

Reporting of Aspiration Pneumonia or Choking as a Cause of Death in Patients Who Died With Stroke

Chia-Yu Chang, Tain-Junn Cheng, Ching-Yih Lin, Jen-Yin Chen, Tsung-Hsueh Lu and Ichiro Kawachi

Stroke. 2013;44:1182-1185; originally published online February 28, 2013;

doi: 10.1161/STROKEAHA.111.000663

Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Copyright © 2013 American Heart Association, Inc. All rights reserved.

Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://stroke.ahajournals.org/content/44/4/1182>

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Stroke* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the [Permissions and Rights Question and Answer](#) document.

Reprints: Information about reprints can be found online at:
<http://www.lww.com/reprints>

Subscriptions: Information about subscribing to *Stroke* is online at:
<http://stroke.ahajournals.org/subscriptions/>

Reporting of Aspiration Pneumonia or Choking as a Cause of Death in Patients Who Died With Stroke

Chia-Yu Chang, MD, MS; Tain-Junn Cheng, MD, PhD; Ching-Yih Lin, MD;
Jen-Yin Chen, MD, MS; Tsung-Hsueh Lu, MD, PhD; Ichiro Kawachi, MD, PhD

Background and Purpose—It is not known how many stroke patients die from fatal pulmonary complications such as aspiration pneumonia (AP) and choking each year in the United States. This study aimed to determine the frequency of reporting of AP or choking as a cause of death on death certificates with mention of stroke in the United States as a proxy measure of the incidence of dying from AP or choking among patients with stroke.

Methods—We used multiple-cause mortality data for the years 2001 to 2010 to identify death certificates with mention of stroke (*International Classification of Diseases, Tenth Revision* code I60–I69), AP (*International Classification of Diseases, Tenth Revision* code J69), and choking (*International Classification of Diseases, Tenth Revision* code W78–W80) for analysis.

Results—Of 2 424 379 death certificates with mention of stroke in the United States between 2001 and 2010, 5.1% (n=124 503) reported AP as a cause of death, and 1.5% (n=36 997) reported choking as a cause of death. However, if we confined the analysis to autopsy-confirmed cases, the frequency decreased to 1.3% (555/42 732) and 1.3% (541/42 732), respectively. The adjusted odds ratios of reporting AP or choking as a cause of death were higher among men, increased with age, and were higher among decedents who died in a nursing home/long-term care.

Conclusions—The estimated incidence of dying from AP and choking among patients who died with stroke was 5% (~12 000 deaths per year) and 1% (~3700 deaths per year) according to information reported on death certificates. Efforts are needed to reduce the number of deaths from these 2 preventable complications. (*Stroke*. 2013;44:1182–1185.)

Key Words: aspiration pneumonia ■ choking ■ death certificate ■ stroke

Dysphagia (difficulty in swallowing) after acute stroke is common and increases the risk of pulmonary complications such as aspiration pneumonia (AP) and choking and the related mortality.^{1–5} However, it is not known how many stroke patients die from AP or choking each year in the United States. The main reason for the lack of this information is that the traditional cause-specific mortality is tabulated based on the underlying cause of death (COD), which is defined by the World Health Organization as the disease or injury that initiated the train of morbid events leading directly to death.⁶ In the following example, stroke would be selected as the underlying COD for mortality tabulation, and the information on choking or AP would not be available in the underlying COD mortality data.

- (1) Aspiration pneumonia
- (2) Choking by food
- (3) Stroke

To remedy this limitation, researchers suggest the use of multiple COD data to illustrate the complications leading to death.^{7,8} This study aimed to determine the frequency of reporting of AP or choking as a COD on death certificates with mention of stroke using multiple-cause mortality files of the United States for years 2001 to 2010 as a proxy measure of the incidence of dying from AP or choking among patients with stroke.

Methods

Data Source

We used the multiple COD database of Centers for Disease Control and Prevention Wide-ranging Online Data for Epidemiological Research (CDC WONDER) for the years 2001 to 2010 to identify death certificates with mention of stroke (*International Classification of Diseases, Tenth Revision* code I60–I69), AP (*International Classification of Diseases, Tenth Revision* code J69), and choking (*International Classification of Diseases, Tenth Revision* code

Received December 31, 2012; final revision received January 14, 2013; accepted January 15, 2013.

