



Dysphagia in Parkinson's Disease

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Introduction

Dysphagia

Each year, approximately one in 25 adults will experience a swallowing problem in the United States (ASHA, 2019). Dysphagia is a neurological condition that causes difficulty in swallowing. This condition is more common among older individuals and it affects 22% of adults over the age of fifty and as many as 35% of patients older than 75 years of age (Roden & Altman, 2013).

There are many symptoms of dysphagia that can occur. For example, some symptoms may include mild choking, drooling, coughing, gagging, hoarseness, sensation of food getting stuck in the throat or chest, regurgitation, weight loss, difficulty controlling food in the mouth, difficulty starting the swallowing process, and recurrent pneumonia (Mayo Clinic, 2019). Some of the most common and most severe complications of dysphagia include malnutrition, choking, and aspiration pneumonia (ASHA, 2019).

Parkinson's Disease

Over 75% of dysphagia has a neurologic cause (White, O'Rourke, Ong, Cordato, & Chan, 2008). The most common neurologic causes of dysphagia include stroke, dementia, and Parkinson's disease (White et al., 2008). Parkinson's disease is a progressive chronic disorder that is caused by the degeneration of the substantia nigra in the brain which in turn, reduces the production and transmission of dopamine (Bhatnagar, 2012). Parkinson's disease has no known cause, however there can be some influences such as genes and exposure to toxins (ASHA, 2019).

There are many symptoms of Parkinson's disease that include resting tremors, slowed movement, rigid muscles, loss of balance, limited muscle capacity, speech impairments, and writing challenges (Lin, Chen, & Wang, 2016). Parkinson's disease can also result in non-movement symptoms such as anxiety, breathing and respiratory issues, inability to smell, sleep difficulties, small handwriting, and speech and swallowing difficulties (Lin, Chen, & Wang, 2016). These swallowing, chewing and eating difficulties are known as dysphagia.

Dysphagia & Parkinson's Disease

Some common symptoms of dysphagia in individuals with Parkinson's disease include aspiration, residue, and leakage (Pflug, Bihler, Ermsik, Nissen, Nienstedt, Fiegel, & Koski, 2018). Individuals that have Parkinson's disease may also have a delayed swallow trigger and penetration. (Bhatnagar & O'Connor Wells, 2019). Some other symptoms that can occur in this population include oropharyngeal rigidity, incomplete oropharyngeal contraction, and delayed initiation of the swallowing reflex (Bhatnagar & Speyer, 2009).

In the oral phase of swallowing, it is very common to see repetitive pump movements of the tongue to get the bolus towards the back of the mouth, and residue, premature swallow, and precocious deglutition which includes separating the bolus into two or three separate swallows (Suttnip & Warnecke, 2016). In the pharyngeal phase of swallowing, some residue in the vallecula and pyriform sinuses may occur, aspiration in 50% of these patients, sensory deficits, as well as a reduced rate of spontaneous swallows. The esophageal phase may also show some symptoms within this population such as hypomotility, spasms, and multiple contractions (Suttnip & Warnecke, 2016).

Aspiration Pneumonia

More than 80% of patients with Parkinson's disease suffer from dysphagia. Of these individuals, aspiration occurs in approximately half of these patients (Gaeckle, Domahs, Karmann, Tomandl, & Frank, 2019). According to a study by Gaeckle, Domahs, Karmann, Tomandl, and Frank (2019), "Aspiration pneumonia is among the primary causes of mortality in Parkinson's disease patients". When compared with non-Parkinson's disease patients, Parkinson's disease patients have a nearly decimal increase in the incidence of aspiration pneumonia.

Gastrostomy Tube

Many individuals with dysphagia and co-occurring Parkinson's disease are not able to eat and get nutrition by mouth and therefore are given a gastrostomy tube for feeding. A gastrostomy tube is a tube that is inserted through the abdomen that delivers nutrition directly into the stomach. There are a number of complications that can be associated with a gastrostomy tube including site infection, irritation at the site, occlusion of the tube, and accidental removal of the tube (Conroy, 2009). Although there may be complications, gastrostomy tubes are reported to be associated with low mortality and morbidity (Conroy, 2006).

Current Research

Currently, there is little research on dysphagia in Parkinson's disease patients. There is much research and studies completed about dysphagia itself from Lind (2003) and Parkinson's disease itself from Amstrong and Okun (2020), however there are limited studies completed about the effects of dysphagia in Parkinson's disease patients (Bhatnagar & Speyer, 2009). Current research of the incidence data on population level dysphagia incidence among hospitalized Parkinson's disease patients is not available.

