



Minimally Invasive Approach for Mitral Valve Surgery is Associated with Increased Risk of Postoperative Diaphragm Dysfunction

Sameer K. Singh MD¹, Marco Tagliafierro MD¹, Darina Kirilina MS¹, Paul Kurlansky MD¹, Syed Tasnim Raza MD¹

¹Columbia University Irving Medical Center, New York, NY



INTRODUCTION

- Minimally invasive mitral valve surgery (MIMV) has grown in popularity due to reduced postoperative pain, length of stay, and improved cosmesis
- Diaphragm dysfunction (DD) after cardiac surgery is well described and associated with prolonged ventilation, pneumonia, and chronic shortness of breath
- The risk of DD after MIMV has not been studied
- Purpose of this study was to describe the incidence, risk factors, and postoperative outcomes associated with diaphragm dysfunction after MIMV

METHODS

- Patients at single institution who underwent isolated mitral valve surgery between July 2015 – June 2024 were included
- Patients grouped based on full sternotomy (FS) or MIMV approach via right lateral thoracotomy
- Postoperative diaphragm dysfunction diagnosed based on diaphragm elevation on radiograph and confirmed with ultrasound Sniff test
- Baseline characteristics, operative details, and postoperative outcomes collected and compared between groups
- Risk factors for diaphragm dysfunction assessed using logistic regression analysis
- Association of diaphragm dysfunction with respiratory specific postoperative outcomes using linear regression

RESULTS

- 1155 patients** (973 FS, 182 MIMV)
- Overall rate of DD = **3.0% (n = 35)**
 - 1.8%** after FS
 - 9.3%** after MIMV (all right sided DD)

Characteristic	Diaphragm Dysfunction (n = 35)	No Diaphragm Dysfunction (n = 1120)	p-value
Age	58.0 (51.0, 70.0)	64.0 (56.0, 73.0)	0.028
Gender			0.11
Female	23 (66%)	583 (52%)	
Male	12 (34%)	537 (48%)	
	Regression estimate	p-value	0.51
Age 30-50			0.6
Vent duration (hours)	-27(-92,38)	0.42	
ICU duration (hours)	-45(-154,64)	0.42	
Hospital LOS (days)	-1.9(-9.0,5.3)	0.61	0.59
Age 50-70			0.92
Vent duration (hours)	-10.5(-78.6,57.6)	0.76	0.51
ICU duration (hours)	-0.1(-71.5,71.3)	0.99	0.16
Hospital LOS (days)	0.6(-4.7,5.9)	0.82	
Age >70			
Vent duration (hours)	76.5(8.4,144.6)	0.03	
ICU duration (hours)	16.3(-77.7,110.3)	0.73	0.35
Hospital LOS (days)	7.4(1.2,13.7)	0.02	
Former Smoker	12 (34%)	317 (28%)	
Never Smoker	17 (49%)	677 (60%)	
Unknown	2 (5.7%)	44 (3.9%)	
Operative Approach			<0.001
Sternotomy	19 (54%)	954 (85%)	
Thoracotomy	16 (46%)	166 (15%)	
Tricuspid Valve Procedure			0.88
No	28 (80%)	884 (79%)	
Yes, planned	7 (20%)	236 (21%)	
Mitral Valve Procedure			0.18
Repair	14 (40%)	576 (51%)	
Replacement	21 (60%)	544 (49%)	
Previous Cardiac Intervention	16 (46%)	433 (39%)	0.4

Baseline characteristics compared between DD and no DD patients

Factor	OR	95%CI	p-value
Age	0.978	(0.95, 1.0)	0.09
BMI	1.03	(0.99, 1.08)	0.29
MIMV approach	5.1	(2.37, 11.0)	< 0.001
Hx lung disease	0.682	(0.30, 1.53)	0.35
Pneumonia (recent)	2.82	(0.61, 13.0)	0.18
Pneumonia (remote)	2.01	(0.44, 9.1)	0.37

