RISK FACTORS FOR POST-OPERATIVE COMPLICATIONS IN SIXTY DIABETIC PATIENTS

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ABSTRACT

Sixty diabetic patients undergoing surgery over a 1 year period were included in this study. After a thorough history and physical examination, Biochemical evaluation and ECG (with assessment of heart rate variability) was done in all patients. Intra-operatively capillary blood glucose estimation was done hourly and post operatively, plasma glucose estimation was done for two days and thereafter on 3-4 occasions over the next 7 days. Regimen I was used for those patients who were well controlled on OHA, Regimen II for those poorly controlled on OHA or insulin and Regimen III in those who were well controlled on insulin. All the patients were followed up for a period of 10 days for evidence of delayed wound healing, wound infection, urinary tract infection, cardiovascular morbidity and mortality. Post-operative insulin requirement was also noted.

There were 18 (30%) patients in the age group of 25-50, 36 (60%) in the age group of 51-75 years and 6 (10%) above 76 years. Diabetes was detected on routine pre-operative testing in 14 (23.33%) of them. Duration of diabetes was <5 years in 22 (36.66%), 5-10 years in 14 (23.33%) and in 10 (16.66%) patients, the duration was >10 years. Lower limb disease (35%) constituted majority of cases. This was followed by genitourinary (25%) and abdominal surgery (15%). Nearly a half of them were operated for diabetes related complications (46.66%). Target organ damage was found in a total of 54 (90%) patients and hypertension was found in 66% of patients. Mortality rate was 8.3% (5/60). Hyperglycemia and mortality was higher in Regimen II than in other regimens ($P<0.05$). There was no correlation between mortality and blood glucose levels; however morbidity increased with blood glucose levels >200mg/dl. There was no significant correlation between duration of diabetes and complications. There was significant correlation between target organ damage and post-operative complications. All the patients who died had multiple target organ damage and four of them died due to diabetes related complications. All of these had cardiac autonomic neuropathy.

KEY WORDS: Type 2 diabetes; Surgery; Mortality; Morbidity; Target organ damage; Glycemia.

INTRODUCTION

It is postulated that 50% of the patients with diabetes mellitus would require surgery at some point in their lives (1). It is reported that mortality is 1.5 times higher in diabetics undergoing surgery than in non-diabetics (2). Several studies have suggested that diabetes itself may not be an independent risk factor for predicting morbidity and mortality and that pre-existing cardiac, renal vascular and neurological abnormalities are responsible for surgical complications (3). Mackenzie et al (4) have suggested that infection, renal insufficiency and cerebral ischemic events were more likely in diabetes with pre-operative end organ damage. In diabetes without underlying nephropathy, neuropathy or retinopathy complications are rare. Several authors (1-12) have published data regarding management of a surgical diabetic patient, but there is paucity of Indian literature on this topic. Hence a study was undertaken to study the modes of glycemic control and post-operative complications in 60 diabetic patients undergoing surgery and to identify the risk factors for complications.

MATERIALS AND METHODS

Sixty diabetic patients undergoing surgery in Kasturba Medical College Hospital during the year 1998-00 were included. After a thorough history and physical examination, the following investigations were done in all patients viz.: hemoglobin, complete blood picture, erythrocyte sedimentation rate (ESR), blood urea, serum creatinine, serum electrolytes, serum cholesterol, fasting and 2-hour post prandial plasma glucose, urine microscopy, albumin, ketones and sugar, an electrocardiogram with calculation of heart rate variability. Echocardiography, chest X-ray and ultrasound abdomen were done wherever necessary.

Intra-operatively capillary blood glucose estimation was done hourly and post operatively, plasma glucose estimation was done for two days and thereafter on 3-4 occasions over the next 7 days. Urine examination was repeated after 48 hours of surgery. Glycemic control

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was achieved by using one of the following regimens.

