Fuzzy Logic-Based Model to Stratify Cardiac Surgery Risk

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Supplementary Material

Table 1. List of fuzzy variables, categories and definitions selected by the "clinical expert" to predict operative mortality.

Variables	Categories		Definitions	Observations
Gender	Female	0	Self-defined	Female gender is associated with worse surgical results
	Male	0.01		
Age	Old	1	>75 years	Age is associated with different surgical risk
	Senior	0.1	Between 65 and 75 years	
	Young	0	<65 years	
Valued age	Older	0.1	Seems to be older than the chronological age	Apparent age could be associated to better or worse prognosis
	Same age	0.02	Seems to have the chronological age	
	Younger	0	Seems younger than the chronological age	
Body Types	Obese	0.2	Seems to have>20% the ideal weight	Body constitution is associated with technical difficulty during surgery
	Endomorph	0.1	Classically defined body types	
	Mesomorph	0.02		
	Ectomorph	0		
Body surface	Small	1	Approximately below 1.8m²	Patients with smaller surfaces have higher surgical risk (aortic surgery)
	Large	0.02	Approximately above 2.1m²	
	Standard	0	Between the above ones	
General aspect	Bad	1	Patient with neglected appearance	
	Regular	0.2	Patient with regular appearance	
	Good	0	Patient with impeccable appearance	
General condition	Critical	1	Ventilated or in shock	
	Unstable	0.1	Hemodynamically unstable or unstable angina	
	Stable	0	Excludes the above conditions	
Time of surgery	Emergency	1	Within the first 24 hours	The moment of surgery has been associated with surgical mortality in many risk scores
	Urgency	0.2	During hospitalization	
	Programmed	0	Self-defined	
Psychology	Depressive	1	Self-defined	There is consensus on the importance of the psyche in postoperative recovery.
	Excited	1		
	Alert	0.01		
	Fearful	0.01		
	Normal	0		
Wish to undergo surgery	Forced	0.1	Does not wish to undergo surgery	The disposition or wish to undergo surgery is a previous condition in clinical practice and could be associated to the outcome.
	Indifferent	0.02	Does not express any wish	
	Voluntary	0	Wishes to undergo surgery	
Family context	Bad	0.1	Unfavorable	The weight of trust in the procedure and in those who perform it.
	Regular	0.02		
	Good	0	Favorable	
Socio-economic level	Low	0.01	Classically defined	Access to healthcare varies according to the socioeconomic level.
	Average	0		
	Middle-High	0		
History of diabetes	Poorly managed	1	Poorly controlled	Not only diabetes but its management along time define the general condition and quality of coronary vessels
	Long standing	0.1	Well controlled but long standing	
	Well treated	0.02	Presence of diabetes	
	None	0	Self-defined	

(continue)

Variables	Categories		Definitions	Observations
Other comorbidities	Severe	1	CRF, CHF, neurologic, hematologic	Comorbidities can increase surgical risk
	Mild	0.1	COPD	
	None	0	Self-defined	
Antiaplatelet therapy	Recent use of IIb/IIIa	0.1	Administered until 5-10 days previously	Aspirin or clopidogrel use are associated to
	Aspirin	0	Is presently taking or has taken aspirin until	higher rate of postoperative bleeding
			previous week	
	Aspirin interruption	0	Interrupted aspirin more than one week ago	
Combined surgery	Mitral	1	CABG+ mitral valve replacement or repair	Combination surgery poses greater risk
	Aortic	0.1	CABG + aortic valve replacement	than single coronary artery surgery
	None	0	Self-defined	
Reoperation	Patent mammary	1	Presence of patent mammary	Not only redo surgery implies greater risk,
	Prior valve surgery	0.5	Prior mitral, aortic or congenital surgery	but presence of a patent mammary vein or
	Prior coronary surgery	0.2	Prior CABG	cardiomegaly increases the risk of technical
	None	0	Self-defined	complications.
History of angioplasty	Left main CA	0.2	Left main coronary artery percutaneous coro-	Presence of one or more previous percuta-
			nary intervention	neous coronary intervention may be associ-
	Yes	0.02	Prior percutaneous coronary intervention (ex-	ated to worse coronary beds or LV function
	None	0	cept main CA)	impairment
			Self-defined	
Coronary vessel quality	Poor	1	Self-defined	Coronary vessel quality is specially related to
	Moderate	0.1		long-term outcomes
	Good	0		
Anterior descending	Absent	1	Self-defined	The left anterior descending bed is intimate-
bed	Poor	1		ly associated with immediate and long-term
	Present	0		coronary artery surgery outcomes
Coronary lesions	Left main + RCA	0.3	Left main and right coronary artery lesion	Location of coronary artery lesions
	Left main	0.2	Left main coronary lesion with intact right	
			coronary artery	
	2-3 vesssels	0.1	Two- or 3-vessel disease	
	1 vessel	0.02	One-vessel lesion (generally LDA)	
	None	0	Non-coronarypatient	
Left ventricular function	Severe	1	Self-defined	LV function is considered in almost all risk
	Moderate	0.1		scores
	Normal	0		
Valve surgery	Aortic regurgitation	0.2	Self-defined	Valve surgery, whether or not alone, is asso-
	Mitral surgery	0.1		ciated with greater surgical risk. The quality
	Aortic stenosis	0.1		of the ascending aorta in aortic regurgita-
	None	0		tion may impair the replacement technique

