population. Intervention acceptance rate was 87.7%, with an OR=2.91 (99% CI: [2.45, 3.47]). HS is an effective method allowing daily communication and provider education.

Introduction

The Centers for Disease Control and Prevention (CDC) recently released antimicrobial resistance data estimating that over three million people may be infected with a hospital-acquired infection, resulting in more than 50,000 deaths annually.¹ In part due to this developing antimicrobial-resistance crisis, the Committee for Medicare and Medicaid Services has required all U.S. hospitals to have an antimicrobial stewardship program (ASP) in place no later than March 30, 2020.² The goals of an ASP are to use the right drug at the right dose for the most effective duration, thus leading to prevention of misuse and unnecessary use of antibiotics. The CDC has published core elements and the Infectious Diseases Society of America (IDSA) has published guidelines for the development of an antimicrobial stewardship program.^{3,4} These organizations place a major emphasis on prospective audit with feedback and antibiotic preauthorization (henceforth known as traditional stewardship).³

Handshake stewardship is a term coined by the antibiotic stewards at Children's Hospital of Colorado (CHCO). This strategy incorporates a physician-pharmacist team that reviews all prescribed antibiotics at 24 hours and 72 hours, five days

weekly.⁵ Personal recommendations are then delivered to the individual providers during daily clinical rounds. Hurst and Parker have shown a high intervention acceptance rate⁶ and MacBrayne, et al. have shown a 25% reduction in antimicrobial use over a five-year period using this method of antimicrobial stewardship⁷.

Despite previous research supporting the effectiveness of handshake stewardship at CHCO, there is a paucity of data about the use of this method of antimicrobial stewardship when working with adult patients. The aim of this research brief is to describe our experience with a partial handshake stewardship technique in adults who received care in our critical care units during an eight-year period.

Methods

This study was conducted at Washington Regional Medical Center (WRMC), a 425-bed community hospital located in Fayetteville, Ark.. The Washington Regional Antimicrobial Stewardship Program (WRASP) was developed and implemented by a board-certified infectious diseases physician (the "ASP steward") in January 2012. As part of the implementation process, the ASP steward participated in daily multidisciplinary critical-care rounds five days weekly after chart review of each critical care patient and prior to rounds each day. Through nursing-led patient presentations and a review of all the antimicrobial data available in the medical record, the ASP steward provided recommendations directly to the responsible intensivist or the attending physician for the patients located in the intensive care unit or the coronary care unit.

Available patient data consisted of prescriber acceptance of ASP interventions as well as if handshake stewardship was utilized. Consequently, the total sample of patients were stratified into groups based upon acceptance or rejection of the ASP recommendations by the provider (compliance and non-compliance) and further stratified by stewardship type (handshake or traditional).

To assess the effect of handshake stewardship on compliance with ASP recommendations, descriptive statistics such as the difference in sample compliance rates and the sample odds ratio (OR), where OR compares the odds of compliance given handshake stewardship to the odds of compliance given traditional stewardship, were calculated. Additionally, confidence interval estimates were constructed at the 99% confidence level. To further assess the statistical significance of the effect of handshake stewardship on compliance, χ^2 -Tests were performed, with statistical significance defined as $p < 0.01$.

Results

Of 14,234 patient records available between 2012 and 2019, approximately 16.0% had received handshake stewardship as a technique for ASP. The overall rate of compliance with ASP recommendations was approximately 73.7%. To determine the effect of handshake stewardship on compliance with ASP recommendations, this overall rate of compliance was compared for each stewardship type.

The difference in compliance rates between those patients that received handshake stewardship and those patients

that received traditional stewardship was approximately 16.7%, with handshake stewardship resulting in 87.7% compliance and traditional stewardship resulting in 71.0% compliance. There was a statistically significant difference between the rates of compliance, with the rate of compliance being approximately 14.6% to 18.7% higher when handshake stewardship was utilized ($p < 0.0001$). Furthermore, the observed OR of 2.91 suggested that the odds of compliance with ASP recommendations when handshake stewardship was utilized were approximately three times that of the odds of compliance otherwise (99% CI: [2.45, 3.47]). An odds ratio of 1.0 would indicate that there was no statistically significant effect of stewardship type on compliance. The constructed confidence interval for the OR, as well as a χ^2 -Test to determine if the OR was significantly greater than 1.0, suggested that handshake stewardship increases the odds of compliance to ASP recommendations ($p < 0.0001$).