Two research questions will be answered in this paper: 1) How does the incidence of dysphagia among hospitalized Parkinson's disease patients affect the differing demographics and clinical characteristics? 2) How does the incidence of dysphagia among hospitalized Parkinson's disease patients affect the length of hospital stay, hospital charges, incidence of gastrostomy tube, and prevalence of pneumonia? I hypothesize that the incidence of dysphagia among hospitalized Parkinson's disease patient will increase the risk of pneumonia and gastrostomy tube as well as increase the patient's length of hospital stay and hospital charges.

Methods

All the research was completed by the Division of Patient Safety and Quality of Illinois Department of Public Health. They hold data regarding the number of deaths resulting from Parkinson's disease in all of Illinois from 2012 to 2015 differing by a variety of demographics such as race, gender, ethnicity, and age range.

All patient data from Illinois acute care hospitals, specialty hospitals, and ambulatory surgical treatment centers were collected for this study. The patient data includes demographic information and clinical characteristics, primary diagnosis and secondary diagnoses, the incidence of gastrostomy tube, the incidence of pneumonia, their length of stay, and their total hospitalization charges.

This study includes all in-patients in Illinois who had a primary diagnosis of Parkinson's disease during the time frame of September 2012 to September 2015. ICD-9 codes were used for diagnosis coding to identify diseases, disorders, symptoms, and injuries.

Dysphagia incidence among Parkinson's disease hospitalizations were analyzed and arranged by sex, age, race/ethnicity, and co-morbidity of pneumonia and gastrostomy tube. Chi-square testing was used to determine the statistical significance of dysphagia rates among comparison groups.

A p-value was used to determine the statistical significance of results. A t-test is a type of statistic that is commonly used to determine if there is any differences between the means of two groups that may otherwise be related. A general linear model is a model used to compare how variables affect other variables in a study. A multivariate analysis was used to establish a correspondence of the impact of secondary dysphagia among Parkinson's disease patients on co-morbidities, length of stay, and total charges.

Results

Table 1. Demographic and clinical characteristics among hospitalization of Parkinson's disease patients by secondary dysphagia diagnosis

Sex	Dysphagia				
	No	Yes	% Yes	p-value	
Male	1,187	198	14.3	0.003	
Female	766	85	10.0		
Age (years)	20-64	398	32	7.4	0.001
	65-84	1,202	192	13.8	
	85+	351	59	14.4	
Race/ethnicity	White	1,438	211	12.8	0.481
	Black	209	31	12.9	
	Hispanic	173	18	9.4	
	Other	133	23	14.7	
Co-morbidity	Pneumonia	43	11	20.4	0.084
	Gastrostomy	9	3	25.0	
Total	Yes	1,910	272	12.5	0.186
	No	1,944	280	12.6	
Total	Yes	1,953	283	12.7	
	No	1,944	280	12.6	

- Differing demographics and clinical characteristics among hospitalization of Parkinson's disease patients by secondary dysphagia diagnosis are given and examined.
- The patients were split into categories depending on sex (male or female), age, race/ethnicity, and co-morbidity of pneumonia or gastrostomy tube.
- The ages of the patients were split into three separate groups: ages 20-64, 65-84, and 85 and older.
- Race/ethnicity of the patients were divided into White, Black, Hispanic, or other.
- The findings from this table are as follows: the incidence of dysphagia was 12.7% of the hospitalized Parkinson's disease, with 14.3% in males and 10% in females.
- Dysphagia incidence increased as the patients became older, 85 and up. The younger population, 20-64 showed an incidence of 7.4%, ages 65-84 showed 13.8%, and 85 years and up showed an incidence of 14.4%.
- For Parkinson's disease patients with co-morbidities of pneumonia and gastrostomy tube, the incidence of dysphagia were similar, presenting with 20.4% with pneumonia and 25% with gastrostomy tube.
- The p-value for each of the demographic and clinical characteristics was determined and presented in the table as well. The p-value for sex and age are less than .05 meaning there is a statistical difference. The average male comprises around 14% of hospitalizations of Parkinson's disease patients by secondary dysphagia and the average female comprises around 10% of the hospitalizations. This means that males are significantly more likely than females in this population to be diagnosed with dysphagia than ages 20-64 and 65-84. The other demographic and clinical characteristics including race/ethnicity and co-morbidity of pneumonia and gastrostomy tube had no significant statistical difference in the rates of being diagnosed with dysphagia.

