CHAPTER 5

RESULT

5.1 Baseline Characteristics

Between January 1993 to December 1998 , 109 chronic renal failure patients were treated by CAPD in Nephrology unit, Medical Department, Bhumibol Adulyadej Hospital, Bangkok, Thailand. Among these, 7 patients were found not to meet all the criteria (2 patients were SLE , one patient performed kidney transplantation and 4 patients performed chronic hemodialysis). The remainder 102 patients were included in the analysis. Base line characteristics of the patients are showed in table 5.1 . The patients were well balance in both age group. Fifty patients were middle age (< 60 years), and 52 cases were aging ($\geq$60 years). The mean age was 57. 3 years. 40 patients (39.2%) were diabetic. The majority of the patients used the Baxter standard (single - bag system). The common education level of the patients was primary school. The common cause of chronic renal failure was chronic tubulointerstitial disease. The mean duration of CAPD in this study was 650 days , with the range 61 - 1935 days.

Table 5.2. shows the laboratory investigation of the patient. All of them were collected at 2 months after dialysis. The mean level of Hb was 9.3 gm/dl (4.2 - 14.6). The mean level of BUN was 41.9 mg/dl (13 - 116), and serum albumin was 3.1 gm/dl (1.5 - 4.5). Education was divided into two groups in the analysis, low education level (0-6 years), and high education level ($\geq$ 7 years). Rare cases were in the level of no education , so the division into four groups led to losing the power of analysis. By the same reason, type of bag and system was also divided into single - bag system, and double - bag system.

Table 5.1. Base-Line Characteristics of CAPD patients

Characteristics	N = 102
Male	53
Female	49
Age mean (SD)	57.3 (12.5)
< 60 years (middle age)	50
$\geq$ 60 years (aging)	52
Educational levels (case, %)	
0 (no education)	2 (2%)
1-6 (primary school)	48 (47%)
7-12 (high school)	30 (29.4%)
>12 (more)	22 (21.6%)
Causes of CRF (case, %)	
Chronic glomerulonephritis	7 (6.9%)
Chronic tubulointerstitial	50 (49%)
Unknown	45 (44.1%)
DM (case, %)	40 (39.2)
No DM	62 (60.8)
Type of bags and system (case, %)	
Baxter standard system (single-bag system)	71 (69.6%)
Baxter ultra-bag system (twin-bag system)	19 (18.6%)
Fresinius safety lock (single-bag system)	10 (9.8%)
Fresinius ANDY plus (twin-bag system)	2 (2%)
Duration of CAPD (day, mean ,SD)	650 (449)
range (day)	61-1935
median (day)	519

Table 5.2. Laboratory investigation in CAPD patients

Laboratory investigation	minimum	maximum	mean	SD
Hemoglobin (Hb, gm/dl)	4.2	14.6	9.3	2.1
Blood urea nitrogen (BUN, mg/dl)	13	116	41.7	16.5
Albumin (Alb, gm/dl)	1.5	4.5	3.1	0.6

Table 5.3. Outcome of CAPD patients in the study

Catheter infection (47 episodes in 29 cases, 28.4%)	
episode (mean, SD)	0.46 (0.9)
range	0-5
median	0
Peritonitis (157 episodes in 70 cases, 68.6%)	
episode (mean, SD)	1.54 (1.75)
range	0 - 9
median	1
Causes of death (N = 27, 26.5%)	
peritonitis induced sepsis (case, %)	8 (7.8%)
Other	17 (16.7%)

5.2 Clinical Patterns and Long-term Outcomes

The outcome of CAPD is described in table 5.3. During the study, there were 47 episodes of catheter infection in 29 patients (28.4%). The frequency varied from 0 -5 episodes, with the average of 0.46 episodes per patients. Peritonitis occurred 157 episodes in 70 cases (68.6%) , with the average rate of

1.54 episodes per year per person. The range of peritonitis varied from 0 to 9 episodes per case. The average of time to first peritonitis episode was 283.05 days. Overall mortality was 26.5 % (27 cases). Death from peritonitis was 7.8% (8 cases), and form other causes 16.7% (17 cases).