Discussion

Handshake stewardship has been shown to be an effective strategy that results in high compliance with ASP interventions.^{6,8} Our retrospective analysis showed comparable results in an adult, critical care population. We showed a nearly three-fold increase in ASP intervention acceptance over an eight-year period in the units where handshake stewardship was utilized. Although this method of stewardship is labor-intensive, the outcomes justify the workload. Additionally, the personal interaction with colleagues allows the ASP steward to be highly visible and that allows ample opportunity for two-way communication and education to explain reasons for decisions leading to the intervention. As Dr. Goff notes, “communication skills necessary to succeed at ASP are very different than the communication skills on a consult service.”⁹ It is never easy to give or accept unsolicited advice in medicine, but daily communication helps build trust that can lead to improved ASP intervention compliance.

Our study is limited by the fact that it is

observational and retrospective in nature. The lack of demographics data does not provide an adequate sample comparison. Since handshake stewardship was used only in the critical care units, this suggests that handshake stewardship should be effective in a patient population that is not critically ill fewer comorbidities. Additionally, because of the lengthy duration of the study, antibiotic days of therapy (DOT)/1000 patient days were not available for the entire study period to determine if there was an impact on decreasing antimicrobial use globally or for specific antimicrobial classes or specific agents. Standard antimicrobial administration ratios (SAARs) were only available at our hospital since May 2017; therefore, no comparison of SAARs prior to the implementation of handshake stewardship rounds is possible. Because an infectious disease-trained pharmacist was not available for the duration of the study, the impact of a pharmacist could also not be assessed.

Despite limitations, this study confirms that handshake stewardship is a viable, effective, and sustainable alternative to traditional stewardship that leads to a high acceptance rate for ASP interventions in adult critical care patients.

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GCA Masquerading as Altered Mental Status and Diarrhea: A Case Report

Abstract

Giant Cell Arteritis (GCA) is a large-cell vasculitis with systemic effects. Classic symptoms include fever, night sweats, headaches, jaw claudication, and visual loss; however, GCA can present initially with psychiatric and neurologic symptoms. Our case highlights a patient who presented with altered mental status leading to functional decline and pellagra-like symptoms associated with GCA. While there have been some documented cases of GCA-related vascular dementia, it would not explain our patient's improvement with prednisone and nutrient replenishment. Identifying atypical manifestations of GCA aids in rapid diagnosis and leads to decreases in fatalities.

Introduction

GCA is a cell-mediated immune response due to endothelial injury. It primarily targets medium and large arteries in the arch of the aorta, with highest involvement of the superficial temporal, vertebral, ophthalmic, and posterior ciliary arteries. Inflammatory changes occur mostly in the intima and internal elastic lamina and is non-contiguous, meaning there are "skip lesions." Systemic inflammation is caused by T-cells and macrophages mediated release of IL-6 and other pro inflammatory cytokines.¹

Over 80% of GCA is found in patients over the age of 70, and primarily in Caucasian populations. The lifetime risk is 1% in women and 0.5% in men.^{1,2} Common presentation of GCA includes headache, vision loss, jaw claudication, weight loss, night sweats, and fatigue. There are some unusual presentations of GCA that have a predominant neurologic presen-

tation such as GCA-induced vascular dementia and stroke.² Even more unusual, there have been some cases of patients presenting with changes in mentation that improved upon diagnosis and treatment of GCA.^{2,5,3} We present a case of a patient with altered mental status (AMS) related to GCA and a literature review of similar cases.

