Physician volume, physician specialty and in-hospital mortality for patients with acute myocardial infarction

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Abstract

This study sets out to assess the relationship between in-hospital mortality rates and physician acute myocardial infarction (AMI) volume, along with an examination of the impact of physician specialty on in-hospital mortality rates in Taiwan. Analysis was undertaken on a total of 19,086 patients hospitalized for AMI, following the division of the sample patients into four roughly equivalent groups. Within each physician specialty, the AMI patients were also subsequently grouped into four roughly equivalent groups based upon physician volume. After adjusting for other factors, the likelihood of in-hospital mortality among patients treated by low-volume physicians was 2.141 ($p<0.001$) times as high as that for patients treated by high-volume physicians, and 2.410 ($p<0.001$) times as high as that for patients treated by very high-volume physicians. However, while such an inverse relationship was found to persist for those physicians specializing in general internal medicine and 'others', this was not the case for cardiologists.

Keywords: Acute myocardial infarction; Specialty; In-hospital mortality

Numerous studies have documented an inverse relationship between adverse outcomes and the number of procedures and conditions treated by surgeons or hospitals [1–6]. Among the various procedures and conditions undertaken by surgeons/hospitals, an area which has drawn considerable attention, and which has been explored in detail over recent years, is cardiovascular medicine; however, most of the studies on AMI have tended to focus mainly on those patients undergoing elective angioplasty procedures, with relatively few studies having focused on the relationship between the mortality rates following AMI and the number of AMI cases admitted by physicians in different practice specialties.

The purposes of this study are two-fold. Firstly, using a nationwide population-based dataset, we set out to determine whether, in a developing country such as Taiwan, the inverse relationship continues to exist between the number of cases admitted by physicians and the in-hospital mortality rate following an AMI. Secondly, we aim to assess whether the specialty of the admitting physicians has any impact on the primary angioplasty outcomes for AMI, and whether this can influence the relationship between the number of procedures treated by physicians and AMI mortality rates.

Since the National Health Insurance program in Taiwan covers almost all of Taiwan's 23 million citizens, the patients' information provided by this system is far more comprehensive than most studies. In addition, due to the shortage of cardiologists in Taiwan, general internists are frequently requested involving in the treatment of AMI, regardless the conditions of AMI patients, thus the results we find should reflect a more realistic scenario of the variations in either physician specialty following an AMI, or the subsequent volume–outcome relationship.

Our study uses a nationwide dataset, covering the years 1997–1999, obtained from the National Health Insurance Research Database. We selected as our study sample all patients who had been hospitalized for acute myocardial infarction, with an ICD-9-CM code of 410.XX as the primary diagnosis, between 1 January 1997 and 31 December 1999. Those who were less than 18 years of age were excluded so as to limit the study sample to adult patients. Those who had been hospitalized for an AMI during the previous 2 years were also excluded in order to limit the study sample to first-time AMI hospitalizations. In addition, those patients who had undergone 'coronary artery bypass graft' surgery as part of the index admission were also excluded. Ultimately, our study sample comprised of 19,086 admissions, treated by 2030 physicians.

The sample patients were thus divided into four roughly equivalent physician volume groups comprising of ≤ 14 cases (low volume), 15–39 (medium volume), 40–65 (high volume) and ≥ 66 cases (very high volume). We also divided the sample patients into four roughly equivalent physician volume groups within every physician specialty (cardiology, general internal medicine, and 'others') so as to examine the volume–outcome relationship for each physician specialty. The 'others' group includes the physicians other than cardiologist and general internists.

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Table 1
Crude in-hospital mortality rate and crude and adjusted odds ratios for in-hospital mortality by physician volume and specialty of admitting physician.

Physician specialty	Physician AMI volume quartile			
	Low (%)	Medium (%)	High (%)	Very high (%)
Crude in-hospital mortality				
Total	14.96	8.31	6.35	5.09
Cardiology	7.93	5.53	6.56	4.27
General internal medicine	14.27	8.69	6.76	5.59
Others	19.41	11.44	8.69	3.22
Crude odds ratio	Low	Medium	High	Very high
		OR, 95% CI	OR, 95% CI	OR, 95% CI
Total	1.000	0.515 (0.452–0.587)***	0.386 (0.335–0.444)***	0.305 (0.262–0.354)***
Cardiology	1.000	0.679 (0.471–0.980)*	0.815 (0.575–1.154)	0.517 (0.351–0.763)***
General internal medicine	1.000	0.572 (0.487–0.672)***	0.435 (0.365–0.519)***	0.356 (0.296–0.428)***
Others	1.000	0.536 (0.404–0.712)***	0.395 (0.287–0.543)***	0.138 (0.089–0.214)***
Adjusted odds ratio	Low	Medium	High	Very high
		OR, 95% CI	OR, 95% CI	OR, 95% CI
Total	1.000	0.566 (0.488–0.655)***	0.467 (0.390–0.550)***	0.415 (0.348–0.494)***
Cardiology	1.000	0.814 (0.517–1.283)	0.995 (0.654–1.512)	0.932 (0.544–1.597)
General internal medicine	1.000	0.701 (0.583–0.843)***	0.584 (0.477–0.716)***	0.482 (0.389–0.597)***
Others	1.000	0.732 (0.40–0.992)*	0.557 (0.396–0.785)***	0.210 (0.128–0.344)**

