

## CHAPTER 9: CARDIOVASCULAR DISEASE IN DIALYSIS PATIENTS

### SUMMARY

- The percentage of patients who have achieved a systolic blood pressure of less than 140 mmHg had decreased from 48% in 1993 to 32% in 2002.
- When adjusted for age, gender, primary diagnosis and time on RRT, patients with systolic blood pressure less than 120 mmHg or 180 mmHg or higher were associated with a decreased five-year patient survival. This suggests a 'U' curve relationship between systolic blood pressure and patient survival in haemodialysis patients.
- Blood pressure control was better in CAPD than haemodialysis patients.
- Patients on haemodialysis with a pulse pressure of 80mmHg or higher had a poorer outcome however this was not seen in patients on CAPD.
- Low total cholesterol levels in both CAPD and haemodialysis patients and low triglyceride levels (in haemodialysis patients only) were associated with significantly poorer adjusted 5 year patient survival. High triglyceride levels were associated with significantly better chance of patient survival in both haemodialysis and CAPD patients. High cholesterol levels were not associated with higher risk of mortality.

### Introduction

Cardiovascular (CV) disease is a major problem among dialysis patients and cardiovascular complications account for more than 50% of deaths in the dialysis population. [1,2]

The excess risk of death from CV disease compared to the general population has previously been shown to vary from 500 times in young patients (i.e. 25 to 35 patients) to 5-fold in elderly patients above 85 years of age.[3]

In the general population, the major risk factors for CV disease include hypertension, diabetes mellitus, hyperlipidaemia and smoking. In the dialysis population, additional risk factors exist that contribute to the occurrence of vascular calcification and myocardial fibrosis that is characteristically seen in dialysis patients and contribute to the huge CV morbidity and mortality. These risk factors include:

1. Anaemia
2. Fluid and salt overload
3. Hyperdynamic circulation due to high fistula flow rates
4. Calcium and phosphate abnormalities
5. Hyperparathyroidism
6. Hyperhomocysteinaemia
7. Chronic inflammatory state
8. Increased oxidant stress
9. Prothrombotic tendency

### Blood Pressure

The relationship between blood pressure (BP) and mortality in dialysis patients is bimodal i.e. a very high and very low pressure having an adverse effect.[4].

Low blood pressure in dialysis patients (i.e. pre-dialysis systolic BP < 110 mmHg) indicates poor myocardial function and is an indicator of poor outcome in these patients. Low blood pressure leads to myocardial ischaemia and fibrosis leading to diastolic dysfunction. On the other hand,

uncontrolled blood pressure is also associated with increased mortality.

Hypertension in dialysis patients may be related to salt and water retention or renin. Long standing hypertension in chronic renal failure induces a cardiomyopathy characterized by small vessel disease. This leads to left ventricular hypertrophy (LVH), left ventricular dilatation and systolic dysfunction.

Death usually results from arrhythmias, cardiac failure or myocardial infarct. In patients with LVH, the median survival is 5 years. In the presence of systolic dysfunction or congestive cardiac failure, the median survival is reduced to 3 years. Following myocardial infarct, the one year survival is 40% and 5 years survival is just 10%.

Thus, there is increasing evidence that uncontrolled hypertension reduces survival on dialysis:

- High systolic BP is associated with LVH [5]
- High diastolic BP is associated with development of congestive cardiac failure. [6]
- A high pulse pressure is associated with poor arterial compliance and increase in mortality [7]
- Treating BP improves mortality [8]

Thus, the control of BP is paramount and the suggested targets according to the UK Renal Association Standards are:

- Pre-dialysis BP 140/90 mmHg
- Post-dialysis BP 130/80 mmHg

It is recommended that the BP should be taken at the sitting position in the non fistula arm at the heart level. Preferably the reading should be repeated in the standing position to exclude postural hypotension post dialysis.