Case Report

Our patient is a 74-year-old Caucasian male with past medical history significant for coronary artery disease (CAD), hypertension, non-insulin dependent diabetes, and hypothyroidism who presented from an outside hospital for confusion. On initial examination at the outside hospital, his vitals were normal except for a temperature of 100.2°F. On exam, patient was noticed to be confused and lethargic. Family reported memory decline and decreased ability to perform instrumental activities of daily living (IADL) over the past three months. His initial lab workup was remarkable for white blood cell (WBC) count of 19.0 x 103/mm³ (normal <10), hypokalemia, hyponatremia, and creatinine of 2.7mg/dL (baseline was <1.2), all of which improved with hydration. There was concern for sepsis, and he was started on broad-spectrum antibiotics that were narrowed to Levofloxacin after *C. difficile* rule out. The only remarkable imaging finding was computed tomography (CT) of the abdomen, which showed distended bowel loops. During his stay, his WBC remained elevated at 20.0 x 103/mm³ and patient remained confused.

At that time, the patient was transferred

to our institution. Vital signs upon arrival were normal; he was in no acute distress, but appeared intermittently somnolent and confused—not oriented to place or time. The physical examination was grossly normal except for abdominal distension, clean sacral ulcers, and some desquamation bilaterally on both hands. Laboratory workup showed a WBC count of 14.8 x 103/mm³ and hemoglobin of 8.1g/dL (baseline was >13.5). His labs were remarkable for elevated erythrocyte sedimentation rate (ESR) and ferritin and low Folate, Vitamin B3, Vitamin B6, and Zinc. Head magnetic resonance imaging (MRI), CT-angiography (CTA), colonoscopy, and biopsy were unremarkable. We considered GCA as a diagnosis based on his age, new onset confusion, elevated inflammatory markers, and negative imaging. We then performed a temporal artery biopsy, which revealed GCA; the patient was started on high-dose systemic steroids. The patient continued to have diarrhea, which improved after administration of IV-potassium and IV-multivitamin with minerals. After a two-week duration of treatment, the family reported he returned to normal and was discharged from our facility.

Discussion

As demonstrated in our case, AMS in GCA patients is an unusual presentation. While most documented cases attribute this to infarction, we found six cases in the literature where GCA presented with memory alterations not related to depression or infarction. Cognitive changes include memory changes, disorientation, delirium, and hallucinations (Table 1). Five patients improved after steroid

Table 1: Review of Literature showing similar manifestations of GCA.

Article	Age	Gender	Memory Changes	Disorientation	Delirium	Impaired Attention	Hallucinations	Treatment	Did patient improve?
Lahaye 2020 (3)	70	M	Yes	Yes	Yes	Yes	Yes	0.7 mg/kg/day of Oral Prednisone	Yes
Mahraj 2014 (4)	70	M	No	Yes	Yes	No	Yes	High Dose IV Methylprednisolone	Yes
Pascuzzi 1989 (5)	72	M	Yes	Yes	Yes	Yes	No	Daily Prednisone 60mg	Yes
Cochran 1978 (6)	77	M	Decrease in nonverbal	No	No	Mild	No	Prednisone 20mg four times daily	Yes
Pauley and Hughes 1960 (7)	72	F	Yes	No	No	No	Yes	Prednisone 20mg four times daily	Yes
Vereker 1952 (8)	67	M	Yes	Yes	Yes	Yes	No	Codeine	Patient died before treatment

administration, while one patient died before receiving steroids (Table 1). There have been many purported mechanisms for the causes of these mental status changes in GCA patients. One mechanism is that intracranial or meningeal vasculitis induces mild global ischemia due to decreased blood flow.⁹ A global, systemic, inflammatory effect cannot be ruled out as another possible cause. While subacute dementia is not considered a possible manifestation of temporal arteritis, this case demonstrates that GCA can be detected by examining the patient for signs and symptoms of depression, confusion, delirium, hallucinations, etc. Our patient exhibited significant altered mental status that manifested as progressive cognitive decline, loss of memory, disorientation to self and others, and increased irritability. GCA should be considered in the differential diagnosis for altered mental status in elderly patients, especially since it is treatable and can lead to significant improvement in function.