Regimen-I: Diabetics who were well controlled on oral hypoglycemic agents (OHA) were asked to skip the previous night and morning dose of OHA on the day of the surgery and started on 5% dextrose infusion on the day of surgery and insulin was administered if they had hyperglycemia >200mg/dl. They were restarted on OHA the next day if plasma glucose was <200/dl.

Regimen-II: In those diabetics on OHA who were poorly controlled or were already on insulin prior to surgery, the morning dose of insulin was omitted and the patient was infused dextrose in the morning. They were restarted on insulin on the evening of the surgery and the usual dose of insulin was restarted from the next day.

Regimen-III: These patients were well-controlled on regular insulin and on the morning of the surgery they were started on dextrose 5% or 10% with 10 units of regular insulin and 10Meq of potassium which was infused over 4-6 hours. Intra-operative blood glucose was estimated and additional insulin units were added if hyperglycemia exceeded 250mg/dl.

All the patients were followed up for a period of 10 days for evidence of delayed wound healing, wound infection, urinary tract infection, cardiovascular morbidity and mortality. Post-operative insulin requirement was also noted.

RESULTS

Sixty diabetic patients underwent surgery over a period of one year of which 14 (23.33%) were newly diagnosed. There were 18 (30%) patients in the age group of 25-50, 36 (60%) in the age group of 51-75 years and 6 (10%) above 76 years. Diabetes was detected on routine pre-operative testing in 14 (23.33%) of them. Duration of diabetes was <5 years in 22 (36.66%), 5-10 years in 14 (23.33%) and in 10 (16.66%) patients, the duration was >10 years. Table 1 shows the indication for surgery in 60 patients. Lower limb disease constituted majority of cases. Nearly a half of them were operated for diabetes related complications (46.66%). Target organ damage was found in a total of 54 (90%) patients and hypertension was found in 66% of patients. Table-2 shows the target organ damage seen in our patients.

Table-3 shows mean blood sugar values in three different regimens and percentage rise of blood sugar intra-operatively. Table-4 shows complications seen in patients during or after surgery. There was no correlation between intra-operative blood glucose and intra-operative complications except for cardiac complications. Table 5 shows correlation of complication to duration of diabetes. There was no significant correlation between duration of diabetes and complications. Table 6 shows complication rates in various regimens. Hyperglycemia and mortality was higher in Regimen II than in other regimens (P<0.05).

Table 1: Type of Surgery Undertaken in 60 Diabetic Patients (%)

Surgery	n (%)
1: Lower limb surgery	21 (35)
a) Ulcer slough excision, I & D fasciotomy	9 (15)
b) Amputation toes	6 (10)
c) Amputation leg	5 (8.33)
d) Fracture reduction	1 (1.66)
2: Genitourinary surgeries (TURP, hydroelectomy, penitectomy, cystolithopraxy, nephrectomy, hysterectomy, oopherectomy)	15 (25)
3: Abdominal surgery	9 (15)
a Herniorrhapy	6 (8.33)
b Perianal abscess	2 (3.33)
c Pancreatojejunostomy	1 (1.66)
4: Abdomino – perineal resection	1 (1.66)
5: Head and neck surgery	2 (3.33)
6: Scalp abscess drainage	1 (1.66)
7: Maxillectomy	1 (1.66)
8: Thoracic surgery	3 (5)
9: Breast surgery	2 (3.33)
10: Ophthalmic surgery	5 (8.33)
a) Cataract	4 (6.66)
b) Visceration	1 (1.66)
TOTAL	**60 (100)**

Table-2: Target Organ Damage and Related Conditions

Target Organ Damage	N (%)
Retinopathy	25 (41.66)
Nephropathy	45 (75)
Neuropathy	32 (50.33)
Peripheral vascular disease	24 (40)
Myocardial ischemia or infarction	7 (11.66)
Hypertension	4 (6.66)
Cardiac autonomic neuropathy	34 (56.66)

There was no correlation between mortality and blood glucose levels; however morbidity increased with blood glucose levels >200mg/dl. Table 6 shows correlation between target organ damage and post-operative complications. There was significant correlation between target organ damage and post-operative complications. All the patients who died had multiple target organ damage and four of them died due to diabetes related complications. All of these had cardiac autonomic neuropathy. Table-7 shows cause of death, details of target organ damage, type of glycemic control and type of surgery. Table-8 shows insulin requirement which had decreased on the day of surgery and on the post operative day.