Catheter infection occurred 47 episodes in 29 cases (28.4%) , with the average rate of 0.46 episodes per year per person. The range of infection varied from 0 to 5 episodes per case.

The description of microbiology of catheter infection is showed in table 5.4 S. aureus and coagulase negative staphylococcus were common organisms in catheter infection . Twenty four episodes (51.1%) of catheter infection caused by S. aureus. 54 catheters were removed for the reasons listed in table 5.5 . Infection was the most common causes of removal. The mean survival of the catheter was 1430 days. The other common causes of catheter removal were changing to hemodialysis, or kidney transplantation.

Table 5.4. Organisms of Catheter infection

Catheter infection	episode (N= 47)	case (N=29)
S. aureus	24 (51.1 %)	17 (58.7 %)
Coagulase negative Staphylococcus	2 (4.3 %)	2 (6.9 %)
E.coli	1 (2.1%)	1 (3.4 %)
Pseudomonas.sp	1 (2.1 %)	1 (3.4 %)
Serratia.sp	1 (2.1 %)	1 (3.4 %)
Streptococcus	1 (2.1 %)	1 (3.4 %)
No growth	17 (36.2 %)	6 (20.8 %)

Table 5.5 . The Reasons in Removing the Catheters

Reason	Number (54)	Percent of all lost catheters	Percent of all patients (52.9%)
Uncontrolled peritonitis	12	22.2 %	11.8%
Frequent peritonitis	1	1.9 %	1 %
Death from peritonitis	8	14.8%	7.8%
Death from other causes	18	33.3%	17.7%
Other	15	27.8%	14.7%

Table 5.6. Organisms of peritonitis

Peritonitis	Episode	Case
S. aureus	2 (1.3 %)	2 (2.8 %)
Coagulase negative staphylococcus	6 (3.8 %)	6 (8.5 %)
E.coli	2 (1.3 %)	2 (2.8 %)
Pseudomonas.sp	7 (4.5 %)	5 (7.1 %)
Klebsiella.sp	6 (3.8 %)	5 (7.1 %)
Serratia.sp	1 (0.6 %)	1 (1.4 %)
Bacillus.sp	2 (1.3 %)	2 (2.8 %)
Enterobacter	2 (1.3 %)	2 (2.8 %)
Acenetobacter	1 (0.6 %)	1 (1.4 %)
No growth	128 (81.5 %)	45 (63.5%)

The organisms which caused peritonitis are listed in Table 5.6. Only 18.5% of all episodes of peritonitis were culture positive. Pseudomonas species were

found to be the most common causes of peritonitis (7 episodes, 4.5%). The incidence of peritonitis from coagulase negative Staphylococcus was the same as Klebsiella sp. (6 episodes, 3.8%). Peritonitis from S. aureus was less common (2 episodes, 1.3%).

5.3 Analysis for the Diabetic Patients

40 patients (39.2%) were diabetic. The baseline characteristics of diabetic patients are compared to non diabetic cases in table 5.7. The two groups were very well balanced in term of base-line characteristics except age, and mortality rate from peritonitis. The mean age in diabetic patients was 59.9 years, significantly higher than in non diabetic group (mean age 54.2 years, P= 0.04). Infection and causes of death are showed in table 5.8. The rate of peritonitis in diabetic group seemed to higher , but not statistically different from non diabetic group. The rate of catheter infection in diabetic patients was not different from non diabetic group. The mortality rate from peritonitis in diabetic group, (40%), was significantly higher than non diabetic (17.7%, P= 0.02).

5.4 Analysis for the Aging Patients

There were 50 patients in middle age group, (mean age = 45.4 years), and 52 patients in aging group,(mean age = 67.02 years). The two groups were very well balanced in term of base-line characteristics (table 5.9). The outcome of CAPD in aging are showed in table 5.10. The mortality of aging seemed to higher than middle age (32.6% Vs 20%), but was not statistically significant.

