

Long-Term Survival on Medical Therapy Alone after Blunt-Trauma Aortic Regurgitation:

Report of a New Case with Summary of 95 Others

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Aortic regurgitation resulting from blunt chest trauma has been reported only 95 times, to our knowledge. The noncoronary and right coronary cusps are the cardiac structures most often injured. Although the aortic leaflets can appear to be undamaged after nonpenetrating trauma, they can have pathologic abnormalities and insufficient function. Some cases of posttraumatic aortic regurgitation progress slowly. Aortic valve replacement is the optimal treatment. We present the case of a then-62-year-old man who has lived more than 5 years after blunt-trauma aortic regurgitation. His is the only case of long-term survival on medical therapy alone among the 96 cases summarized in this report. (Tex Heart Inst J 2016;43(5):446-52)

Key words: Aortic valve/ injuries/pathology; aortic valve insufficiency/diagnosis/etiology; thoracic injuries/complications; time factors; treatment outcome; wounds, nonpenetrating/ complications/pathology

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Traumatic aortic regurgitation (AR), an infrequently reported sequela of blunt chest trauma, is characterized by a history of such trauma, a normal-appearing heart during post-trauma examination, subsequent aortic insufficiency of sudden onset, and the exclusion of other causes of aortic incompetence.¹ Traumatic AR has typically been diagnosed early after chest trauma; however, 18% of the reported cases were diagnosed after one year because of slowly progressive degenerative patterns. The noncoronary cusp (NCC) and right coronary cusp (RCC) were injured in 73% of reported instances. Aortic valve replacement (AVR) has led to a good prognosis (mortality rate, 1%). Aortic valvuloplasty has yielded poorer results, and previous outcomes from medical therapy alone were uniformly fatal. We report the case of our medically treated AR patient, and we summarize the other published reports of blunt-trauma AR.

Case Report

In July 2011, a 62-year-old man, who had never had heart murmurs during annual medical checkups, was driving his car on the highway and sustained a chest bruise from a stone that crashed through his windshield. At a subsequent clinical visit, no abnormalities were detected. However, 6 months later, he had a grade 3/6 diastolic murmur, audible at the left sternal border. At our hospital, he reported no chest discomfort. Transesophageal echocardiograms revealed moderate AR caused by prolapse of the RCC (Fig. 1). The diagnosis was traumatic AR, on the basis of the following criteria¹: the patient's history of trauma, his normal-appearing heart upon recent physical examination, the sudden onset of aortic insufficiency, and our exclusion of other causes of aortic incompetence. Transthoracic echocardiograms showed that the patient's left ventricular systolic diameter was 37 mm; diastolic diameter, 56 mm; and ejection fraction, 0.63. Surgical treatment did not seem to be indicated, and we prescribed medical therapy (olmesartan 20 mg/d and enalapril 5 mg/d). During the last 2 years, the patient's clinical and echocardiographic status has gradually deteriorated (Table I). Although surgical treatment is indicated at the time of this report, he declines to undergo an operation.

Discussion

Nonpenetrating cardiac traumas can result in rapid death from cardiac tamponade. From 1955 through 2015, 95 cases of AR after blunt trauma were described (Table