Table 2. Length of stay and total charge among hospitalization of Parkinson's disease patients by secondary dysphagia diagnosis

Length of stay	Non-dysphagia			Dysphagia			p-value	
	n	mean	SD	n	mean	SD		
All Parkinson's disease	1,953	4.32	4.10	283	9.55	6.94	<.001	
With pneumonia	43	7.67	5.98	11	14.64	4.97	<.001	
W/O pneumonia	1910	4.24	4.03	272	9.34	6.93	<.001	
With gastrostomy	9	3.33	1.5	3	5.33	4.16	0.495	
W/O gastrostomy	1944	4.32	4.1167	280	9.59	6.95	<.001	
Total charge	All Parkinson's disease	1,953	44,165	42,925	283	43,635	33,556	0.812
	With pneumonia	43	41,082	54,096	11	54,074	29,088	0.289
W/O pneumonia	1,910	44,234	42,656	272	43,213	33,703	0.652	
With gastrostomy	9	24,495	15,389	3	26,955	9,525	0.803	
W/O gastrostomy	1944	44,256	42,993	280	43,814	33,681	0.843	

Table 3. Impact of secondary dysphagia diagnosis among Parkinson's disease in-patients on co-morbidities, Length of stay, and total charge by - results of multivariate analysis

	Odds ratio*	Lower 95% CI	Upper 95% CI	p value
gastrostomy	1.92	0.51	7.30	0.34
Pneumonia	1.63	0.82	3.22	0.16

*No secondary diagnosis of dysphagia is used as the reference.

Length of stay	Adjusted mean difference dysphagia vs no dysphagia*		
	Mean	95% CI	p value
Length of stay	5.12	4.55 - 5.69	<.0001
Total charges (\$)	1728.647	-9927.84	0.5

*adjusted for sex, age, race, and co-morbidities including pneumonia and gastrostomy.

- The length of hospital stay, and total charges were determined with all of the Parkinson's disease patients whether they presented with dysphagia or not.
- They were divided into groups depending on the presence of pneumonia and gastrostomy tube as well.
- After determining the differing demographics resulting in the length of hospital stay and hospital total charges, the mean and standard deviation was found for each group. The standard deviations presented were all large indicating a big inter-subject variability between the various groups.
- The p-value was also noted for each individual group as well. The length of stay p-value of Parkinson's disease patients with and without pneumonia and without gastrostomy tube are less than .05 indicating that the findings of the two groups are statistically different.
- The mean hospital stay for Parkinson's disease patients without the diagnosis of dysphagia is 4.32 days. When these patients were diagnosed with pneumonia, the length of stay increased to 7.67 days. When these patients were given a gastrostomy tube however, the mean length of stay decreased to 3.33 days. The mean hospital stay for Parkinson's disease patients with the diagnosis of dysphagia is 9.55 days. When these patients were diagnosed with pneumonia, the length of stay increased to 14.64 days. When these patients were given gastrostomy tubes, the length of stay decreased to 5.33. However without a gastrostomy tube the patients length of stay increased to 9.59 days.
- The mean total hospital charges for individuals with Parkinson's disease who are not diagnosed with dysphagia is \$44,165 and decreases to \$41,082 with the diagnosis of pneumonia. When these patients are given a gastrostomy tube, the total charges decrease to \$24,495. The mean hospital stay for Parkinson's disease patients who are diagnosed with dysphagia is \$43,635 and increases to \$54,074 when diagnosed with pneumonia as well. When given a gastrostomy tube, the mean total charges decrease to \$26,955.
- The individuals with Parkinson's disease with dysphagia have an average length of stay of 9.55 days and individuals without dysphagia have an average length of stay of around 4.32 days concluding that Parkinson's disease patients with dysphagia have a greater change of lengthening their hospital stay than without dysphagia. Individuals with Parkinson's disease and pneumonia who also develop dysphagia have an average hospital stay of 14.64 days, whereas individuals who do not develop dysphagia have an average of 7.67 days indicating that these patients with dysphagia are significantly more likely to have an increased hospital stay than those without dysphagia. The individuals with Parkinson's disease without a gastrostomy tube who have dysphagia have an average hospital stay of 5.33 days, whereas without dysphagia they have an average hospital stay of 3.33 days.
- The remaining p-values for the total hospital charges are all above .05 indicating that there is no statistical difference between the hospital charges of Parkinson's disease patients with pneumonia and gastrostomy tube with or without dysphagia. The presence of dysphagia in Parkinson's disease patients increased the mean length of hospital stay by more than double from a mean of 4.32 to a mean of 9.55. However, the total hospital stay decreased by 530 days with the presence of dysphagia in Parkinson's disease patients. With a Parkinson's disease patient with co-morbid dysphagia and pneumonia, the length of stay doubled from a mean of 7.67 to 11.64 which also increased the total charges from \$41,082 to \$54,074. With a Parkinson's disease patient with co-morbid dysphagia and gastrostomy tube, the mean hospital length of stay increased from 3.33 to 5.33 and the total charges increased as well from \$24,495 to \$26,955.
- The impact of secondary dysphagia diagnosis among Parkinson's disease inpatients on co-morbidities, length of stay, and total charges was determined using a multivariate analysis.
- The presence of gastrostomy tube and pneumonia were examined, and the odd ratio was found as well as the lower 95% confidence interval and upper 95% confidence interval.
- The odds ratio is used to estimate relative risk. The p-value was determined from this analysis as well. With this data, no secondary diagnosis of dysphagia was used as a reference.
- The length of hospital stay and total charges were examined in this table and the found the adjusted mean, the 95% confidence interval, as well as the p-value.
- The presence of gastrostomy tube, pneumonia, and total hospital charges all have a p-value greater than .05. This indicates that the groups are different, however the difference is more likely due to chance.
- The p-value for the length of stay presented is less than .05 indicating that the groups are statistically different. The adjusted mean presented the difference between dysphagia versus non-dysphagia patients and adjusted for age, sex, and co-morbidities of the patients. A multivariate analysis is used to control confounding factors.
- The odds ratio for co-morbid gastrostomy tube showed 1.92 indicated that Parkinson's disease patients with dysphagia was 1.92 times more likely to have gastrostomy tube than without dysphagia.
- The lower 95% confidence interval was .51 and the upper 95% confidence interval of 7.30. The odds ratio for co-morbid pneumonia showed 1.63 with a lower 95% confidence interval of .82 and an upper 95% confidence interval of 3.22. This indicates that Parkinson's disease patients with dysphagia are 1.63 times more likely to have pneumonia as opposed to Parkinson's disease patients without dysphagia.