Table 5.7. Base line characteristics, in diabetic and non diabetic patients

Characteristics	DM (N=40)	No DM (N=62)	P value
Sex Male	20	33	
Female	20	29	NS *
Age mean (SD)	59.9 (9.2)	54.2 (16.6)	0.04 **
Educational level			
0 - 6 (low education)	20	29	
≥ 7 (high education)	18	33	NS *
Causes of CRF			
Chronic glomerulonephritis	0	7	
Chronic tubulointerstitial	1	6	
Diabetic Nephropathy	39	0	
Miscellaneous	0	5	
Unknown	45	0	
Type of bags and system			
Baxter standard system	29	42	
Baxter ultra-bag system	6	13	
Fresinius safety lock	4	6	
Fresinius ANDY plus	1	1	
Duration of CAPD (day, mean, SD)	585.6 (403.8)	691.5 (475.8)	NS **
Hemoglobin level (gm/dl, mean, SD)	9.5 (1.9)	9.1 (2.3)	NS **
BUN (mg/dl, mean, SD)	40 (20.7)	41.7 (13.4)	NS **
Albumin level (gm/dl, mean, SD)	3.04 (0.7)	3.36 (0.6)	NS

* Chi-Square Test,   * * Independent-Sample T-Test

Table 5.8. Infection and cause of death in diabetic

Characteristics	DM (40)	No DM (62)	P value
Peritonitis (case)	29	41	NS *
episode	74	83	
Rate of peritonitis (mean, SD)	1.20 (1.15)	0.86 (0.97)	NS ***
range	0 - 4.68	0 - 3.72	
median	1.02	0.61	
Peritonitis from S.aureus (case)	1	1	
Catheter infection (47 episodes, 29 cases)			
mean (SD)	0.3 (0.6)	0.56 (1.05)	NS ***
range	0 - 3	0 - 5	
median	0	0	
Cath. infection (case)	10	19	NS *
episode	12	35	
Catheter infection from S.aureus (case)	1	1	
Cause of death (case, %)	16 (40%)	11 (17.7%)	.02 *
peritonitis induced sepsis	6 (15%)	2 (3.2%)	
Other	10 (25%)	9 (14.5%)	

* Chi-Square Test,   *** Mann-Whitney Test

Table 5.9. Base line characteristics, in aging and middle age groups.

Characteristics	Age < 60 (N=50)	Age ≥ 60 (N=52)	P value
Sex Male	26	27	
Female	24	25	NS *
Educational level			
0 -6 (low education)	24	25	
≥ 7 (high education)	24	27	NS *
Causes of CRF			
Chronic glomerulonephritis	5	2	
Chronic tubulointerstitial	2	3	
Diabetic Nephropathy	17	23	
Miscellaneous	3	2	
Unknown	23	22	
Type of bags and system			
Baxter standard system	37	34	
Baxter ultra-bag system	10	9	
Fresinius safety lock	3	7	
Fresinius ANDY plus	0	2	
DM	17	23	
No DM	33	29	NS *
Duration of CAPD (mean, SD)	688.12 (457.2)	613.38 (444.2)	NS **
Hb (gm/dl, mean, SD)	9.1 (2.3)	9.3 (2.0)	NS **
BUN (mg/dl, mean, SD)	43.1 (15.4)	39.1 (17.4)	NS **
Alb (gm/dl, mean, SD)	3.21 (0.6)	3.14 (0.7)	NS **

* Chi-Square Test,   * * Independent-Sample T-Test

Table 5.10. Infection and cause of death in aging

Characteristics	Age<60 (N=50)	Age≥60 (N=52)	P value
Cath.infection (47 episodes, 29 cases)			
mean (SD)	0.54 (1.05)	0.38 (0.75)	NS ***
range	0 - 5	0 - 3	
median	0	0	
Cath. infection (case)	15	14	NS *
episode	27	20	
Cath. infection from S. aureus (case)	10	7	NS *
Peritonitis			
no peritonitis (case)	18	14	
peritonitis (case)	32	38	NS *
episode	68	89	
rate of peritonitis (mean, SD)	0.84 (0.9)	1.15 (1.1)	NS ***
range	0 - 3.44	0 - 4.67	
median	0.43	0.89	
peritonitis from S.aureus	1	1	
Cause of death (case, %)	10 (20%)	17 (32.6%)	NS *
peritonitis induced sepsis	3 (6%)	5 (9.6%)	
Other	7 (14%)	12 (23%)	