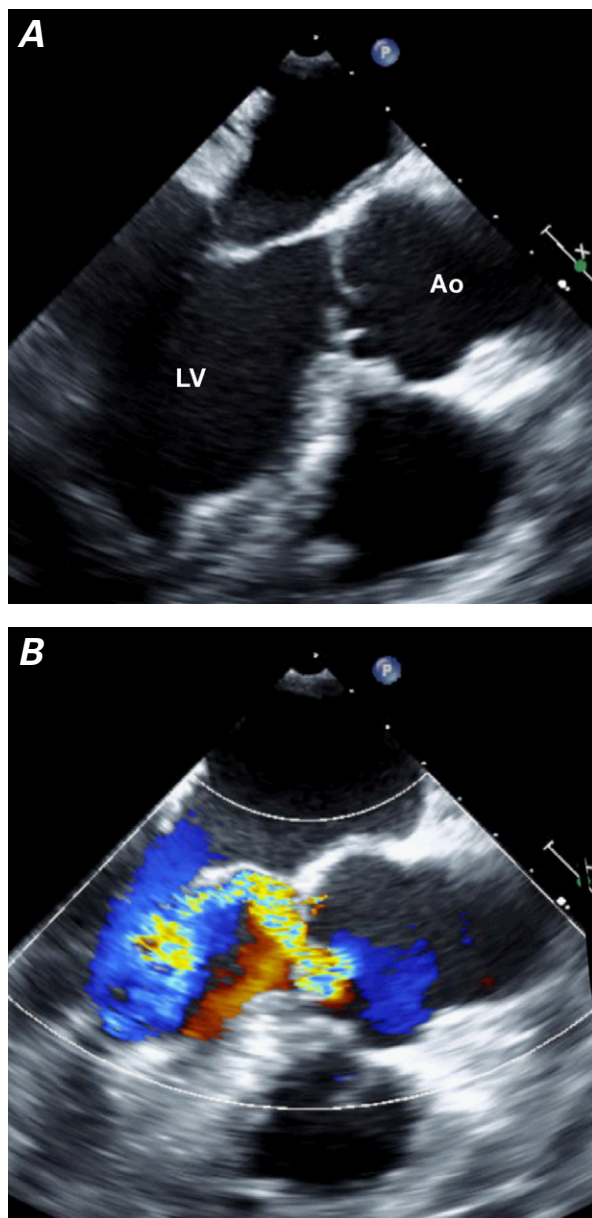


Fig. 1 Transesophageal echocardiograms. **A)** Midesophageal long-axis view (135° rotation) shows a flail right coronary cusp. **B)** Color-flow Doppler mode reveals the resultant moderate aortic regurgitation.

Ao = aorta; LV = left ventricle

II). Counting our patient, traumatic AR has been diagnosed in 85 men and 11 women (age range, 5–83 yr; median, 44 yr). The causes were automobile accidents in 49 instances, motorcycle accidents in 18, falls in 12, falling objects in 6, sports injuries in 4, and other causes in 7. The time from the index incident to the diagnosis of traumatic AR ranged from immediately to 10 years or longer: 34 cases were diagnosed within 3 days,²⁻³⁴ 20 within 1 month,^{1,35-54} 12 within 3 months,^{45,55-64} 5 within 6 months,^{1,65-68} 4 within 1 year,^{32,69-71} 2 within 2 years,^{72,73} 2 within 3 years,^{74,75} 5 in over 5 years,^{65,76-78} and 12 after

TABLE I. Progression of Traumatic Aortic Regurgitation in Our Patient

Variable	Years after Blunt Trauma			
	3	3.5	4	4.5
Systolic blood pressure (mmHg)	116	142	125	128
Diastolic blood pressure (mmHg)	75	81	67	46
NYHA functional class	II	II	II	III
Brain natriuretic peptide (pg/mL)	40	46	49	11
Cardiothoracic ratio (%)	45	49	49	49
LV end-systolic diameter (mm)	37	43	44	45
LV end-diastolic diameter (mm)	56	61	62	62
LV ejection fraction	0.63	0.57	0.58	0.50
Aortic regurgitation grade	Moderate–severe	Severe	Severe	Severe

LV = left ventricular; NYHA = New York Heart Association

an unspecified duration.⁷⁹⁻⁸⁸ Early diagnoses (within 3 d) were 35% of the total; in the other patients, AR apparently progressed slowly.

Table III shows which cardiac structures were injured. Chief among these were the NCC and the RCC (in 71 of 96 instances). The left coronary cusp—injured far less often—might be protected by its coronary arteries, which perfuse a large area and might serve as buffers against high hydrostatic pressures.

We summarize the treatment outcomes of the 96 patients, in Table IV. Of 70 patients who underwent AVR, 62 had a good outcome, and only 1 patient died (mortality rate, 1%). The other 7 outcomes were unspecified. Aortic valvuloplasty yielded good outcomes in 13 of 20 patients, new-onset AR murmurs in 4, and 2 deaths. In stark contrast, of the 6 patients who were prescribed medical therapy alone, only our patient survived—now longer than 5 years.