Of note, our patient had multiple nutritional and vitamin deficiencies. We found the patient suffered from Folate, B3, B6, and Zinc deficiency related to poor oral consumption. After ruling out other etiologies of diarrhea, we also attributed his diarrhea and dementia to a pellagra-like reaction caused by niacin deficiency. His lack of photosensitive dermatitis on presentation may be due to confinement to his house, nursing home, and hospital over several months prior to admission.

On supplementation of vitamins and minerals, we observed an improvement in both diarrhea and cognition. Literature review is limited on vitamin deficiencies and GCA prior to steroid treatment; however, it has been shown that homocysteine levels can be elevated in autoimmune disorders such as GCA. The most frequent causes of elevated homocysteine levels are due to deficiencies in folic acid or vitamin B12, which was seen in our patient. Hyperhomocysteinemia is an independent risk factor for ischemic optic neuropathy, silent brain infarction, and stroke. Martinez, et al., found a slight association between elevated homocysteine levels in a small sample of patients with GCA and increased ischemic events, which he predicts to be greater with increased sample size.¹⁰ After supplementation with B9/B12, levels of homocysteine were significantly decreased in GCA patients, possibly decreasing their risk for future ischemic complications. Though this may have been a potential cause of AMS in our patient as he had low B6 and folate, there was no evidence of acute vascular injury on imaging.

Conclusion

In conclusion, altered mental status secondary to GCA and pellagra is a rare phenomenon; however, the sequelae can lead to severe morbidity. Expansion of diagnostic criteria for GCA is the key to improving patient outcomes. Biopsy is a critical component in diagnosis and treatment should focus on steroids and

nutrient replenishment.

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For more references, email

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A Rare Case of Septic Thrombophlebitis Caused by Haemophilus Influenzae

Abstract

Once a common cause of bacterial meningitis and other invasive disease, *Haemophilus influenzae* is now mostly the cause of routine upper respiratory infection. This report presents a case of septic thrombophlebitis caused by *H. influenzae* and highlights the continued presence of this organism in the context of invasive infection. There is only one other documented case of septic thrombophlebitis caused by *H. influenzae* in the literature. This report further discusses the risk factors of *H. influenzae* infection and reinforces the need for caution when encountering an unusual presentation of presumed viral pharyngitis.

Background

The prevalence of uncomplicated pharyngitis in the context of widespread antibiotic resistance makes it difficult to discern when a sore throat warrants further workup. While most cases are caused by nonvirulent strains of common inhabitants of the oropharynx, rare instances are due to more virulent pathogens with risk of descending infection. Prompt treatment depends on a high index of suspicion and administration of empiric antibiotics upon presentation.¹ *H. influenzae* has become an uncommon cause of invasive disease with the implementation of routine vaccination but should still be considered in a patient with incomplete or unknown vaccination status, asplenia, or immunocompromise.² Most cases of invasive infection are due to *H. influenzae* type b (Hib) or nontypeable *H. influenzae*.

This is the case of a previously healthy 36-year-old female presenting with an elusive case of septic thrombophlebitis. She initially presented to the emergency department with complaints of sore throat, neck pain and swelling, andodynophagia. Following an unremarkable physical exam and negative workup for

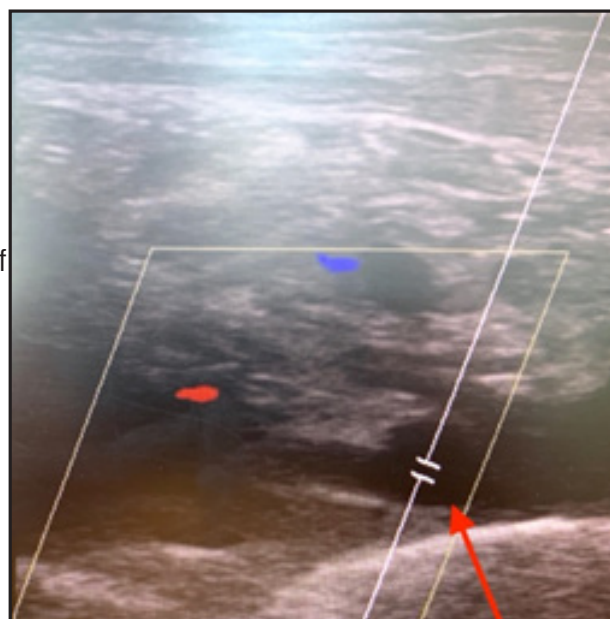


Figure 1: Right upper extremity venous Doppler showing partially occlusive thrombus in right subclavian vein (arrow).