Several studies have shown that post dialysis BP correlated more closely with the interdialytic ambulatory BP. This is because the BP rises rapidly in the pre-dialysis phase. (i.e. In the few hours preceding dialysis).

## HAEMODIALYSIS

### Systolic Blood Pressure

Data from 1993 to 2002 (Table 9.1 and Figure 9.1) show that there is an increasing trend in the mean and median systolic BP in HD patients. The percentage of patients with systolic BP of >140 mmHg has increased from 53% to 68% and the percentage of patients with a SBP of >160 mmHg increased from 19% to 32%.

These data show that the percentage of patients who have achieved a SBP of < 140 mmHg has decreased from 47% in 1993 to 32% in 2002 suggesting that efforts to achieve better BP control need to be intensified. This trend could also be contributed by greater acceptance into the dialysis programme of older and diabetic patients in recent years, and as shown in Table 9.2 and Table 9.4 older patients and those with diabetes had higher SBP. There was no gender difference in systolic BP observed over the years. (Table 9.3)

Table 9.5 and Figure 9.5 show the negative

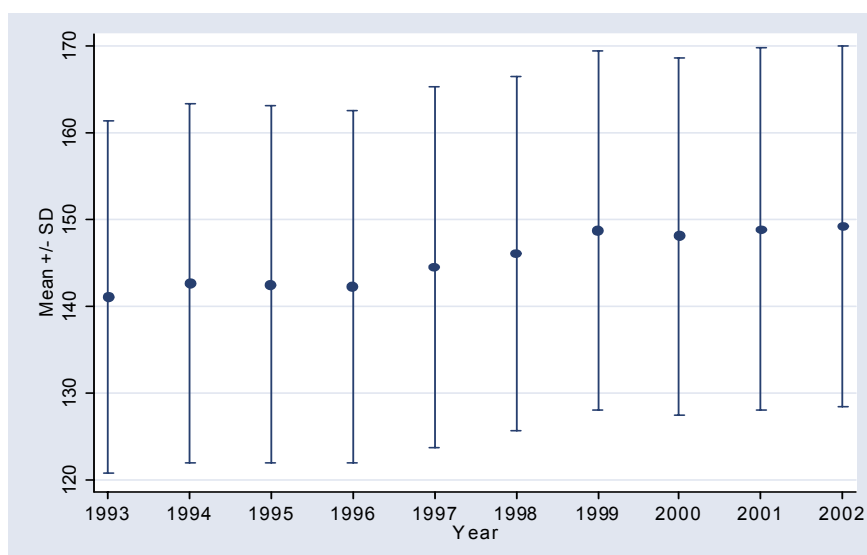
impact of uncontrolled SBP on mortality. Unadjusted five year patient survival was 72% in patients who achieved a SBP of 120-<140 mmHg compared with 63% in patients who achieved a SBP of 160-<180 mmHg and only 44% in patients with SBP  $\geq$ 180 mmHg. Kaplan –Meier survival estimates also show that patients in the SBP  $\geq$ 180 mmHg have much lower survival than patients with a SBP of < 180 mmHg.

When adjusted for age, gender, primary diagnosis and time on RRT, patients with SBP < 120 mmHg and > 180 mmHg were associated with a decreased five-year patient survival (Table.9.6). This suggests a 'U' curve relationship between SBP and patient survival in haemodialysis patients. Kaplan Meier survival estimates (Fig. 9.6) showed a significantly reduced cumulative patient survival at 5 years for patients with SBP > 180 mmHg compared to those with SBP <180 mmHg.