* Chi-Square Test,   *** Mann-Whitney Test

Table 5.11. Base line characteristics, in S.aureus infection

Characteristics	No S. aureus (N =83)	S. aureus (N=19)	P value
Sex Male : Female	46 : 37	7 : 12	NS *
Age mean (SD)	57.2 (14.7)	52.7 (12.9)	NS **
Aging (case)	44	8	NS *
DM (case)	34	6	NS *
Educational level			
0 - 6 (low education)	37	13	
≥ 7 (high education)	46	6	NS *
Causes of CRF			
Chronic glomerulonephritis	5	2	
Chronic tubulointerstitial	4	1	
Diabetic Nephropathy	33	7	
Miscellaneous	5	0	
Unknown	36	9	
Type of bags and system			
Baxter standard system	56	15	
Baxter ultra-bag system	16	3	
Fresinius safety lock	9	1	
Fresinius ANDY plus	2	0	
Hb (gm/dl, mean, SD)	9.2 (2.2)	9.4 (1.9)	NS **
BUN (mg/dl, mean, SD)	41.7 (16.9)	38.1 (14.8)	NS **
Alb (gm/dl, mean, SD)	3.1 (0.7)	3.5 (0.4)	0.01 **
Duration of CAPD (mean, SD)	561.06 (391.5)	1038.63 (491.6)	.001 **

* Chi-Square Test,   * * Independent-Sample T-Test

5.5 Analysis for the Staphylococcus infected patients

S. aureus infections occurred 24 episodes (51.1%) of catheter infection in 17 patients, and 2 episodes (2.8%) of peritonitis in 2 patients. The base line characteristics of S. aureus infection and non S. aureus group are showed in table 5.11. The characteristics between two groups were different in serum albumin and duration of CAPD. Albumin level in S. aureus infected patients was higher (3.5 Vs 3.1 gm/dl, P = 0.01). The duration of S. aureus infected patients was longer (1038 Vs 561 days, P= 0.001).

Table 5.12. Infection and cause of death in S.aureus infection.

Characteristics	No S. aureus (N =83)	S. aureus (N=19)	P value
Peritonitis (case)	53	17	NS *
no peritonitis (case)	30	2	
episode	106	51	
rate of peritonitis (mean, SD)	0.96 (1.1)	1.16 (0.86)	NS ***
range	0 - 4.67	0 - 2.93	
median	0.72	1.14	
Catheter infection (case, %)	12 (14.45%)	17 (89.47%)	.001
episode	17	30	NS
mean (SD)	0.20 (0.58)	1.58 (1.22)	.001 ***
range	0 - 3	0 - 5	
median	0	1	
Cause of death (case, %)	23 (27.6%)	4 (21.1%)	NS *
peritonitis induced sepsis	7 (8.4%)	1 (5.3%)	
Other	16 (19.2%)	3 (15.8%)	

* Chi-Square Test, *** Mann-Whitney Test

The outcome of S. aureus infection are showed in table 5.12. S. aureus was the most common organisms in catheter infection (51%) ,so the rate of catheter infection in S. aureus group was higher. There was no S. aureus catheter infection before the peritonitis . One episode of catheter infection was MRSA (methicillin resistance S. aureus) . This case was cured by treatment with oral cloxacillin and fucidic acid cream locally. The mortality in S. aureus infection group was non statistically lower than the remainder group.
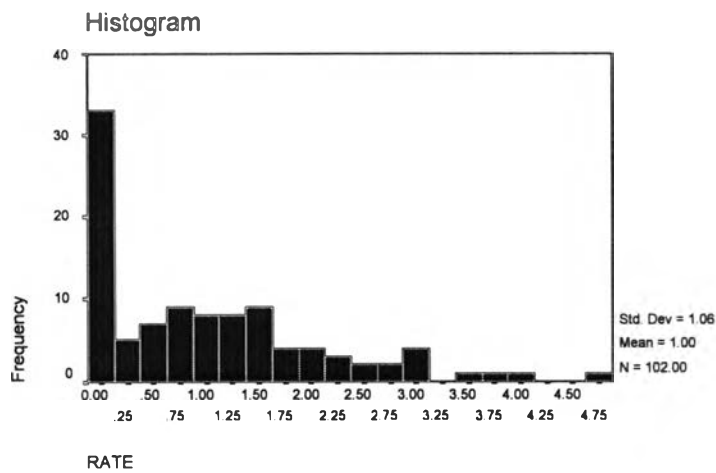
Figure 5.1 Distribution of rate of peritonitis