On macroscopic examination, the aortic leaflets can appear to be undamaged when instead they are pathologically abnormal,¹⁸ and this can cause valvular insufficiency. German and colleagues¹³ reported up to an 80% recurrence of aortic insufficiency after valvuloplasty and recommended AVR for treating traumatic AR. Some authors^{31,32,78} have reported good results after valvuloplasty, but the long-term outcomes in those cases are unknown.

Our patient's experience and our review of the earlier cases indicate that AR from blunt trauma can gradually worsen. Therefore, patients thus affected should be

TABLE II. Summary of the 96 Reported Cases of Traumatic Aortic Regurgitation

Reference	Age (yr), Sex	Cause of Trauma	Injured Structure	Treatment	Outcome
Leonard JJ, et al. ³⁵ (1955)	17, M	Kicked by horse	NA	Hufnagel valve	Good
McCormack LJ and Proudfit WL ³⁶ (1956)	45, M	Car accident	LCC	Medical	Died
Ramage JH and Morgan JB ⁷⁹ (1957)	34, M	Falling object	RCC	Medical	Died
Dimond EG, et al. ⁷⁶ (1957)	32, M	Falling object	NA	Hufnagel valve	Died
Spurny OM and Hara M ⁸⁰ (1961)	62, M	Falling object	LCC	AVP	Died
Levine RJ, et al. ³⁷ (1962)	35, M	Falling object	LCC	AVP	Died
Dubourg G, et al. ⁸¹ (1963)	56, M	Fall	NCC	AVP	Good
Beall AC Jr and Shirkey AL ⁷² (1964)	39, F	Car accident	LCC + NCC	AVP	Reoperation
Dauphin G and Dauphin M ⁸² (1965)	62, M	Car accident	NCC	Medical	Died
Gregersen H and Nielsen K ⁸³ (1965)	48, M	Motorcycle accident	LCC	Medical	Died
Miti L, et al. ⁸⁴ (1966)	65, M	Car accident	LCC	Medical	Died
Najafi H, et al. ¹ (1968)	62, M	Car accident	LCC	AVR	Good
	53, M	Shoveling snow	All cusps	AVR	Good
Lutes CA and Givertz B ² (1970)	32, M	Car accident	NCC	AVR	Good
Hecquet JP, et al. ⁶⁹ (1971)	40, M	Train accident	NCC + RCC	AVR	Good
Loop FD, et al. ³ (1971)	19, M	Car accident	LCC	AVR	Good
Jausseran JM, et al. ⁴ (1972)	67, M	Car accident	RCC	AVR	Good
Irving JB ⁷³ (1974)	44, M	Car accident	LCC	AVR	Good
Merchant F, et al. ³⁸ (1974)	45, M	Struck edge of door	LCC + NCC	AVR	Good
Ohashi H, et al. ⁵⁵ (1974)	26, M	Motorcycle accident	NCC + RCC	AVR	Good
Payne DD, et al. ⁶⁵ (1974)	53, F	Car accident	NCC	AVR	Good
	66, F	Car accident	NCC + RCC	AVR	Good
Massachusetts General Hospital ³⁹ (1976)	15, M	Sports injury	NCC + RCC	AVR	NA
Kimbler RW, et al. ⁵ (1977)	73, F	Car accident	NCC	AVR	Good
Chi S, et al. ⁴⁰ (1977)	21, M	Motorcycle accident	NCC + RCC	AVR	Good
McIlduff JB and Foster ED ⁶ (1978)	43, M	Car accident	LCC + NCC	AVR	Good
Shimizu Y, et al. ⁸⁵ (1978)	24, M	Car accident	LCC	AVP	Murmur
	61, M	Fall	RCC	AVR	Good
Gotoh N, et al. ⁸⁶ (1979)	54, M	Fall	NCC + RCC	AVR	Good
Morritt GN, et al. ⁷ (1979)	19, M	Car accident	All cusps	AVR	Good
Onishi S, et al. ⁵⁶ (1982)	38, M	Car accident	NCC	AVP	Murmur
Gay JA, et al. ⁷⁰ (1983)	27, M	Fall	LCC	AVR	Good
Devineni R and McKenzie FN ⁸ (1984)	30, M	Sports injury	LCC	AVR	Good
Grande AM, et al. ⁵⁷ (1985)	50, M	Car accident	NCC	AVP	Good
Schwaitzberg SD and Khalil KG ⁹ (1985)	20, M	Motorcycle accident	NCC	AVR	Good
	21, M	Struck tractor-trailer	LCC + RCC	AVR	Good
DiMarco RF, et al. ¹⁰ (1986)	71, M	Car accident	All cusps	AVR	Good
Rumisek JD, et al. ¹¹ (1986)	56, M	Car accident	Bioprosthesis	AVR	NA
Passik CS, et al. ¹² (1987)	74, F	Heimlich maneuver	NCC	AVR	NA
Grimball A, et al. ⁴¹ (1987)	69, M	Car accident	NCC	AVR	Good
Okamoto K, et al. ⁸⁷ (1989)	47, M	Car accident	NCC + RCC	AVR	Good
Ovil Y, et al. ⁴² (1990)	23, M	Motorcycle accident	RCC	AVP	Good
German DS, et al. ¹³ (1990)	34, M	Car accident	NCC	AVR	Good
Nishimura H, et al. ⁵⁸ (1991)	65, M	Fall	NCC	AVR	Good
Toda S, et al. ¹⁴ (1991)	17, M	Motorcycle accident	NCC + RCC	AVR	Good
Kanno M, et al. ⁵⁹ (1992)	18, M	Motorcycle accident	NCC + RCC	AVR	Good
Murray EG, et al. ⁷⁴ (1993)	34, M	Car accident	LCC + RCC	AVP	Good
Kasuya S, et al. ⁴⁵ (1993)	70, M	Motorcycle accident	RCC	AVR	Good
Reiland-Smith J, et al. ⁴³ (1993)	83, M	Car accident	NA	AVR	Good