**Table 9.1** Distribution of Systolic Blood Pressure (mmHg), HD patients 1993-2002

Year	No of subjects	Mean	SD	Median	LQ	UQ	% patients <120 mmHg	% patients 120-<140 mmHg	% patients 140-<160 mmHg	% patients 160-<180 mmHg	% patients $\geq$ 180 mmHg
1993	715	141	20.3	140.8	127.3	154.6	13	34	34	16	3
1994	937	142.6	20.7	142.5	128.3	156.1	13	30	37	16	4
1995	1019	142.4	20.5	142.5	129.2	155.8	13	32	36	15	4
1996	1239	142.2	20.3	141.7	129	155.8	13	33	34	16	4
1997	1661	144.5	20.8	144.2	130.8	158.1	11	30	35	19	4
1998	2109	146	20.4	146.7	133.2	159.2	10	27	39	19	5
1999	2967	148.7	20.8	148.5	135.3	162.2	8	25	38	23	6
2000	4313	148.1	20.6	147.8	134.8	161.7	9	25	38	23	6
2001	5149	148.8	20.9	148.8	134.9	162.6	8	25	37	23	7
2002	5594	149.1	20.8	149	135.7	163.5	8	24	37	25	7

**Figure 9.1** Distribution of Systolic Blood Pressure (mmHg), HD patients 1993-2002



**Table 9.2** Distribution of Systolic Blood Pressure in relation to Age, HD patients 1993-2002

Year		Age group (years)			
		<20	20-39	40-59	≥60
1993	Mean ± SD	128.5 ± 16.7	136.5 ± 18.8	145.4 ± 21.4	149.5 ± 15.3
	Median ± IQR	127.5 ± 13.3	136.1 ± 25.7	145 ± 30.1	148.5 ± 20.2
1994	Mean ± SD	131 ± 14.4	138.5 ± 20.1	146.1 ± 21	149.5 ± 18.4
	Median ± IQR	130.4 ± 20.4	138.3 ± 26.7	146.7 ± 26.5	152.5 ± 27.4
1995	Mean ± SD	129 ± 19.9	138.3 ± 20	145.7 ± 20.4	150.2 ± 18.7
	Median ± IQR	129.2 ± 22.4	137.5 ± 27.2	145.7 ± 25	150 ± 25.9
1996	Mean ± SD	130.3 ± 18.9	137.7 ± 19.1	145.1 ± 20.4	151.9 ± 18.5
	Median ± IQR	131.5 ± 23	136.7 ± 25.4	145 ± 26.1	153.5 ± 29.5
1997	Mean ± SD	131.3 ± 18.6	138.1 ± 19.5	149.2 ± 20.4	149.5 ± 20.4
	Median ± IQR	130 ± 23.5	137.7 ± 24	150 ± 25.4	149.7 ± 28.4
1998	Mean ± SD	131.2 ± 19.8	140.2 ± 19.1	150.2 ± 19.9	150.7 ± 20.5
	Median ± IQR	131.9 ± 34.6	140.6 ± 24.5	150.9 ± 24.7	150 ± 24.3
1999	Mean ± SD	132.3 ± 20.2	142.5 ± 19.4	152.1 ± 20	154.3 ± 21.2
	Median ± IQR	131.3 ± 31.9	142.1 ± 24.9	151.8 ± 26.1	153.6 ± 25.1
2000	Mean ± SD	132.2 ± 18.7	142.5 ± 19.3	150.6 ± 20.3	152 ± 20.8
	Median ± IQR	131.5 ± 28.6	142.5 ± 25.3	150.5 ± 27.5	151.2 ± 27
2001	Mean ± SD	132.4 ± 18.6	143.3 ± 19.8	151.4 ± 20.8	151.5 ± 20.5
	Median ± IQR	132 ± 23.4	143.2 ± 25.5	152.2 ± 28	150.8 ± 27.5
2002	Mean ± SD	133.6 ± 19.9	143.7 ± 19.3	151.8 ± 20.4	151.2 ± 21.4
	Median ± IQR	131.8 ± 26.1	144.1 ± 26.3	152.1 ± 27.5	150 ± 28.3