Histogram

Std. Dev = 1.06
Mean = 1.00
N = 102.00

RATE

Table 5.13 Test distribution of rate by One-Sample Kolmogorov-Smirnov Test

		Rate
N		102
Normal Parameters	Mean	1.000275
	Std. Deviation	1.059387
Most Extreme	Absolute	.173
Differences	Positive	.151
	Negative	-.173
Kolmogorov-Smirnov Z		1.743
Asym. Sig. (2-tailed)		.005

5.6 Factors which affect the rate or risk of Peritonitis

The distribution of rate of peritonitis is showed in Figure 5.1. Test distribution by Kolmogorov-Smirnov Test (table 5.13) shows that this is not normal distribution. By Logistic Regression Analysis (table 5.14), BUN level, duration, and education are found to affect risk of the peritonitis ($P<0.05$).

Table 5.14 . Logistic regression Analysis: Factors affected to Peritonitis

Backward Technique , Dependent variable = peritonitis (Yes or No)

Variable = age, education, type of bags and system, present of catheter infection,

DM, BUN, Alb, Hb, duration

-2 Log Likelihood   97.262

Goodness of Fit   117.943

Cox & Snell - R^2   .207

Nagelkerke - R^2   .295

Variable	B	S.E.	Wald	df	Sig	R
BUN	- 0.362	0.0169	4.5661	1	0.0326	- 0.146
Duration	0.0015	0.0007	4.9679	1	0.0258	0.1570
Education	- 1.2966	0.5397	5.7718	1	0.0163	- 0.1770
Constant	2.6031	0.9527	7.4712	1	0.0063	

		95% CI for	Exp (B)
Variable	Exp. (B)	Lower	Upper
BUN	0.9645	0.9330	0.9970
Duration	1.0015	1.0002	1.0028
Education	0.2735	0.0950	0.7876

Causes was not analyzed in the Logistic Regression Analysis, because there was a high number of missing data (45 cases). In clinical practice, the kidney biopsy did not necessary to perform in all cases .

5.7 Factors Association To Time to first peritonitis episode

Multiple Regression Analysis was used in analysis the patients who developed peritonitis, BUN level (P value 0.017) ,Hb level (P value .027), and duration of CAPD (P=0.000), are found to associate with the time to first peritonitis episode (table 5.15). By Pearson Correlation (table 5.16) , duration (correlation = 0.638, P value 0.000), Hb level (correlation = 0.367, P value 0.001), albumin level (correlation = 0.356, P value 0.002) and BUN (correlation = 0.341 P value 0.003), are the factors that significantly correlate to time to first peritonitis episode. The other factor that has some correlation (correlation > 0.1) is the presence of catheter infection.

5.8 Survival Analysis

Aging, DM, and S. aureus infection do not effect the technique survival (table 5.17) . Survival analysis ,(Kaplan-Meier, Log Rank Test), are showed in figure 5.2 - 5.4. The survival in diabetic patients is statistically less than non diabetic cases (P value 0.0056). The survival in aging group is not different from middle age group (P value 0.1272). Table 5.18 shows the survival of S. aureus infection . The survival of S. aureus patients is not different from no infection (P value 0.6317). In contrast, the survival in S. aureus infected group is statistically higher than other infected group (P=.0236).