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TABLE II Continued. Summary of the 96 Reported Cases of Traumatic Aortic Regurgitation

Reference	Age (yr), Sex	Cause of Trauma	Injured Structure	Treatment	Outcome
Prêtre R and Faidutti B ⁴⁴ (1993)	37, M	Car accident	NCC	AVP	Good
Tokizawa N, et al. ⁶⁰ (1994)	65, F	Car accident	BAV	AVR	Good
Habre WN, et al. ⁴⁶ (1994)	37, M	Car accident	NCC	AVP	Good
Shigemitsu O, et al. ⁷⁵ (1995)	71, M	Car accident	RCC	AVR	Good
Iriyama T, et al. ¹⁵ (1995)	19, M	Motorcycle accident	NCC	AVR	Good
Miralles A, et al. ⁶⁶ (1995)	65, M	Fall	NCC + RCC	AVR	Good
Takaki Y, et al. ¹⁶ (1996)	59, M	Falling object	NCC + RCC	AVR	Good
Kohno M, et al. ¹⁷ (1996)	55, M	Car accident	NCC + RCC	AVR	Good
Imamaki M, et al. ⁶¹ (1996)	63, M	Car accident	NCC + RCC	AVR	Good
Paone RF, et al. ⁸⁸ (1996)	18, M	Car accident	LCC	AVR	Good
Ashida Y, et al. ¹⁹ (1997)	70, M	Car accident	NCC	AVR	Good
Oda H, et al. ⁶² (1997)	67, M	Fall	RCC	AVR	Good
Egoh Y, et al. ¹⁸ (1997)	16, M	Motorcycle accident	NCC	AVR	Good
Parry GW and Wilkinson GA ⁶³ (1997)	34, M	Sports injury	NCC	AVR	Good
	42, M	Car accident	NCC	AVR	Good
Yamazaki Y, et al. ⁴⁷ (1998)	48, F	Car accident	NCC	AVR	Good
	57, M	Fall	RCC	AVR	Good
Rambaud G, et al. ²⁰ (1999)	73, M	Car accident	RCC	AVR	Good
Sandrelli L, et al. ⁴⁸ (2000)	65, F	Car accident	NCC + RCC	AVP	Good
Meunier JP, et al. ²¹ (2001)	16, F	Car accident	NCC	AVP	Good
Fujimoto K, et al. ²² (2002)	27, M	Motorcycle accident	BAV	AVR	NA
Ishiyama T, et al. ⁶⁴ (2003)	53, M	Motorcycle accident	NCC	AVR	Good
Silva R, et al. ⁷⁷ (2004)	18, M	Motorcycle accident	NCC	AVP	Murmur
Bernabeu E, et al. ²³ (2004)	25, M	Car accident	NCC	AVR	Good
Onorati F, et al. ²⁴ (2004)	30, M	Car accident	LCC	AVR	Good
Camarasa P, et al. ⁴⁹ (2004)	16, F	Car accident	NCC	AVP	Good
Yuasa T, et al. ⁷¹ (2005)	61, M	Fall	NCC	AVR	Good
Siegenthaler MP, et al. ²⁵ (2005)	19, F	Car accident	NCC	AVP	Murmur
Anselmino M, et al. ²⁶ (2006)	60, M	Car accident	BAV	AVR	NA
Chu MW and Myers ML ²⁷ (2006)	19, M	Car accident	NCC	AVR	Good