From the Department of Neurology, Chi Mei Medical Center, Tainan, Taiwan (C.-Y.C., T.-J.C.); Department of Biotechnology, Southern Taiwan University of Science and Technology (C.-Y.C.); Occupational Medicine, Management in Medical Records and Information, Chi Mei Medical Center, Tainan, Taiwan (T.-J.C.); Department of Occupational Safety/Institute of Industrial Safety and Disease Prevention, College of Sustainable Environment, Chia Nan University of Pharmacy and Science, Tainan, Taiwan (T.-J.C.); Department of Occupational and Environmental Medicine, National Cheng Kung University Hospital, Tainan, Taiwan (T.-J.C.); Department of Internal Medicine, Chi Mei Medical Center, Tainan, Taiwan (C.-Y.L.); Department of Leisure, Recreation, and Tourism Management, Southern Taiwan University of Science and Technology (C.-Y.L.); Department of Anesthesiology, Chi Mei Medical Center, Tainan, Taiwan (J.-Y.C.); Department of Senior Citizen Service Management, College of Humanities and Social Sciences, Chia Nan University of Pharmacy and Science, Tainan, Taiwan (J.-Y.C.); Institute of Public Health, College of Medicine, National Cheng Kung University, Tainan, Taiwan (T.-H.L.); and Department of Society, Human Development and Health, Harvard School of Public Health, Harvard University, Boston, MA (I.K.).

Correspondence to Tsung-Hsueh Lu, MD, PhD, No. 1, Dah Hsueh Rd, Institute of Public Health, College of Medicine, National Cheng Kung University, Tainan, Taiwan. E-mail robertlu@mail.ncku.edu.tw

© 2013 American Heart Association, Inc.

Stroke is available at <http://stroke.ahajournals.org>

DOI: 10.1161/STROKEAHA.111.000663

W78–W80) for analysis. CDC WONDER is an easy-to-use, menu-driven system that makes the information resources of the Centers for Disease Control and Prevention available to public health professionals and the public at large.⁹

Analysis

In the first part of the analysis, we first calculated the frequency of reporting of AP or choking as the COD on death certificates with mention of stroke by year, sex, age, race, and place of death. We then computed the odds ratios and 95% confidence intervals for the reporting of AP or choking as the COD based on the logistic regression model, adjusting for year, sex, age, race, and place of death. In the second part of the analysis, we confined the analyses to deaths with autopsy confirmation only. Autopsy information was available beginning in 2003.

Results

Of 2 424 379 death certificates with mention of stroke in the United States between 2001 and 2010, 5.1% (n=124 503) reported AP as a COD, 1.5% (n=36 997) reported choking as a COD, and 0.51% (n=12 439) reported both AP and choking. The adjusted odds ratios of reporting AP or choking as a COD decreased from 2001 to 2010, were higher among men, and increased with age (Table 1).

However, if we confined the analysis to autopsy-confirmed cases only, the percentage of reporting of AP, choking, and both

as COD decreased to 1.3% (555/42 732), 1.3% (541/42 732), and 0.12% (53/42 732), respectively. The adjusted odds ratios of reporting AP or choking as a COD in autopsy-confirmed cases were higher among men, increased with age, and were higher among decedents who died in a nursing home/long-term care (Table 2).

Discussion

This is the first study to attempt to estimate how many stroke patients die from AP or choking. The findings of this study indicated that of ~240 000 patients who died with stroke each year in the United States during the past decade, ~12 000 were reported as dying from AP, and 3700 were reported as dying from choking on death certificates by certifying physicians. Fortunately, the risk of death from AP, or choking declined from 2001 to 2010. However, we found that the risk was higher among men, increased with age, and was higher among decedents who died in a nursing home/long-term care.

The incidence estimated in this study was based on the information reported on death certificates by certifying physicians. However, it is sometimes very difficult for certifying physicians to assign a stroke-related COD.^{10–12} For example, choking is a symptom involving something penetrating the airway and is difficult to distinguish from coughing. Chest

Table 1. Frequency and Adjusted OR and 95% CIs of Reporting AP or Choking as a COD on Death Certificates With Mention of Stroke by Year, Sex, Age, Race, and Place of Death in the United States, 2001 to 2010