Note: *$p<0.05$; **$p<0.01$; ***$p<0.001$; OR = odds ratio; CI = confidence interval.

The SAS 8.2 (SAS Institute, Cary, NC) statistical package was used to perform the statistical analysis of all of the data in this study. After adjusting for surgeon, patient and hospital characteristics, multivariate logistic regressions were also undertaken, employing the generalized estimating equation method, in order to determine whether there was any independent association between physician AMI volume and inpatient mortality.

A summary of the crude in-hospital mortality rates, by physician AMI volume groups and specialty of the admitting physician, is provided in Table 1, which shows that with increasing physician AMI volume there was a corresponding decline in crude in-hospital mortality rates; the rates were 14.96% for low-volume physicians, 8.31% for medium-volume physicians, 6.35% for high-volume physicians and 5.09% for very high-volume physicians ($p<0.001$).

After adjusting for physician and hospital characteristics, as well as the gender, age and comorbidities of the patients, we found that the likelihood of in-hospital mortality for patients treated by low-volume physicians was 1.767 (reciprocal of 0.566) times as high as that for those treated by medium-volume physicians, 2.141 times as high as that for high-volume physicians, and 2.410 times as high as that for very high-volume physicians.

As regards physician specialty, although the adjusted association between lower in-hospital mortality rates and higher volume groups persists for those patients treated by physicians specializing in general internal medicine and 'others', the volume–outcome relationship nevertheless disappears for those patients treated by physicians specializing in cardiology.

This study found an inverse relationship between inpatient mortality following an AMI and the volume of AMI cases treated by admitting physicians. This correlation between higher-volume physicians and better outcomes, essentially as a result of their more extensive experience with such procedures, has been reported by other studies, thereby suggesting that the 'practice makes perfect' hypothesis also applies to the treatment of AMI patients [7–13].

We have observed lower mortality for those patients with AMI who were treated either by cardiologists or general interns and physician specializing in other areas with high-AMI volume; therefore, AMI patients should, whenever possible, be directed to a cardiologist as the first priority. If there is no cardiologist available, then the treatment of AMI patients should be restricted to those physicians with high-AMI volume. Those hospitals which are part of the Emergency Operation Centers (EOC) system, but which do not have cardiologists on site, should seek to improve their outcomes by adopting the care protocols used by higher-volume hospitals, including standard operational protocols for the treatment of AMI patients, adhering to guideline-supported therapies, assigning all of their AMI cases to a few experienced physicians, or arranging for low-volume physicians to work with high-volume physicians when treating AMI patients.

For policy making purposes, and in order to save more lives, the EOC should ensure that patients with AMI are transported to those hospitals with cardiologists on site as the priority choice. At same time, the EOC should adopt a system under which all hospitals with high-AMI volume physicians are listed, as a backup plan, if beds are unavailable at any particular time at the first choice hospitals.

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Impaired transient receptor potential vanilloid 1 in streptozotocin-induced diabetic hearts ☆

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Abstract

Little is known about the effect of diabetes mellitus (DM) on transient receptor potential vanilloid 1 (TRPV1) located in cardiac sensory nerves. This study was performed to test the changes of TRPV1 and its main neuropeptides in diabetic hearts. DM was induced by intraperitoneal injection of streptozotocin (STZ) in C57BL/6J mice. The protein and mRNA expression of TRPV1, calcitonin gene-related peptide (CGRP) and substance P (SP) levels in hearts were measured, respectively. Compared with control mice, blood glucose was significantly increased in diabetic mice ($P<0.05$), while the protein and mRNA expression of TRPV1, CGRP and SP levels in hearts were essentially reduced in diabetic mice ($P<0.05$). TRPV1 and its main neuropeptides, CGRP and SP, in hearts were impaired during DM.

Keywords: Diabetic neuropathy; Transient receptor potential vanilloid 1; Calcitonin gene-related peptide; Substance P

1. Introduction

Transient receptor potential vanilloid 1 (TRPV1) is mainly distributed in primary sensory nerves [1]. It can result in the release of some neuropeptides, including

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