Table 3: Mean Blood Glucose Values ± SD and Percent Rise in Groups on Three Different Insulin Regimens

Regimen	Pre-operative Glucose (Mean ± SD)	Intra-operative Glucose (Mean ± SD)	Post-operative Glucose (Mean ± SD)	% Rise
I	129.2 ± 8.86	167.1 ± 15.11	137.5 ± 11.07	29.3
II	187.6 ± 3.46	212.4 ± 14.5	205.5 ±16.12	13.21
III	170.6 ± 17.6	175.4 ± 8.21	195.4±33.29	2.81

P value for regimen I and II <0.05 (0.039), P value for regimen II and III and I and III >0.05

Table 4: Correlation between Blood Glucose Values and Peri-operative Complications.

Blood Glucose	Cardiac	Hyper-glycemia	Hypo-glycemia	Delayed Wound Healing	Sepsis	UTI	Mortality
<200mg/dl (n=39)	2 (5.1)	6 (15.3)	4 (10.2)	14 (35.9)	8 (20.5)	2 (5.1)	3 (7.7)
>200mg/dl (n=21)	3 (14.2)	12 (57.1)	4 (19.05)	6 (28.5)	5 (23.6)	2 (9.5)	2 (9.5)
P. Value	>0.05	>0.05	P>0.05	>0.05	>0.05	>0.05	

Table 5: Correlation between Duration of Diabetes and Peri-operative Complications

	< 5 years (n=36)	>5 years (n=24)
Hyperglycemia	5 (16.12%)	3 (10.3%)
Hypoglycemia	8 (25.8%)	9 (31%)
Cardiac complications	3 (9.6%)	2 (6.8%)
Delayed wound healing	7 (22.5%)	13 (44.8%)
Infection	5 (16.12%)	8 (27.5%)
Urinary tract infection	4 (12.9%)	1 (3.4%)
Mortality	4 (12.9%)	1 (3.4%)

P>0.05 for all parameters by t Test

Table 6: Complication Rates in Various Regimens

Complication	Regimen-I (n=15)	Regimen-II (n=35)	Regimen-III (n=10)	P value
Hypoglycemia	1 (6%)	5 (14.28%)	2 (20%)	0.89
Hyperglycemia	2 (13.3%)	14 (40%)	1 (10%)	0.27
Hypotension	-	2 (5.7%)	-	0.054
Arrhythmia	-	1 (2.8%)	-	0.051
Cardiac failure	-	1 (2.8%)	-	0.57
Myocardial infarction	-	1 (2.8%)		0.057
Wound infection	1 (6%)	8 (22.8%)	4 (40%)	0.06
Delayed healing	4 (26.6%)	13 (37.1%)	4 (40%)	0.055
Urinary tract infection	1 (6%)	4 (11.42%)	-	0.052
Mortality	-	5 (14.82)		0.046

Table 7: Clinical Details of 5 Patients who Expired.

Age/Sex	60/M	60/M	40/M	66/F	80/F
Duration of diabetes	4 yrs	4 yrs	1yr	7yrs	10yrs
Indication for surgery	Foot ulcer	Lung malignancy	Gangrene	Carcinoma colon	Ulcer foot
Target surgery	Slough Excision	Pneumon-ectomy	Amputation	AP Resection	Amputation
Anesthesia	GA	GA	GA	GA	GA
Target organ damage					
PVD	+	-	+	+	+
Cardiac autonomic neuropathy	+	+	+	+	+
IHD	-	-	-	+	+
Peripheral neuropathy	+	-	+	-	-
Nephropathy	+	+	+	+	+
Retinopathy	-	+	-	+	+
Pre-operative blood glucose	102	188	86	290	98
Intra-operative blood glucose	-	329	89	370	163
Post-operative blood glucose	149	195	94	-	136
Regimen	II	II	II	II	II
Complication	MI	VT/VF	Renal failure	Intra-operative hemorrhage	Stump infection sepsis

Table 8: Insulin Requirement during the Day of Surgery and 48 Hours after that.