The results from Table 1 indicate that dysphagia in Parkinson's disease patients is incredibly prevalent. It presents more prevalent in Caucasian patients, older patients, and male patients. The results also showed that the incidence of Parkinson's disease patients with co-morbidities were similar, however the presence of gastrostomy tube was higher than pneumonia.

After examining the results from Table 2, it is evident that the presence of dysphagia in Parkinson's disease patients increases the length of hospital stay and the total amount of hospital charges. The length of stay and the total hospital charges also increase with the presence of a gastrostomy tube or pneumonia.

After analyzing the results from Table 3, it is apparent that patients with Parkinson's disease are more likely to have a gastrostomy tube or pneumonia when also presenting with dysphagia than without dysphagia.

Discussion

Clinical Implications

The demographic and clinical features of Parkinson's disease with dysphagia have been reported in a study conducted by Goh, Acharyya, Bos, Ng, Kooi, Ng, Li, Tay, and Tan (2016). This research analyzed characteristics such as gender, age, race/ethnicity, and co-morbidities. In this sample, the population differed from the current research and included ethnic groups such as Chinese, Malay, Indian, and others. There were no substantial variations between the groups when analyzing race in both research studies.

The current research found that duration of hospital stay of patients with Parkinson's disease is 4.32 days. This value is in line with the mean length of stay for Parkinson's disease patients reported in a study conducted by Goh, Acharyya, Bos, Ng, Kooi, Ng, Li, Tay, and Tan (2016). This value is also in line with the mean length of stay for Parkinson's disease patients reported in a study conducted by Goh, Acharyya, Bos, Ng, Kooi, Ng, Li, Tay, and Tan (2016). This value is also in line with the mean length of stay for Parkinson's disease patients reported in a study conducted by Goh, Acharyya, Bos, Ng, Kooi, Ng, Li, Tay, and Tan (2016). This value is also in line with the mean length of stay for Parkinson's disease patients reported in a study conducted by Goh, Acharyya, Bos, Ng, Kooi, Ng, Li, Tay, and Tan (2016).

Limitations

Taking into consideration the limitations of this study, more research should be conducted to include a longitudinal study of Parkinson's disease patients that allows us to observe the cause-and-effect relationship.

