

Statistical analysis of predictors of myocardial infarction and delirium after total hip replacement in patients over 60 years

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Relevance and Significance

According to the WHO, in 2000 the number of patients with hip fracture comprised 1,672,000 throughout the world, including 311,000 in the USA and 620,000 in Europe.

The overall mortality during hospitalization^{1,2} 4% – 5% and within one year after fracture^{1,3} 12.7% – 33%.

[1] Aharonoff G.B., Koval K.J. Skovron M. L. et. al. “Hip Fractures in the Elderly: Predictors of One Year Mortality Issue”. Volume 11(3), April 1997, pp 162-165.

[2] Khalid Alzahrani, Rajiv Gandhi, Aileen Davis, Nizar Mahomed “In-hospital mortality following hip fracture care in southern Ontario”. Can J Surg. 2010 October; 53(5): 294–298

[3] Jiang HX, Majumdar SR, Dick DA, et. al. “Development and initial validation of a risk score for predicting in-hospital and 1-year mortality in patients with hip fractures”. J Bone Miner Res. 2005 Mar; 20(3):494-500. Epub 2004 Nov 29.

Myocardial infarction: prevailing cause of early in-hospital death

Within 30 days after operation the incidence of MI comprised from¹ 0.4% to² 2.2%.

The median time to MI was 1 day¹:

83% events occurred within 3 days,

93% occurred within 14 days after the operation.

[1] Carlos B. M., T. T. Horlocker, D. R. Schroeder, et. al. "Frequency of Myocardial Infarction, Pulmonary Embolism, Deep Venous Thrombosis, and Death following Primary Hip or Knee Arthroplasty". *Anesthesiology* 2002; 96:1140–6.

[2] I. Matot, A. Oppenheim-Eden, R. Ratot, et. al. "Preoperative Cardiac Events in Elderly Patients with Hip Fracture Randomized to Epidural or Conventional Analgesia". *Anesthesiology* 2003; 156–63.

Delirium: the most common complication after hip fracture

Incidence of delirium in older adults undergoing surgery for hip fracture ranged from¹ 16% to 62% with an average rate of 35%.

Patients with POCD at hospital discharge were more likely to die in the first three months after surgery².

[1] Bitsch M, Foss N, Kristensen B, Kehlet H “Pathogenesis of and management strategies for postoperative delirium after hip fracture”. A review. Acta Orthop Scand 2004; 75:378–89.

[2] Terri G. Monk, B. Craig Weldon, Cyndi W. Garvan, et.al. “Predictors of Cognitive Dysfunction after Major Noncardiac Surgery” .Anesthesiology 2008; 108:18–30.

DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

Characteristics	NO. OF PATIENTS	%
Age		
60-69	75	28
70-79	132	49.3
80-89	59	22
90 and over	2	0.7
Gender		
Males	30	11.2
Females	238	88.8
Concomitant diseases		
Diabetes	27	10.1
Angina I-II class	56	20.9
Hypertension	173	64.6
Heart failure NYHA class I or II	152	56.7
Asthma	10	3.7
Duodenal and gastric ulcer	23	8.6
History of stroke	12	4.5
Urinary infections	35	13.1

DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

Characteristics	NO. OF PATIENTS	%
Score according to Eagle index		
0	47	17.5
I	93	34.7
II	74	27.6
III	48	17.9
IV	6	2.2
Score according to ASA		
II	23	8.6
III	218	81.3
IV	25	9.3

POSTOPERATIVE OUTCOMES

Outcome	No.	%
Death	14	5.2
MI	12	4.5
Myocardial ischemia	9	3.4
D&CD	37	13.8
PE, fat (inter- and post-)	10	3.7
Gastrointestinal hemorrhage	7	2.6
Diarrhea	7	2.6
Interoperative hypotension followed by vasopressors administration	53	19.8
Urinary infections	26	9.7
Stroke	5	1.9

Myocardial infarction: predictors

- health status according to Eagle index,
- anesthesia type,
- Hg level after operation (day 2),
- transfusion

Predictors: health status (Eagle index)

	Health status (Eagle index), points					Total
	0	I	II	III	IV	
Myocardial infarction, n	0	1	3	6	2	12
No myocardial infarction, n	47	92	71	42	4	256

Health status has statistically significant influence on the incidence of MI ($p < 0.001$, Kendall correlation coefficient = 0.196).