Table 5.15. Multiple regression for Analysis Factors associated to Time to First Episode of Peritonitis

Stepwise Technique

Dependent variable = Time to first episode of peritonitis

Variable = age, education, type of bags and system, present of catheter infection, DM, BUN, Alb, Hb, duration

Model	R	R Square	Ad.R. Sq.	SE of Est.	R. Square change	df 1	df2	Sig. F change
3	.700	.490	.465	174.48	.044	1	60	.027

	Unstandard Coeff.		Standard Coeff.			95% CI for Bound	
Model	B	SE	Beta	t	Sig.	Lower B.	Upper B.
Duration	.277	.054	.515	5.12	.000	.169	.386
BUN	3.812	1.547	.236	2.46	.017	.718	6.907
Hb	24.976	11.012	.222	2.26	.027	2.948	47.003

Table 5.16 Pearson Correlation of the Variables to Time to First Episode Peritonitis

VARIABLE	TIME FIRST	Sig. (1-tailed)
TIME FIRST	1.00	
Duration	0.638	0.000
HB	0.367	0.001
ALB	0.356	0.002
BUN	0.341	0.003

VARIABLE	TIME FIRST	Sig. (1-tailed)
Type of bag-system	0.216	0.043
Catheter infection	0.154	0.112
DM	-0.029	0.409
Education	-0.006	0.481
Age	-0.084	0.255

Table 5.17. Technique Survival (Kaplan-Meier, Log Rank Test)

Event = Off catheter from peritonitis , uncontrolled peritonitis , frequent peritonitis

	N	Censored	Events	Survival time	SE	Stat	df	Sig
Staph. infection	19	15	4	1656	127			
Other infection	58	41	17	1065	76	3.7	1	.0546
Staph. infection	19	15	4	1656	127			
No infection	25	25	0			.3718	1	.3718
Age ≥ 60	52	42	10	1403	122			
Age < 60	50	39	11	1424	122	.00	1	.9780
DM	40	31	9	1096	86			
No DM	62	50	12	1500	105	.87	1	.3509

Table 5.18. Survival Analysis (Kaplan - Meier, Log Rank Test)

Event = Death from any causes

	N	Censored	Events	Survival time	SE	Stat	df	Sig
Staph. infection	19	15	4	1599	139			
No infection	25	23	2	1273	150	.23	1	.63

Figure 5.2. Survival analysis: : Aging and middle age group
(Kaplan-Meier, Log Rank Test)

Event = Death from any causes

|	N	Censored	Events	Survival time	SE	Stat	df	Sig
Middle Age	50	40	10	1467	123			
Aging	52	35	17	1130	112	2.33	1	.13