strep pharyngitis, mononucleosis, and influenza, the patient was discharged home with a diagnosis of viral pharyngitis. The patient then presented to urgent care that afternoon for increasing neck pain and dyspnea and was given steroids and pain medications. She returned to the emergency department two days later with severe pain and continued neck swelling, and a new-onset painful rash on her anterior neck and chest.

The patient was afebrile, in moderate dis-

stress, pale, tachycardic, hypotensive, and unable to open her jaw upon examination. Laboratory tests revealed neutrophilic leukopenia (white blood cell count $2.1 \times 10^9/L$, neutrophils 87%), critically elevated lactic acid (6.8 mmol/L), and elevated BUN and creatinine (BUN 61 mg/dL, Cr 3.46 mg/dL). She was promptly started on IV fluids, norepinephrine, and empiric antibiotics and was arranged for admission to the intensive care unit. Non-contrast CT of the neck showed diffuse, inflammatory stranding of soft tissue, with no obvious focus of infection.

By the following morning, the patient had developed altered mental status, respiratory distress, and atrial fibrillation. Bedside ultrasound indicated a thrombus, likely in the external jugular vein. Upper extremity venous Doppler later demonstrated thrombus in the right subclavian vein (Figure 1). Blood cultures revealed *H. influenzae* as the cause of her bacteremia, and she was continued on vancomycin, ceftriaxone, and metronidazole. Over the following week, new fever and an acute

change in patient condition prompted a CT chest, which revealed bilateral pleural effusion and a pericardial effusion (Figure 2). Bedside US chest showed pleural effusions were complex with septations for which bilateral pig tail catheters were placed and pleural fluid analysis was performed; this confirmed bilateral empyema. Intrapleural tPA and DNase was administered via pig tail catheter bilaterally, with near complete resolution.