MIMV approach independently associated with increased risk of postoperative DD

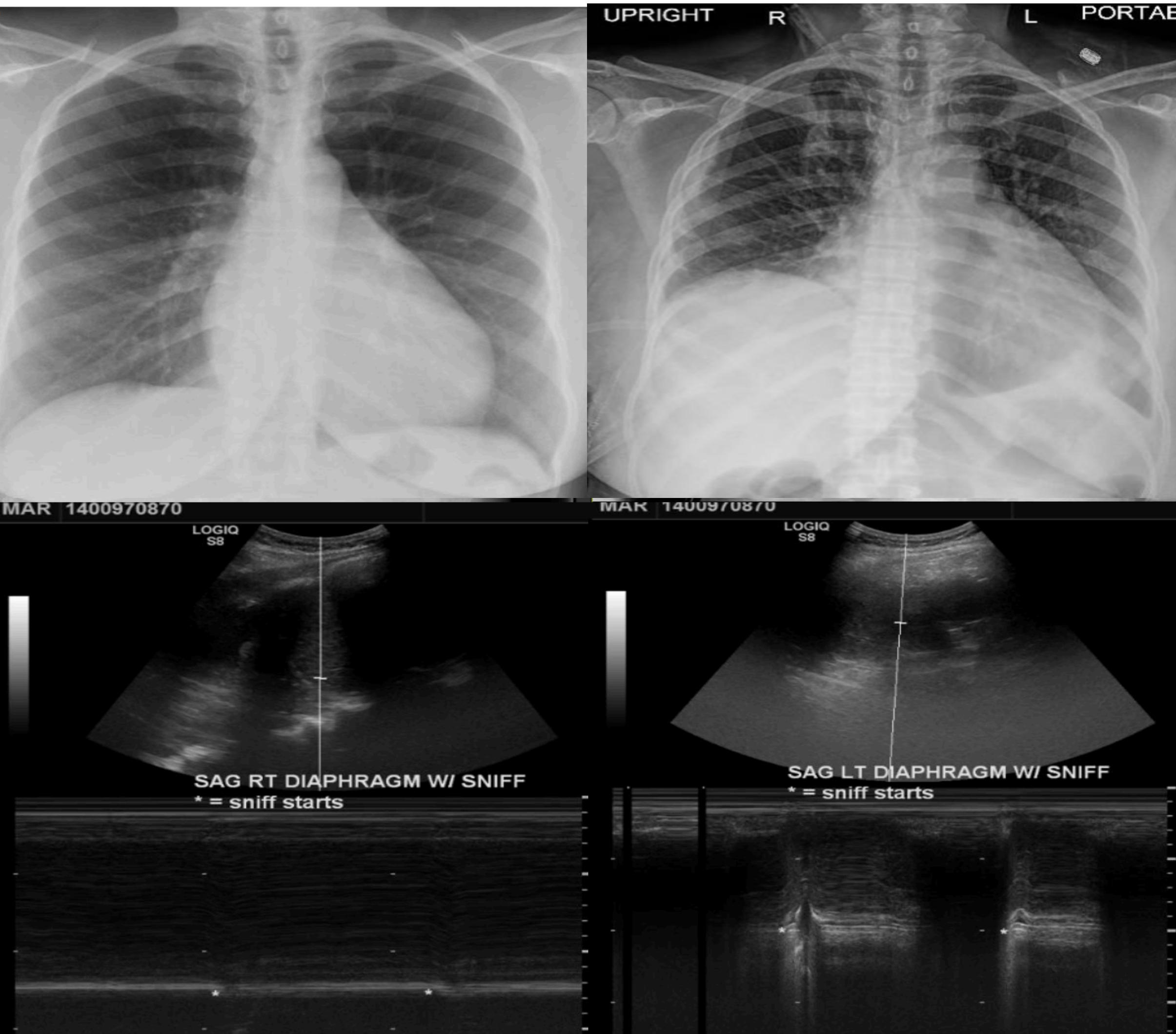
Characteristic	Diaphragm Dysfunction (n = 35)	No Diaphragm Dysfunction (n = 1120)	p-value
Initial ICU hours	54.5 (29.9, 121.5)	60.0 (30.0, 116.2)	0.96
Readmit to ICU	2 (5.7%)	36 (3.2%)	0.32
Hospital LOS	8 (5, 15)	7 (6, 11)	0.65
Reintubation	2 (5.7%)	43 (3.8%)	0.64
Total Vent hours	10.5 (5.0, 17.0)	9.0 (5.0, 17.3)	0.66
Renal failure	0 (0%)	41 (3.7%)	0.63
30-day mortality	0(0%)	19(1.7%)	>0.99

Among all patients, DD and no DD patients with similar postoperative outcomes

	Regression estimate	p-value
Age 30-50		
Vent duration (hours)	-27(-92,38)	0.42
ICU duration (hours)	-45(-154,64)	0.42
Hospital LOS (days)	-1.9(-9.0,5.3)	0.61
Age 50-70		
Vent duration (hours)	-10.5(-78.6,57.6)	0.76
ICU duration (hours)	-0.1(-71.5,71.3)	0.99
Hospital LOS (days)	0.6(-4.7,5.9)	0.82
Age >70		
Vent duration (hours)	76.5(8.4,144.6)	0.03
ICU duration (hours)	16.3(-77.7,110.3)	0.73
Hospital LOS (days)	7.4(1.2,13.7)	0.02

In patients >70 years old, DD associated with increased ventilation time and hospital LOS

POSTOPERATIVE DIAPHRAGM DYSFUNCTION



Top: Preoperative chest x-ray on left and postoperative chest x-ray on the right, demonstrating markedly elevated right diaphragm. **Bottom:** Ultrasound Sniff test demonstrating no movement of the right diaphragm and vigorous motion of the left diaphragm with sniffing.

CONCLUSIONS

- MIMV approach via right thoracotomy is associated with increased risk of postoperative DD, particularly right sided DD
- Postoperative DD after MV surgery is associated with increased ventilation time and hospital length of stay in patients >70 years old
- Further investigation required to understand etiology and mitigate this complication