Note: The values assigned to each characteristic correspond to the final weight and calibration in the test set.
RCA: Right coronary artery. CABG: Coronary artery bypass graft surgery. LDA: Left descending artery. COPD: Chronic obstructive pulmonary disease.
CHF: Chronic heart failure. CRF: Chronic renal failure. LV: Left ventricular.

Fig. 1. Fuzzy cognitive map diagram used to predict mortality with preoperative fuzzy variables
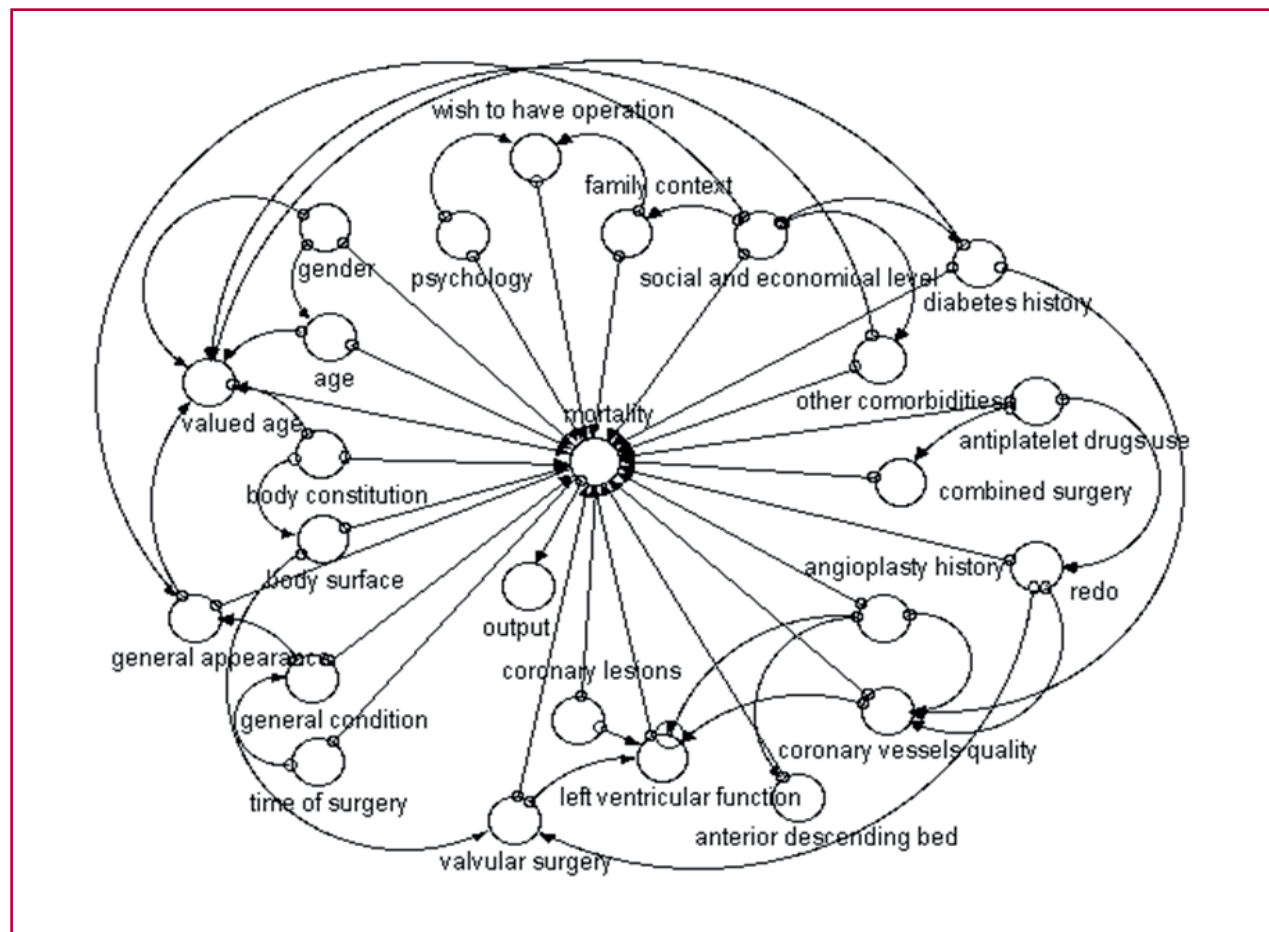
Values between nodes represent the weight (strength of connection) assigned to each relationship based on the tables of influence.