Case Presentation

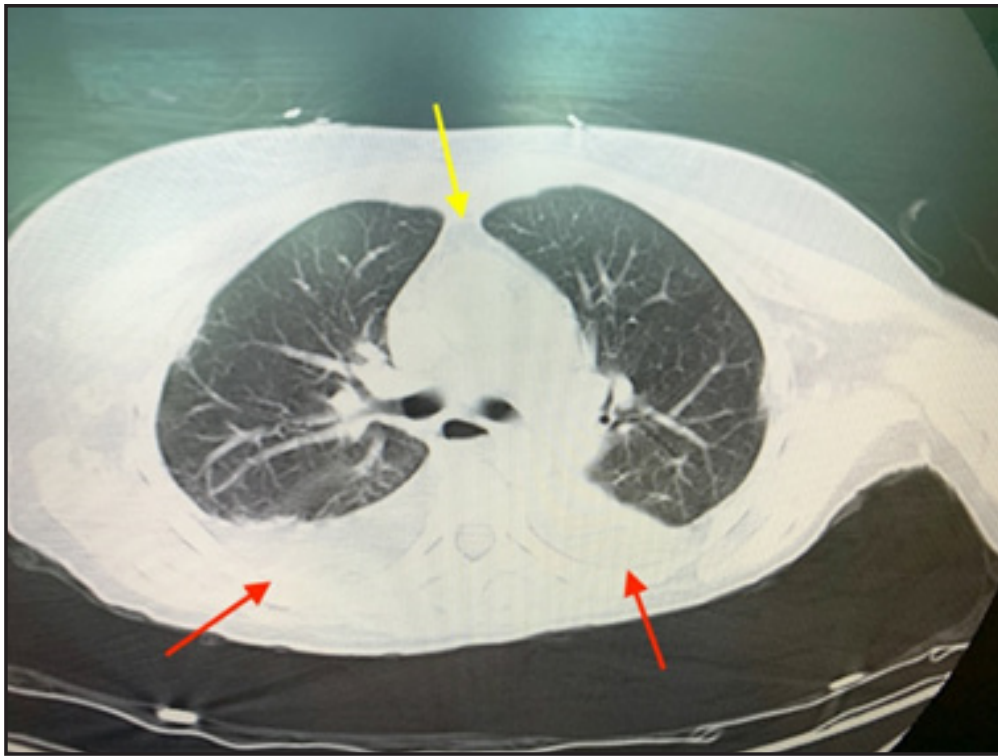


Figure 2: CT chest showing bilateral pleural effusions (red arrows) and pericardial effusion (yellow arrow).

Transthoracic echocardiogram raised suspicion for a complex pericardial effusion, which was confirmed by transesophageal echocardiogram. There was no evidence of tamponade physiology. A pericardial window was performed, and the effusion was evacuated. The patient had a prolonged ICU course, with eventual liberation from mechanical ventilation and slow recovery. The patient was discharged to rehab and then home.

Discussion and Conclusions

Since the advent of the Hib conjugate vaccine in 1985, *H. influenzae* has declined as a major cause of bacterial meningitis to a culprit of noninvasive, acute upper respiratory infections. Among those still affected by invasive *H. influenzae* disease, the most common presentation is in children <1 year of age and adults aged >65 years.³ Most recent data shows the incidence of invasive Hib disease in adults and children >5 years of age is <0.05 per 100,000.³ The vaccination status of our patient is unknown, but she has no known risk factors for serious infection, including immunodeficiency, asplenia, HIV infection, or history of hematopoietic stem cell transplant.² In

a 36-year-old patient, this is a very rare case of an already rare disease.

H. influenzae is an uncommon cause of thrombophlebitis, with only one documented case in the literature. This report, published in 1984, focuses on an adolescent male with common variable immunodeficiency disease who developed septic thrombophlebitis caused by *H. influenzae* following the use of a scalp vein needle.⁴ This patient differs from ours in that he had known immunocompromise and was unvaccinated against Hib. Additionally, he developed the disease after the use of an intravenous needle, a known risk factor for thrombophlebitis.

Septic thrombophlebitis is more widely known as Lemierre's syndrome when it involves the internal jugular vein and is usually caused by anaerobic *Fusobacterium* species. This syndrome has been increasing in incidence over the last several years, due in part to the recent decrease in treatment of pharyngitis with antibiotics, along with *Fusobacterium* as an often-overlooked cause of pharyngitis in young healthy patients.⁵ Our patient's presentation was highly suggestive of Le-

mierre's syndrome but had no evidence of thrombophlebitis of the internal jugular vein.

There has been a drastic decline in invasive disease caused by *H. influenzae* in recent decades. However, as a regular inhabitant of the human respiratory tract, it is important to consider as a cause of descending local infection. This report highlights the importance of continued awareness of serious invasive *H. influenzae* disease. Increasing literature on this topic will hopefully improve prompt recognition of dangerous pharyngeal infection.

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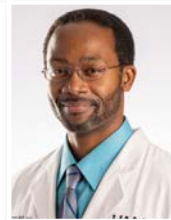
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Demonstration of a Simple, Do-it-Yourself Test of Mask Barrier Function Using Widely Available Commercial Products

Abstract

By December 2020, SARS-CoV-2 had caused the deaths of nearly 1.5 million people worldwide. A common strategy to mitigate spread of the virus is mask wearing. Considerable data demonstrate that masks can create an effective barrier to the respiratory droplets that can carry the virus. However, the effectiveness of consumer masks for this purpose varies, and there are currently no minimum standards that mask manufacturers must meet. Therefore, a need exists for an at-home test of mask barrier function. Here, we demonstrate a simple test to compare the function of selected masks using widely available materials and resources.

