Elevated risk of death persists beyond 30 days after mitral valve surgery

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Survival estimate demonstrating persistent risk of death after mitral valve operations.

Central Message

After mitral valve operations, the risk of postoperative death persists as long as 90 days after mitral valve repair and beyond 90 days after mitral valve replacement.

See Commentaries on pages e175, e177, and e179.

Although persistence of postoperative risk of death beyond 30 days has been demonstrated in coronary artery bypass grafting,¹ this has not been investigated well in patients who underwent mitral valve (MV) surgeries. Increasing attention to outcomes beyond 30-days as a quality metric is evident through federally funded programs, such as the Hospital Readmission Reduction Program² and the newly developed reimbursement scheme to incentivize coordination of postacute phase of care.³ To inform such initiatives for patients undergoing MV operations, we aimed to characterize temporal change in the risk of death within 1 year after MV repair and MV replacement (MVR).

METHODS

We conducted a retrospective cohort study on consecutive patients who underwent either concomitant or isolated MVR or MV repair at our center between 2011 and 2016. Twelve surgeon performed MVR and MV repair during the study period. In-hospital, 30, 90, 180, and 365-day mortalities and survival estimates were calculated for each cohort. Posthospital survival was adjudicated according to patient-level Connecticut State Vital Statistics. The Vital Statistics data do not capture those residing outside Connecticut, and this group was excluded. Kaplan-Meier analysis generated survival estimates, and the time-average of slope of the survival estimate was calculated at each time point to evaluate changes in the monthly risk of death during the 1 year following the surgery. Bivariate analyses were performed with the χ^2 test or Fisher exact test for categorical variables and the Wilcoxon rank sum test for continuous variables. Analyses were conducted with SAS 9.4 statistical software (SAS Institute Inc, Cary, NC).

RESULTS

The cohort of 1048 patients consisted of 624 MV repairs and 424 MVRs. Mean ages were 64.1 ± 13.2 years and 65.9 ± 14.9 years, and female patients comprised 40% and 52% of the MV repair and MVR cohorts, respectively. As expected, the MVR cohort harbored comorbidities more frequently, including preoperative dialysis need, lung disease, history of stroke, and previous sternotomy. Elective

surgery comprised 77% of the MV repair cohort and 58% of the MVR cohort. Isolated MV surgery comprised 64.7% of the MV repair cohort and 50.0% of the MVR cohort (Table 1).

In-hospital mortality was 0% for both cohorts. Thirty-day mortality occurred in 1 patient (0.2%) and 6 patients (1.4%) in the MV repair and MVR cohorts, respectively. Survival estimates after the surgery were 99.0% and 97.0% at 90 days, 98.9% and 94.5% at 180 days, and 98.0% and 92.2% at 365 days in the MV repair and MVR cohorts, respectively. Follow-up at 365 days was complete for 87% of the cohort. The mean monthly rate of decrease in Kaplan-Meier survival estimates at 0 to 30 days, 31 to 90 days, 91 to 180 days, 181 to 360 days, 361 to 540 days, and 540 to 720 days were -0.16% , -0.41% , -0.03% , -0.14% , -0.13% , and -0.15% at the respective times for MV repair, and -1.43% , -0.86% , -0.79% , -0.34% , -0.39% , and -0.31% at the respective times for MVR (Figure 1), suggesting that the elevated risk of death persisted beyond 30 days after MV surgeries and then stabilized after 90 days for MV repair but continued to persist to 180 days for MVR.