	With Mention of Stroke	Reporting AP as COD				Reporting Choking as COD				
		n	%	OR	95% CI	n	%	OR	95% CI	
Total	2 424 379	124 503	5.14			36 997	1.53			
Year										
2001–2002	548 075	32 088	5.85	1.00		9197	1.68	1.00		
2003–2004	517 733	28 494	5.50	0.95	0.93–0.97	8302	1.60	0.96	0.94–0.99	
2005–2006	474 030	23 942	5.05	0.88	0.86–0.89	7425	1.57	0.95	0.92–0.98	
2007–2008	451 056	20 831	4.62	0.81	0.80–0.83	6457	1.43	0.88	0.85–0.91	
2009–2010	433 485	19 148	4.42	0.79	0.78–0.81	5616	1.30	0.80	0.77–0.83	
Sex										
Men	999 956	65 777	6.58	1.78	1.76–1.80	18 923	1.89	1.62	1.59–1.65	
Women	1 424 423	58 726	4.12	1.00		18 074	1.27	1.00		
Age										
0–44 y	55 232	622	1.13	0.40	0.37–0.44	390	0.71	0.75	0.67–0.83	
45–64 y	272 877	7358	2.70	1.00		2572	0.94	1.00		
65–74 y	347 617	16 534	4.76	1.87	1.82–1.92	5078	1.46	1.56	1.49–1.64	
≥75 y	1 748 590	99 988	5.72	2.59	2.53–2.65	28 956	1.66	1.89	1.81–1.97	
Race										
White	2 051 594	106 781	5.20	1.00		31 841	1.55	1.00		
Black	304 617	13 790	4.53	1.00	0.98–1.02	4217	1.38	1.00	0.97–1.03	
Others	68 168	3932	5.77	1.18	1.15–1.22	939	1.38	0.95	0.89–1.01	
Place of death										
Inpatient	1 065 818	63 358	5.94	1.00		16 498	1.55	1.00		
NH/LTC	783 431	43 675	5.57	0.85	0.84–0.86	14 055	1.79	1.10	1.07–1.12	
Home	325 116	8817	2.71	0.41	0.40–0.42	3193	0.98	0.61	0.58–0.63	
Others	250 014	8653	3.46	0.56	0.55–0.57	3251	1.30	0.84	0.81–0.87	

AP indicates aspiration pneumonia; CI, confidence interval; COD, cause of death; NH/LTC, nursing home/long-term care; and OR, odds ratio.

Table 2. Frequency and Adjusted OR and 95% CIs of Reporting AP or Choking as a COD on Death Certificates With Mention of Stroke With Autopsy Confirmed by Year, Sex, Age, Race, and Place of Death in the United States, 2003 to 2010

	With Mention of Stroke	Reporting AP as COD				Reporting Choking as COD			
		n	%	OR	95% CI	n	%	OR	95% CI
Total	42732	555	1.30			541	1.27		
Sex									
Men	24086	348	1.44	1.54	1.29–1.84	338	1.40	1.43	1.19–1.70
Women	18646	207	1.11	1.00		203	1.09	1.00	
Age									
0–44 y	9621	40	0.42	0.63	0.44–0.91	63	0.65	0.71	0.53–0.96
45–64 y	18380	108	0.59	1.00		158	0.86	1.00	
65–74 y	5785	120	2.07	2.85	2.19–3.72	117	2.02	2.25	1.76–2.87
≥75 y	8938	287	3.21	4.09	3.24–5.17	203	2.27	2.29	1.83–2.87
Race									
White	30387	431	1.42	1.00		403	1.33	1.00	
Black	10499	109	1.04	0.94	0.75–1.16	111	1.06	0.91	0.73–1.13
Others	1846	15	0.81	0.68	0.40–1.14	27	1.46	1.25	0.84–1.86
Place of death									
Inpatient	21452	403	1.88	1.00		270	1.26	1.00	
NH/LTC	1763	79	4.48	1.43	1.11–1.85	71	4.03	2.35	1.78–3.10
Home	10951	25	0.23	0.15	0.10–0.22	55	0.50	0.44	0.33–0.60
Others	8566	48	0.56	0.37	0.28–0.50	145	1.69	1.57	1.28–1.93

AP indicates aspiration pneumonia; CI, confidence interval; COD, cause of death; NH/LTC, nursing home/long-term care; and OR, odds ratio.

infections are common after stroke and are sometimes not only because of aspiration but also because of impaired immunity, hypostasis, and hypoventilation. In some places, all pneumonia after stroke will be described as AP, even if there is no direct evidence of aspiration.

The estimated incidence of reporting of AP as a COD was 5% according to all death certificates and was 1% according to autopsy-confirmed cases. One possible explanation of this discrepancy is that, in most cases, it is not necessary to perform an autopsy to determine AP or choking as a COD. Only in a small number of cases, the autopsy is needed to confirm whether the AP or choking was due to what kind of objects (such as vomitus, milk, or foods). As a result, the autopsy rate was only 0.6% among deceased reporting of AP as a COD and 1.9% among deceased reporting of choking as a COD.