Introduction

The novel 2019 severe acute respiratory distress syndrome coronavirus 2 (SARS-CoV-2) emerged from Wuhan, China, in December 2019, and rapidly spread across the globe. The first travel-related cases in the U.S., for example, were detected in late January 2020, and there is evidence of community spread as early as February 26.¹ On March 11, the World Health Organization (WHO) declared COVID-19 a pandemic. Shortly after the WHO declaration, both the WHO and the United States Center for Disease Control and Prevention (CDC) began to recommend wearing masks in public settings. As of December 2020, statewide or regional mask mandates were in effect in 37 U.S. states, and more than 100 other countries have nationwide mask requirements.

Despite widespread masking, there are neither currently no minimum standards for mask manufacturing in the U.S. nor any requirement for mask manufactur-

ers to demonstrate the effectiveness of their products. As a result, numerous masks made with different materials and designs are on the market, and finding one that is most effective as a barrier for containment of respiratory droplets is the responsibility of the consumer. Hence, there is an urgent need for simple, consumer-friendly, at-home tests of barrier function. Several such methods are available already, but have significant limitations. For example, the idea behind the so-called candle test is that an effective mask will prevent one from being able to blow out a candle, but it is not clear if disrupted airflow is a suitable surrogate for droplet escape as that has not been evaluated in a rigorous manner. Other approaches require specialized equipment, such as lasers combined with lenses and sophisticated computer algorithms⁴ or bacterial growth medium and incubators. These items may not be readily available outside of wet laboratories.

Herein, we describe a crude, but likely effective do-it-yourself test to compare the barrier function of different masks that may enable a consumer to select the most effective style from their wardrobe. The test is based on the fact that hairspray atomizers produce liquid droplets with diameters in the same range as respiratory droplets. The apparatus can be assembled in minutes from widely available materials. We also provide results from our own tests with a selection of masks of differing material and construction.

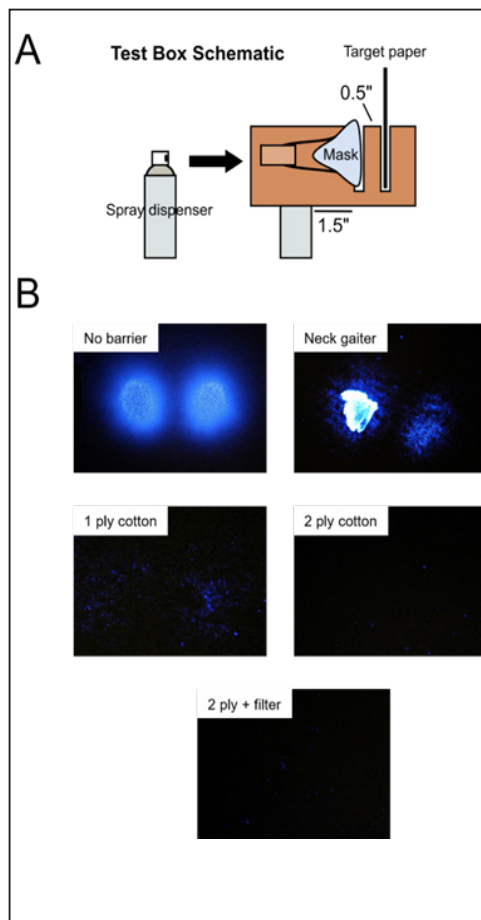
Methods and Results

We purchased UV-fluorescent hairspray, a 10 W black light with a 365 nm UV light-emitting diode (LED), a selection