DISCUSSION

This study suggests that even after favorable in-hospital and 30-day survivals after MV surgery, risk of

TABLE 1. Patient and operative characteristics and outcomes

Variable	MV repair (N = 624)%		MVR (N = 424)%		P value
Baseline					
Age (y; median and IQR)	65	55-74	68	57-77	.006
Female (No. and %)	249	39.9	220	51.9	.0001
Diabetes (No. and %)					
Type 2	66	4.1	72	1.4	<.0001
Type 1	20	1.3	41	0.8	
Preoperative dialysis (No. and %)	5	0.8	31	7.3	<.0001
History of endocarditis (No. and %)	42	6.7	83	19.6	<.0001
Chronic lung disease (No. and %)	23	3.7	29	6.8	.021
Peripheral vascular disease (No. and %)	40	6.4	54	12.7	.0004
History of stroke (No. and %)	37	5.9	65	15.3	<.0001
Previous MI (No. and %)	93	14.9	108	25.5	<.0001
Redo sternotomy (No. and %)	26	4.2	113	26.7	<.0001
History of CABG (No. and %)	8	1.3	33	7.8	<.0001
Congestive heart failure (No. and %)	220	35.3	264	62.3	<.0001
Operative					
Case status (No. and %)					
Elective	482	77.2	246	58.0	<.0001
Urgent	139	22.3	165	38.9	
Emergency	3	0.5	13	3.1	
Crossclamp time (min; median and IQR)	90	73-112	102	78-130	<.0001
Myxomatous disease (No. and %)	520	83.4	60	14.2	<.0001
Concomitant CABG (No. and %)	120	19.2	82	19.3	.97
Myxomatous MV* (No. and %)	65	54.2	13	15.8	<.0001
Concomitant TV repair (No. and %)	47	7.5	61	14.4	.0003
Concomitant maze (No. and %)	129	20.7	91	21.5	.83
Isolated MV (No. and %)	404	64.7	212	50.0	<.0001
Postoperative					
In-hospital mortality (No. and %)	0	0.0	0	0.0	—
30-day mortality (No. and %)	1	0.2	6	1.4	.0144
Stroke (No. and %)	2	0.3	13	3.1	.0002

MV, Mitral valve; MVR, mitral valve replacement; IQR, interquartile range; MI, myocardial infarction; CABG, coronary artery bypass grafting; TV, tricuspid valve. *Denominator is concomitant coronary artery bypass grafting.

mortality may persist beyond 30 days but declines substantially within 1 year. Likely owing to the difference in patient characteristics, risk of death appears to have stabilized earlier (by 90 days) in the MV repair cohort whereas it persisted beyond 90 days in the MVR cohort. This work informs current efforts in improving the post-acute phase of care by defining the time frames and magnitude of the persistent risk of death after MV operations.

Most existing cardiac surgical outcome measures are limited to 30 days after the index operation and the attributions are to the hospital and the surgeon. Beyond this time frame, no measure mechanism exists, and there is a lack of systematic incentive for the health care system to monitor or improve outcomes beyond 30 days. Central question previous to investing in such effort is whether the elevated risk of death after the operation persists beyond the 30-day period.⁴ Our data may suggest that

the elevated risk does persist, and the duration of elevated risk of death differs by the risk profile of patients, as related to case characteristics. MV operations presented an ideal contrast of risk profiles between repair and replacement cohorts to study this, with isolated repair associated with the national 30-day mortality of 1% and replacement associated with a 5% mortality.⁵ Identification of cohorts likely to face persistent risk of death after MV operations may guide targeted monitoring and intervention to mitigate this postoperative hazard. Evolution of percutaneous technology with shifting patient risk profile also warrants ongoing characterization of this phenomenon.

Limitations of the study include the single-center setting, which potentially limits the generalizability, and the limited follow-up beyond 12 months. Assessment of the continuous change in the risk of death was limited by the relatively low event incidences.

FIGURE 1. One-year survival estimate after mitral valve (MV) repair and mitral valve replacement (MVR). Figure shows Kaplan-Meier survival estimate during the 2 years after mitral valve operations. The blue line and red values correspond to mitral valve repair, and the red line and red values correspond to mitral valve replacement. Changes in the monthly risk of death are displayed as percentage values, with stabilization after 90 days in mitral valve repair cohort, whereas risk continued to change during 2 years in the mitral valve replacement cohort.

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