Regarding the denominator, because of the improvement in the acute care of stroke patients, more stroke patients may die from AP or choking many months after the occurrence of stroke. The attending physician, therefore, does not mention stroke at all on the death certificate, resulting in under-reporting of stroke as the underlying COD. This might be one of the possible reasons for which chronic lower respiratory diseases (mainly lower respiratory infection) rose from the fourth leading COD to the third leading COD since 2008.¹³

The findings of this study suggest a decline in the frequency of reporting AP or choking as a COD on death certificates with mention of stroke from 2001 to 2010. This might be because of the increase in implementation of dysphagia screening and management programs in institutions caring for patients with stroke.^{14,15} However, given that most healthcare workers

in stroke services are now aware of the importance of swallow screening and management, there may be an increasing reticence to attribute deaths to choking or aspiration because these are increasingly seen as unacceptable. Caution should be exercised in interpreting the findings.

In conclusion, despite the above-mentioned limitations, this study suggests the potential for using multiple-cause mortality data to estimate the number of deaths from fatal pulmonary complications among patients who died with stroke. The estimated incidence of dying from AP and choking among patients who died with stroke was 5% (~12 000 deaths per year) and 1% (~3700 deaths per year) according to information reported on death certificates. Efforts are needed to reduce the number of deaths from these 2 preventable complications.

Sources of Funding

This study was funded by the Chi-Mei & National Cheng Kung University Joint Program (CMNCKU9916).

Disclosures

None.

References

- Martino R, Foley N, Bhogal S, Diamant N, Speechley M, Teasell R. Dysphagia after stroke: incidence, diagnosis, and pulmonary complications. *Stroke*. 2005;36:2756–2763.
- Smithard DG, Smeeton NC, Wolfe CD. Long-term outcome after stroke: does dysphagia matter? *Age Ageing*. 2007;36:90–94.
- Katzan IL, Cebul RD, Husak SH, Dawson NV, Baker DW. The effect of pneumonia on mortality among patients hospitalized for acute stroke. *Neurology*. 2003;60:620–625.

4. Slot KB, Berge E, Sandercock P, Lewis SC, Dorman P, Dennis M; Oxfordshire Community Stroke Project; Lothian Stroke Register; International Stroke Trial (UK). Causes of death by level of dependency at 6 months after ischemic stroke in 3 large cohorts. *Stroke*. 2009;40:1585–1589.
5. Finlayson O, Kapral M, Hall R, Asllani E, Selchen D, Saposnik G; Canadian Stroke Network; Stroke Outcome Research Canada (SORCan) Working Group. Risk factors, inpatient care, and outcomes of pneumonia after ischemic stroke. *Neurology*. 2011;77:1338–1345.
6. World Health Organization. *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision. Instruction Manual*. Vol. 2. 2nd ed. Geneva, Switzerland: World Health Organization; 2004. http://www.who.int/classifications/icd/ICD-10_2nd_ed_volume2.pdf. Accessed October 1, 2012.
7. Redelings MD. A comparison of underlying cause and multiple causes of death: US vital statistics, 2000–2001. *Epidemiology*. 2006;17:100–103.
8. Redelings MD, Wise M, Sorvillo F. Using multiple cause-of-death data to investigate associations and causality between conditions listed on the death certificate. *Am J Epidemiol*. 2007;166:104–108.
9. Centers for Disease Control and Prevention. CDC WONDER. <http://wonder.cdc.gov>. Accessed October 1, 2012.
10. Lu TH, Shih TP, Lee MC, Chou MC, Lin CK. Diversity in death certification: a case vignette approach. *J Clin Epidemiol*. 2001;54:1086–1093.
11. Halkes PH, van Gijn J, Kappelle LJ, Koudstaal PJ, Algra A. Classification of cause of death after stroke in clinical research. *Stroke*. 2006;37:1521–1524.
12. Brown DL, Al-Senani F, Lisabeth LD, Farnie MA, Colletti LA, Langa KM, et al. Defining cause of death in stroke patients: The Brain Attack Surveillance in Corpus Christi Project. *Am J Epidemiol*. 2007;165:591–596.
13. Towfighi A, Saver JL. Stroke declines from third to fourth leading cause of death in the United States. *Stroke*. 2011;42:2351–2355.
14. Odderson IR, Keaton JC, McKenna BS. Swallow management in patients on an acute stroke pathway: quality is cost effective. *Arch Phys Med Rehabil*. 1995;76:1130–1133.
15. Hinchey JA, Shephard T, Furie K, Smith D, Wang D, Tonn S; Stroke Practice Improvement Network Investigators. Formal dysphagia screening protocols prevent pneumonia. *Stroke*. 2005;36:1972–1976.