Survival Functions
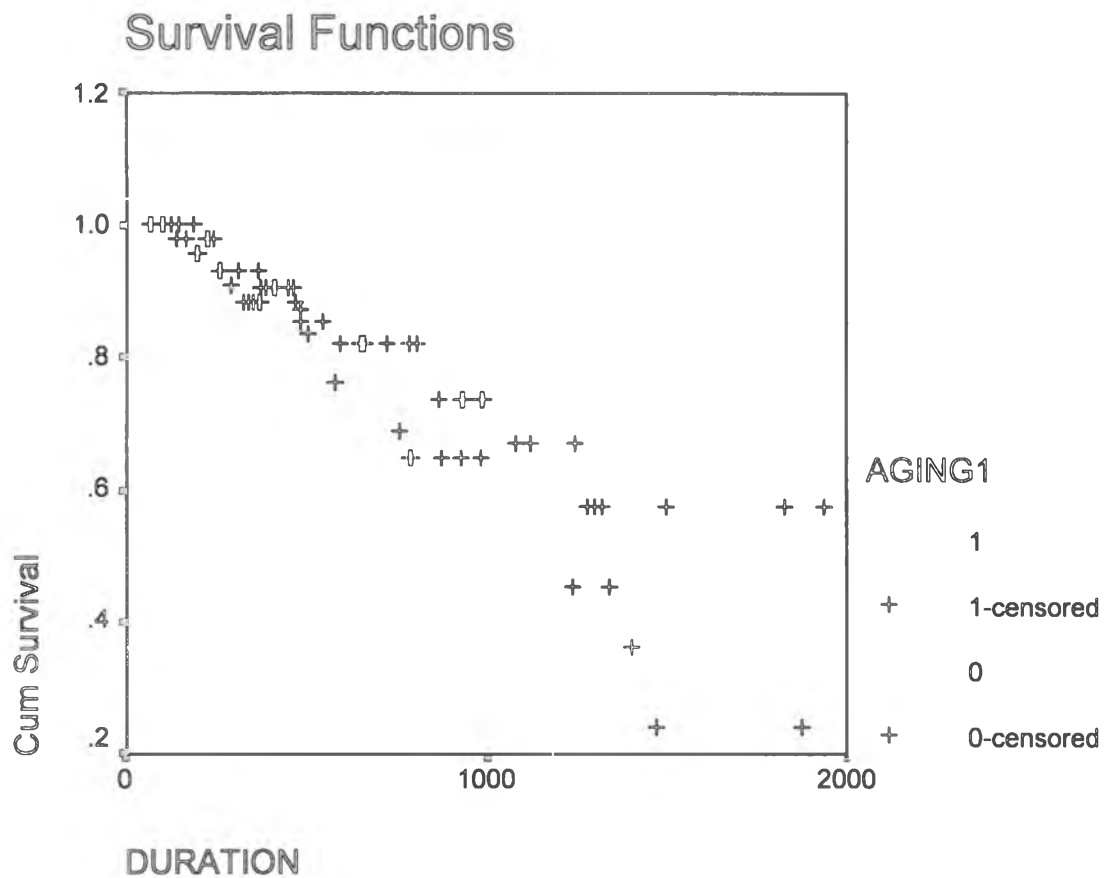
The survival in aging patients is not different from middle age (P value .1272)

Figure 5.3. Survival analysis in diabetic and non diabetic patients

(Kaplan-Meier, Log Rank Test)

Event = Death from any causes

|	N	Censored	Events	Survival time	SE	Stat	df	Sig
No DM	62	51	11	1509	108			
DM	40	24	16	970	89	7.68	1	.0056

Survival Functions
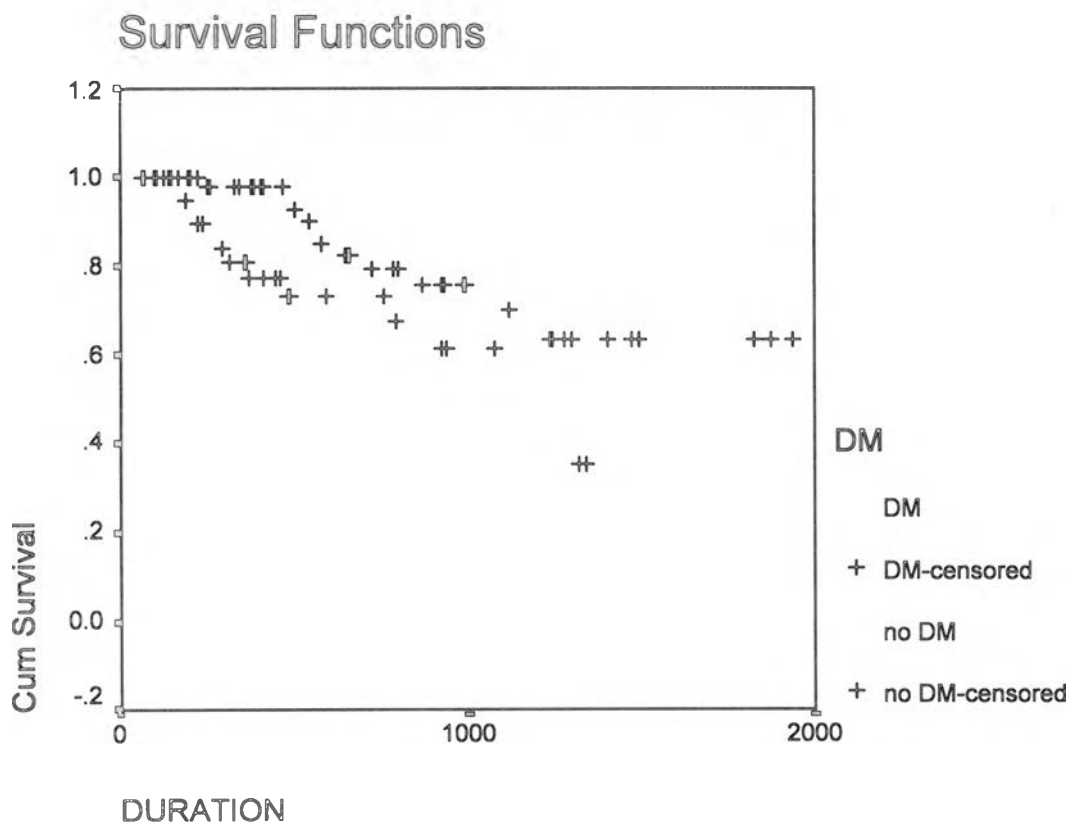
The survival of diabetic patients is less than non diabetic patients significantly

