

Complications of coronary arteriography

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The complications associated with selective coronary arteriography have been of continuing concern since this technique was developed 20 years ago. Many of the problems associated with selective coronary arteriography during its developmental phase have now been greatly reduced or eliminated with improved catheters, contrast agents, radiographic and hemodynamic monitoring equipment and techniques in the management of the unstable cardiac patient. The large difference in complications associated with Sones's and Judkins's techniques of selective coronary arteriography reported in the early 1970s has been resolved. In this brief report, I will present what I believe to be a fair estimate of the complications of selective coronary arteriography as it is now done in large institutional laboratories in the United States. The data summarized below come from the files of the Collaborative Study of Coronary Artery Surgery (CASS) and have been recently published.¹ The data were collected prospectively on 7553 consecutive patients who underwent coronary arteriography between August 1975 and December 1976. The studies were performed at 13 clinics of CASS with either Sones's or Judkins's technique. In *Table 1*, some of the characteristics of the patient population are listed. Since CASS sites register each patient undergoing

selective coronary arteriography for suspected coronary artery disease, the population characteristics are probably similar to those of many diagnostic laboratories.

There were eight deaths 0 to 24 hours and seven deaths 24 to 48 hours after arteriography (2/1000). There were 15 nonfatal myocardial infarctions 0 to 24 hours and four myocardial infarctions 24 to 48 hours after arteriography (2.5/1000). Of 657 patients with left main artery stenosis $\geq 50\%$, five died and three had myocardial infarctions.

Since detailed historical, physical, and laboratory data are available on each CASS patient, it was possible to identify those patient characteristics that are associated with increased risk of death at the time of selective coronary arteriography. Of the many variables examined, only multiple premature contractions on the resting 12-lead electrocardiograms, a history or the presence of signs or symptoms of congestive heart failure, and the presence of treated hypertension were indicative of increased

Table 1. Description of patient population

Number of patients	7553
Men	76%
Mean age (yr)	
Men	53.3 \pm 9.2
Women	54.5 \pm 9.1
Mean ejection fraction	.60 \pm .15
Angina	72%
Prior myocardial infarction	46%
Hypertension	33%
Diabetes	11%
Congestive heart failure	11%
Multiple premature ventricular contractions	3%
Coronary anatomy	
No stenosis, $\geq 70\%$	27%
1 vessel, $\geq 70\%$	20%
2 vessels, $\geq 70\%$	22%
3 vessels, $\geq 70\%$	31%
Left main stenosis, $\geq 50\%$	9%

Table 2. Relative risks for factors associated with death related to arteriography

	Estimated relative risk (95% confidence interval)
Prognostic factors	
Multiple premature ventricular contractions	6.8 (1.7-26.9)
Congestive heart failure	5.3 (1.8-15.7)
Hypertension	4.2 (1.4-13.0)
Angiographic characteristics	
Left main coronary artery stenosis, $\geq 50\%$	6.8 (2.3-20.0)
Three-vessel disease	15.6 (2.8-86.4)
Ejection fraction, 0.30	9.0 (2.6-31.4)

risk associated with selective coronary arteriography. The relative risks of these prognostic variables are noted in *Table 2*. Certain angiographic findings were associated with the increased risk of death at the time of selective coronary arteriography. These included left main artery disease, three-vessel disease, and an ejection fraction $\leq 30\%$ as also noted in *Table 2*.

Since both Sones's technique (1187 cases) and Judkins's technique (6326 cases) were utilized by participating laboratories, we evaluated the complications for each method of selective coronary arteriography. The results of this analysis for death are shown in *Table 3*. In laboratories doing a majority of procedures by Sones's technique, there were no deaths by either method, but in those laboratories doing a minimum of cases by Sones's technique there were significantly more deaths ($p < 0.002$) than those associated with Judkins's procedures in those same laboratories.

Nonfatal complications of selective coronary arteriography occurred less frequently than usually reported in the past. Myocardial infarction occurred in

Table 3. Comparison of mortality rates for brachial and femoral procedures

	Femoral procedures	Brachial procedures	p value
Clinics using procedures			
Majority ($\geq 80\%$) brachial procedures	0.0000 (0/105)	0.0000 (0/654)	NS
Minority (1% to 43%) brachial procedures	0.0005 (2/3770)	0.0113 (6/533)	0.0002*
No brachial procedures	0.0029 (7/2453)

* Fisher's exact test of significant difference in mortality between brachial and femoral techniques.

0.25%, systemic embolization in 0.09%, and vascular complications occurred in 0.74%. Vascular complications occurred more often with Sones's technique, 2.78% than with Judkins's technique, 0.36%.

From this study, we conclude that selective coronary arteriography has become a relatively safe procedure associated with a low level of serious complications and death. The procedure ap-

pears to be most free of major complications when carried out in a laboratory that uses predominantly one method of coronary arteriography.

Reference

1. Davis K, Kennedy JW, Kemp HG Jr, et al: Complications of coronary arteriography from the Collaborative Study of coronary artery surgery (CASS). *Circulation* **59**: 1105-1112, 1979.