Predictors: type of anesthesia

Anesthesia type	Myocardial infarction	
	yes	no
general	1	109
regional	11	147
Total	12	156

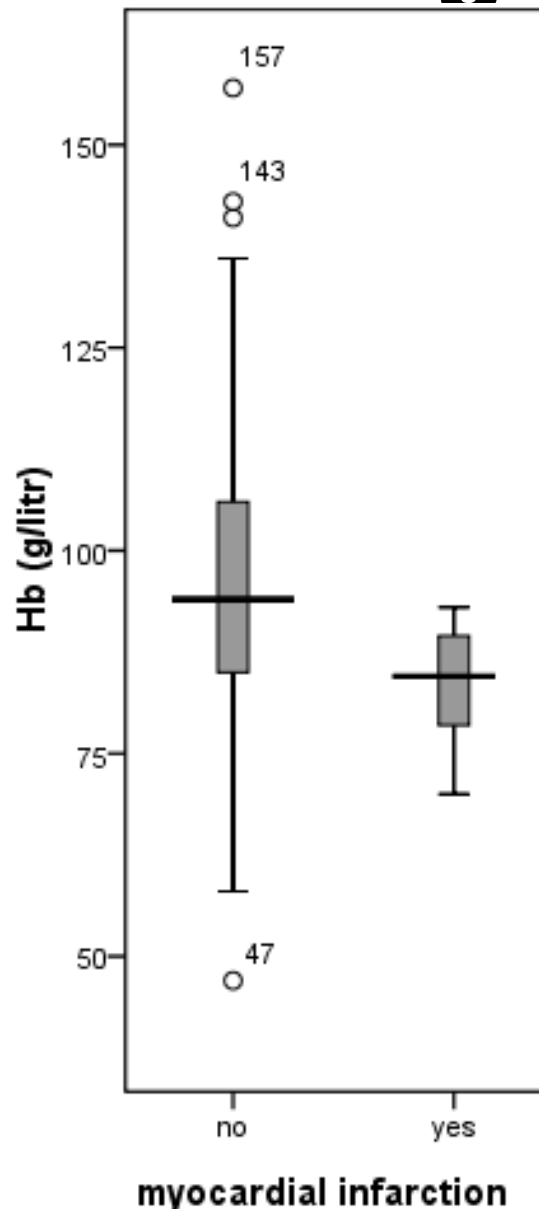
Health status (Eagle index), scores	Anesthesia type	
	general	regional
0	26	21
1	40	53
2	26	38
3	16	32
4	2	4
Total	110	158

Predictors: type of anesthesia

Anesthesia type		Health status (Eagle index), scores					Total
		0	I	II	III	IV	
General	Myocardial infarction	0	0	1	0	0	1
	No Myocardial infarction	26	40	25	16	2	109
Regional	Myocardial infarction	0	1	2	7	1	11
	No Myocardial infarction	21	52	46	25	3	147

For MI and anesthesia type with excluded influence of health status, partial coefficient correlation of Kendall made up 0.137 ($p=0.026$).

Predictors: postoperative level of hemoglobin and transfusion



Postoperative level of hemoglobin:

- group with MI 83 ± 2.2 (95% CI = 78 – 88)
- group without MI 96 ± 1 (95% CI = 94 – 98).

Logistic regression equation

$P = \exp(z)/(1+\exp(z))$, where

P – probability of MI,

z – fictitious variable calculated with formula

$$\begin{aligned} z = & 8.557 - 0.065 * \text{Hg} + \\ & + 0 * [\text{Transfusion} = \text{Present}] - 2.034 * [\text{Transfusion} = \text{Absent}] + \\ & - 22,414 * [\text{Eagle} = 0] - 6.441 * [\text{Eagle} = 1] - 4.8 * [\text{Eagle} = 2] - \\ & - 3.35 * [\text{Eagle} = 3] + 0 * [\text{Eagle} = 4] - \\ & + 0 * [\text{Anesthesia} = \text{Regional}] - 3.459 * [\text{Anesthesia} = \text{General}]. \end{aligned}$$

Distribution of patients due to Hg level

Group No.	Postop. Hg, g/L	Patients No.	Transfusion strategy		
			Liberal	Restrictive	Absent
I	< 90	104	34	37	33
II	90 - 110	112	27	17	68
III	> 110	45	18	0	27

The frequency of transfusions for each group was the following: I – 68.3%, II – 40%, III – 40%.

Incidence of D&CD in groups with different transfusion strategies

Group No.	Patients No.	Patients No with D&CD due to transfusion strategy			p-value
		Liberal	Restrictive	Absent	
I	104	10 (29.4%)	9 (24.3%)	4 (12.1%)	0.219
II	112	0	6 (35.3%)	7 (10.3%)	0.002
III	45	0	0	1 (3.7%)	0.414

Using liberal strategy, the frequency of delirium was significantly lower than in restrictive or absent transfusion.

Conclusion

- High score according to Eagle index was a considerable predictor of MI.
- Postoperative Hg level was an important predictor of MI and D&CD.
- A transfusion trigger preventing the development of acute psychotic dysfunction in elderly patients with hip fracture after hip replacement was hemoglobin level of 100 g/L.
- Liberal blood transfusion strategy improved the results in the examined patients.

Publications [in Russian]

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Менщикова О.А., Кузьмин В.В., Солодушкин С.И. Факторы, влияющие на частоту развития инфаркта миокарда у пациентов пожилого и старческого возраста при эндопротезировании тазобедренного сустава// **Российский нейрохирургический журнал им. проф. А.Л. Поленова**, Т. 4, спец. выпуск, 2012, С. 36-37.