of test masks, and dark-colored construction paper (“target paper”) from an online retailer. Comparable products are available through multiple online retailers, as well as brick-and-mortar hobby stores. We then modified a long, rectangular cardboard box by cutting slots in the sides to hold the target paper and masks approximately 0.5” apart (Figure 1A). To ensure the masks were held firmly in place and stretched similar to regular use, we cut flaps along the sides of the box to accommodate the ear loops and pulled the loops tight. Next, we cut a channel in the bottom of the box to allow entry of the top of the hairspray canister. The channel stopped approximately 1.5” back from the mask. We chose to leave a space between the canister and mask to minimize artifactual passage of liquid through the mask due to the high pressure of the liquid stream upon exit from the cannister nozzle. This also ensures that liquid droplets can spread out to avoid saturating the mask in one spot, which may reduce barrier effectiveness. To test the barrier function of a mask, the user simply places the mask and target paper in their respective slots, inserts the canister, briefly sprays the paper through the mask, and then views the target paper under the black light. As we have done in our tests, we recommend including a positive control mask (such as a common surgical mask) and/or negative control (such as a thin neck gaiter) for comparison. If a consumer mask prevents passage of the hairspray as well as the surgical-style mask, then the consumer mask may be at least a somewhat effective barrier.

To demonstrate use of the apparatus, we tested four common types of mask of

Figure 1. Demonstration of test apparatus. Masks and target paper were secured using the cardboard test box, as illustrated in panel A. Target paper was sprayed twice for each mask, then viewed and imaged under UV light using a commercially available hand-held light source. Results are shown in panel B.



variable construction: 1) A single-layer cotton neck gaiter, 2) a single layer cotton mask, 3) a two-layer cotton mask, and 4) a three-layer surgical style mask with filter. The results are presented in Fig. 1B. It is clear from the images that the neck gaiter was least effective in blocking the hairspray droplets. The single layer cotton mask was more effective than the neck gaiter, while results for the two-layer cotton mask and the surgical-style mask were similar. Importantly, these results are consistent with controversial preliminary data indicating that neck gaiters are poor droplet barriers (Fischer et al., 2020) and, combined with the data showing greatest droplet reduction with the positive control surgical-style mask, help to validate the test method.

Discussion

Although we believe this test method may be useful, it is important to understand that any convenient at-home test of mask function is likely to be crude given the limited scientific sophistication that is possible for the average consumer. Ours is no exception. For one thing, the physicochemical properties and aerosol behavior of propellant-driven hairspray droplets probably differ significantly from those of respiratory droplets produced by speaking, coughing, or sneezing. Second, the power of the light source, the properties of the fluorophore, and the dynamic range of the human eye probably limit the analytical sensitivity of the test. Finally, it is widely thought that the respiratory droplets most likely to spread infection through aerosols have diameters $\leq 5 \mu\text{m}$ and median droplet diameter for propellant-driven hairsprays like ours is approximately $25 \mu\text{m}$.⁵ Thus, a mask could theoretically prevent almost the entire fluorescent signal in this test method but still allow infectious virus particles to pass through. So, it must be stressed that this is not a test of the ability of a mask to prevent virus infection or transmission. Nevertheless, around 5-10% of hairspray droplets are in the 1-10 μm range⁷ so the test could have some value to detect even those small droplets. Furthermore, the utility of the 5 μm diameter cutoff is somewhat controversial in the first place. For example, a droplet that starts at 10-100 μm quickly becomes a 1-5 μm particle (or even simply the remnant nucleus) within milliseconds to seconds through evaporation of these very small liquid volumes.⁵ Since liquid droplets in this range can remain in the air for seconds to minutes, that is more than enough time for them to evaporate and become cause for concern.⁵ Moreover, larger droplets deposited on surfaces that we touch or in the upper airways may still be trapped or absorbed and lead to infection. Finally, the widely used 5 μm cutoff seems to be based in part on toxicology studies of particulate matter (PM) inhalation (for example, Brown et al., 1950; Morawska et al., 1999), but solid PM is obviously not subject to evaporation in the air or absorption in mucosa in the same way

as respiratory droplets and their content. Therefore, it is likely that the method presented here provides at least some indication of how well a mask works to reduce aerosol and droplet spread, though it should not be considered a test of infectiousness. It is also inexpensive, fast, and can be assembled using widely available resources. Overall, we conclude that this is a rapid and convenient test that the average consumer may use to compare the barrier function of their masks to determine which mask in their wardrobe likely offers the greatest protection.

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