Regimen	Day of Surgery	1 Post-operative Day	2 Post-operative Day
Regimen II	Half the dose	Half the dose	Usual dose
Regimen III	Half the dose	Neutralizing dose For IV fluids / half the dose	Usual dose

DISCUSSION

Diabetes is frequently first discovered during the need for surgical services of general hospitals as seen in 23.3% of our patients. This confirms the value of routine blood glucose estimation before surgery. Gallowy and Shuman (5) had made similar observations in a series of 667 patients. Majority of our diabetic surgical patients were elderly and above

50 years (70%) of age as observed by earlier studies (5). This explains the very high rate of target organ damage in them. Hypertension prevalence was very low in our series. Diabetes related problems were responsible for the surgery in nearly half of these patients, thus indicating that diabetic population is likely to have surgery more often than non-diabetics. Lower limb disease was the commonest cause of surgery as also seen in previous studies (5). Nephropathy, as evidenced by microalbuminuria was the commonest target organ damage, followed by cardiac autonomic neuropathy. Those with cardiac autonomic neuropathy were twice at risk of developing complications than those without (66% versus 33%) and all the five patients who died had cardiac autonomic neuropathy as evidenced by poor heart rate variability on deep breathing. Poor heart rate variability is a risk factor for peri-operative morbidity and mortality. Peripheral vascular disease and peripheral neuropathy correlated with delayed wound healing and post-operative infections.

Although there was no statistically significant difference in the intra-operative blood glucose values in patients on 3 different schedules of anti-diabetic treatment, there was significant rise in blood glucose from pre-operative to intra-operative period ($p<0.05$) in regimen I and II. However, intra-operative hyperglycemia did not have any bearing on the intra-operative or post-operative complications.

Cardiac complications and death occurred only in patients on regimen II. Regimen I or III are equally effective in preventing serious complications. However, controlled trials using larger number of patients are warranted to prove the point. More number of patients developed intra-operative hyperglycemia in regimen-II compared to regimen I and III (40% as against 13.3% and 10%). This may be directly responsible for the higher complication rate although hyperglycemia alone was not associated with high complication rate. All the five patients who died, had three or more target organ damage and all had cardiac autonomic neuropathy. There was no association between the type of surgery and mortality. Even a simple surgery like slough excision was associated with mortality. The three patients who had cardiac death did not have evidence of overt ischemic heart disease, indicating that diabetics can have silent coronary artery disease/ cardiac autonomic neuropathy which may predispose the patient to the risk of acute myocardial infarction, arrhythmia or sudden death. As 3 patients who died, had peripheral vascular disease, we can presume that they could have had occult CAD. Similar observations are made by Hjortrup et al and Mackenje et al (3, 4).

Insulin requirement decreased on the day of the surgery in both regimen II and III and also on the next day in regimen III. This is contrary to other studies (5), where insulin requirement increased post-operatively. This is probably because of the high carbohydrate (rice) diet deprivation in the immediate post-operative period in Indian patients.

In conclusion, long duration of diabetes, peripheral neuropathy and peripheral vascular disease correlated with delayed wound healing and infection. Cardiac autonomic neuropathy, increase in target organ damage, peripheral vascular disease and use of regimen-II for glycemic control, correlated with life threatening complications.Regimen-I and Regimen-III were found to be equally effective in achieving glycemic control or preventing major complications. Hence, it is not necessary to change over to insulin pre-operatively if glycemic control is good. Several studies have also proved this point. However controlled trials are warranted to prove this point.

The study was done on a heterogeneous group of diabetics with variable duration of diabetes, target organ damage who underwent different types of surgery. Further studies are warranted in a controlled group undergoing the same type of surgery.

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