(P=0.0056)

Figure 5.4 Survival analysis: S. aureus infection and other infection
(Kaplan-Meier, Log Rank Test)

Event = Death from any causes

	N	Censored	Events	Survival time	SE	Stat	df	Sig
Other infection	58	37	21	1006	72			
Staph. infection	19	15	4	1599	139	5.12	1	.02
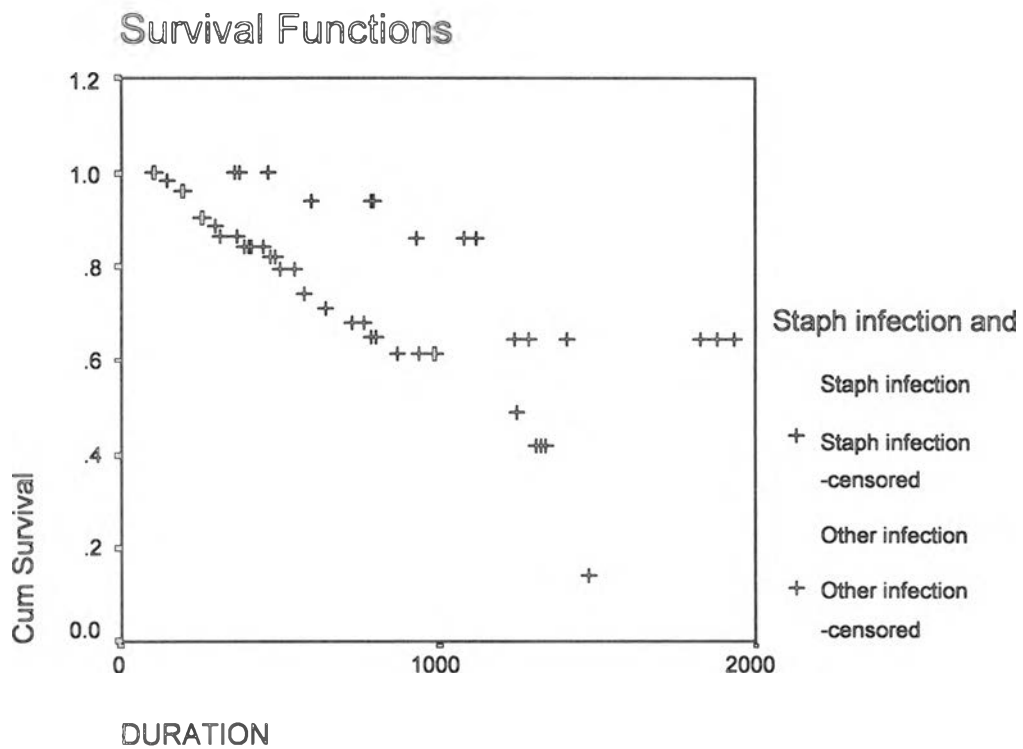
The survival of Staphylococcus infected patients is higher than other infected patients significantly (P=0.02+)