Future research should look at patients with Parkinson's disease and examine how many develop dysphagia, how many develop pneumonia after initial dysphagia diagnosis, and how many require tube feeding after the diagnosis of dysphagia. This is required to fully understand the impacts of dysphagia among hospitalized Parkinson's disease patients.

A larger number of participants from various regions must be included in the analysis in order for the findings to be generalizable. In order to collect the most reliable results, patients from all health care facilities need to be involved in the analysis and not confined to a single facility. This study included specialty hospitals, and ambulatory surgical treatment facilities. To assist with generalizability, individuals that are not hospitalized but are diagnosed will be included in the analysis as well.

Comparison to Other Studies

The conclusions found in the current research can be influenced by several limitations. The internal threat to validity of this research is selection. The individuals selected to participate in the analysis all come from one database, the Illinois Department of Public Health's Division of Patient Care and Quality. When all participants were drawn from one database containing just one territory, there is not much generalization of the findings of the study to the rest of the population.

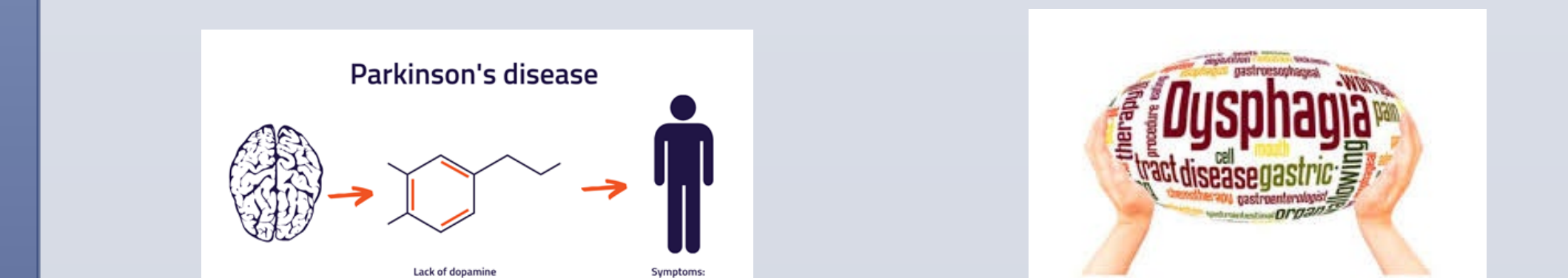
All of the research was from acute care hospitals, specialty hospitals, and ambulatory surgical treatment centers in Illinois, suggesting that the participants in the research were sicker than the general population of patients with Parkinson's disease. The pneumonia rate, for example, may have been higher due to the poor health of these patients, and thus not generalizable to all generalists and persons who are not hospitalized for this disease.

When interpreting the findings of this research, it is important to be cautious when reviewing the standard deviations found on there is an overgeneralization. The current research finds substantial variations between pneumonia patients with Parkinson's disease, gastrostomy tubes, average hospital stay length, and hospital charges, however there is no cause-and-effect relationships among the groups. After examining length of hospital stay and hospital charges, it was found that patients with Parkinson's disease who do not have gastrostomy tubes have a higher standard deviation than patients who have gastrostomy tubes. This may be attributable to the fact that those gastrostomy tube patients have a way to receive nutrients that may result in an earlier release and smaller hospital charges than those without gastrostomy tubes.

Future Research

Conclusion

In conclusion, this research shows that dysphagia is very common in Parkinson's disease patients. For example, 12.7% are secondarily diagnosed with dysphagia among hospitalized patients with Parkinson's disease. Overall, males have a higher average of Parkinson's disease and dysphagia diagnosed patients, approximately 14%, than females. Patients who are 85 years of age and older have the highest average, 14.4%, among hospitalizations of Parkinson's disease patients by secondary dysphagia diagnosis. The current research indicates that following the diagnosis of Parkinson's disease and dysphagia, the prevalence of patients diagnosed with pneumonia is 20.4%. Patients who become reliant on tube feeding by gastrostomy tubes have a rate of 25%. The length of hospital stay and overall hospitalization costs escalate significantly for these co-morbidities. When Parkinson's disease patients are also diagnosed with dysphagia, the period of hospital stay increases from 4.32 days to 9.55 days. When patients have pneumonia or need gastrostomy tubes, the hospital charges rise greatly. Further analysis is required due to the limited sample pool and the inability to derive a cause-and-effect relationship from the given results.



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