Matteucci ML, et al. ²⁸ (2006)	33, M	Motorcycle accident	RCC	AVR	Good
Hyodo M, et al. ⁶⁷ (2007)	70, M	Motorcycle accident	NA	AVR	Good
Taguchi S, et al. ⁵⁰ (2007)	56, M	Car accident	LCC	AVR	Good
Turk T, et al. ⁵¹ (2007)	21, M	Fall	RCC	AVR	Good
Aoyagi S, et al. ⁵² (2007)	79, M	Car accident	NCC	AVR	Good
Kaljusto ML, et al. ²⁹ (2008)	32, M	Motorcycle accident	NCC	AVR	Good
Theron JP, et al. ⁶⁸ (2009)	39, M	Assault	RCC	AVR	Good
Li W, et al. ³⁰ (2011)	55, M	Fall	LCC	AVR	Good
Jayle CP, et al. ³¹ (2011)	74, M	Car accident	LCC	AVP	Good
Kin H, et al. ³² (2011)	20, M	Car accident	RCC	AVP	Good
	50, M	Fall	RCC	AVP	Good
Cuttone F, et al. ³³ (2012)	31, M	Car accident	NCC	AVR	Good
Okuma S, et al. ⁵³ (2013)	62, M	Sports injury	LCC + RCC	AVR	Good
Mori A, et al. ⁷⁸ (2013)	26, M	Motorcycle accident	NCC	AVP	Good
Kim S, et al. ³⁴ (2014)	70, M	Car accident	NCC	AVR	Good
Maini R, et al. ⁵⁴ (2015)	22, M	Motorcycle accident	LCC	AVR	Good
Current case	62, M	Falling object	RCC	Medical	Good

AVP = aortic valvuloplasty; AVR = aortic valve replacement; BAV = bicuspid aortic valve; F = female; LCC = left coronary cusp; M = male; NCC = noncoronary cusp; NA = not available; RCC = right coronary cusp

TABLE III. Cardiac Injuries in the 96 Patients Who Had Traumatic Aortic Regurgitation

Injured Structure	No. (%)
NCC	33 (34)
LCC	17 (18)
RCC	15 (16)
NCC and RCC	14 (15)
LCC and NCC	3 (3)
LCC and RCC	3 (3)
All 3 cusps	3 (3)
Bicuspid aortic valve	3 (3)
Bioprosthesis	1 (1)
Unspecified	4 (4)

LCC = left coronary cusp; NCC = noncoronary cusp; RCC = right coronary cusp

TABLE IV. Treatment Outcomes in the 96 Patients Who Had Traumatic Aortic Regurgitation

Outcome	AVR (n=70)	AVP (n=20)	Medical Therapy (n=6)
Good prognosis	62	13	1
New-onset murmur	0	4	0
Reoperation	0	1	0
Death	1	2	5
Unknown	7	0	0

AVP = aortic valvuloplasty; AVR = aortic valve replacement

carefully monitored, and AVR instead of repair should be the treatment of choice.

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