**Table 9.3** Distribution of Systolic Blood Pressure in relation to Gender, HD patients 1993-2002

Year		Gender	
		Male	Female
1993	Mean ± SD	141.5 ± 20.2	140 ± 20.6
	Median ± IQR	140.8 ± 26	140 ± 28.3
1994	Mean ± SD	143.2 ± 20.5	141.3 ± 21.1
	Median ± IQR	143.3 ± 27.2	141.7 ± 29.8
1995	Mean ± SD	143.5 ± 20.2	140.4 ± 21.1
	Median ± IQR	143.3 ± 26.7	139.9 ± 26.9
1996	Mean ± SD	142.6 ± 19.9	141.3 ± 20.9
	Median ± IQR	142.8 ± 25.1	140 ± 30.2
1997	Mean ± SD	145.2 ± 20.2	143.3 ± 21.8
	Median ± IQR	145.5 ± 26.4	142 ± 28.4
1998	Mean ± SD	146.7 ± 19.8	144.9 ± 21.4
	Median ± IQR	147 ± 24.9	145.1 ± 27.6
1999	Mean ± SD	149.3 ± 20.1	147.7 ± 21.7
	Median ± IQR	149.4 ± 26.2	147.8 ± 27.8
2000	Mean ± SD	148.7 ± 19.7	147.2 ± 21.7
	Median ± IQR	148.4 ± 26.6	146.8 ± 27.7
2001	Mean ± SD	149.3 ± 20.2	148.1 ± 21.8
	Median ± IQR	149.4 ± 26.5	147.8 ± 30.1
2002	Mean ± SD	149.4 ± 19.8	148.8 ± 22
	Median ± IQR	149.3 ± 26.6	148.3 ± 30.5

**Table 9.4** Distribution of Systolic Blood Pressure in relation to Diabetes mellitus, HD patients 1993-2002

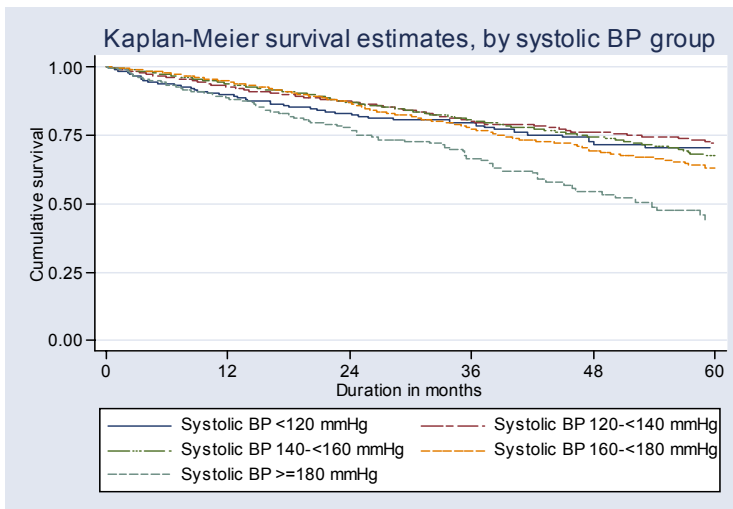
Year		Diabetes mellitus	
		Without DM	With DM
1993	Mean ± SD	139.4 ± 20	152.8 ± 19
	Median ± IQR	138.5 ± 25	153.3 ± 25.8
1994	Mean ± SD	141.3 ± 20.4	150.4 ± 20.9
	Median ± IQR	141.7 ± 26.7	152.1 ± 30.1
1995	Mean ± SD	140.7 ± 20.5	152 ± 18.3
	Median ± IQR	140 ± 25.9	150.5 ± 22.6
1996	Mean ± SD	140.7 ± 20.1	150 ± 19.6
	Median ± IQR	140 ± 26.3	150.8 ± 26.5
1997	Mean ± SD	141.8 ± 20	155.6 ± 20.3
	Median ± IQR	141.4 ± 26	156.7 ± 27.3
1998	Mean ± SD	143.4 ± 19.8	155.3 ± 20.2
	Median ± IQR	143.8 ± 25.8	154.9 ± 24
1999	Mean ± SD	146 ± 20.1	156.7 ± 20.6
	Median ± IQR	146 ± 26	156.7 ± 26.2
2000	Mean ± SD	144.7 ± 20.2	156.1 ± 19.2
	Median ± IQR	144.7 ± 26.2	156.7 ± 25.7
2001	Mean ± SD	145 ± 20	156.9 ± 20.4
	Median ± IQR	145 ± 26.8	157.1 ± 27.2
2002	Mean ± SD	145.6 ± 20.2	156.6 ± 20
	Median ± IQR	145.7 ± 27.4	156.8 ± 27.5

**Table 9.5** Unadjusted five-year patient survival in relation to Systolic Blood Pressure, HD patients 1997-2002

Systolic BP Interval (months)	<120 mmHg		120-<140 mmHg		140-<160 mmHg		160-<180 mmHg		≥180 mmHg	
	% survival	SE	% survival	SE	% survival	SE	% survival	SE	% survival	SE
6	94	1	96	1	97	0	98	0	94	1
12	90	2	93	1	94	1	95	1	89	2
24	83	2	87	1	87	1	87	1	78	3
36	80	3	80	1	81	1	78	1	67	3
48	73	3	76	2	75	1	70	2	55	4
60	70	4	72	2	68	2	63	2	44	5

SE=standard error

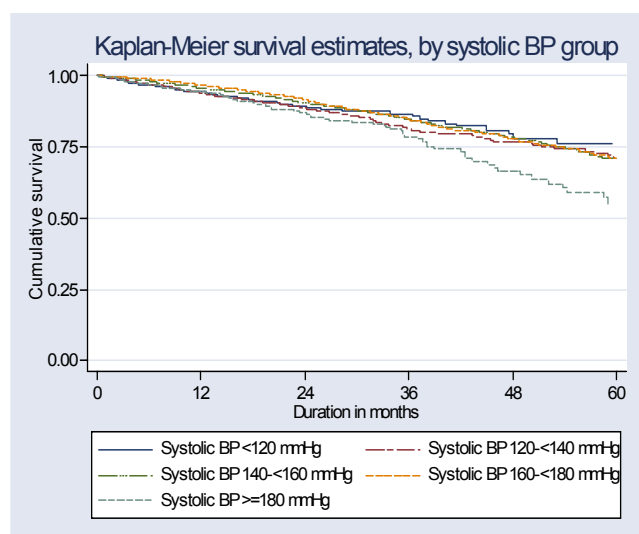
**Figure .9.5** Unadjusted five-year patient survival in relation to Systolic Blood Pressure, HD patients 1997-2002



**Table 9.6** Adjusted five-year patient survival in relation to Systolic Blood Pressure, HD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

Systolic BP	n	Hazard ratio	95% CI	p-value
<120 mmHg	345	1.44	(1.11, 1.87)	0.006
120-<140 mmHg	1392	1.11	(0.94, 1.31)	0.206
140-<160 mmHg	2523	1.00	-	-
160-<180 mmHg	1481	0.96	(0.83, 1.12)	0.614
≥180 mmHg	331	1.54	(1.23, 1.92)	0.000

**Figure 9.6** Adjusted five-year patient survival in relation to Systolic Blood Pressure, HD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)



## Diastolic Blood Pressure - Haemodialysis

In contrast to SBP, there appear to be a decreasing trend in the mean diastolic blood pressure (DBP) from 88.5 mmHg in 1993 to 81.1 mmHg in 2002 and median DBP from 86.7 mmHg in 1993 to 81.3 mmHg in 2002 (Table 9.7 and Figure 9.7). The percentage of patients with a DBP of <90 mmHg had increased from 59% to 80%. Thus a greater proportion of patients had achieved better DBP control over the 10 year period. This may be attributed to the fact that more patients in the older age groups have been accepted into the dialysis program in the last 10 years.

Table 9.8, Table 9.9 and Table 9.10 show that the decrease in both the mean DBP and the

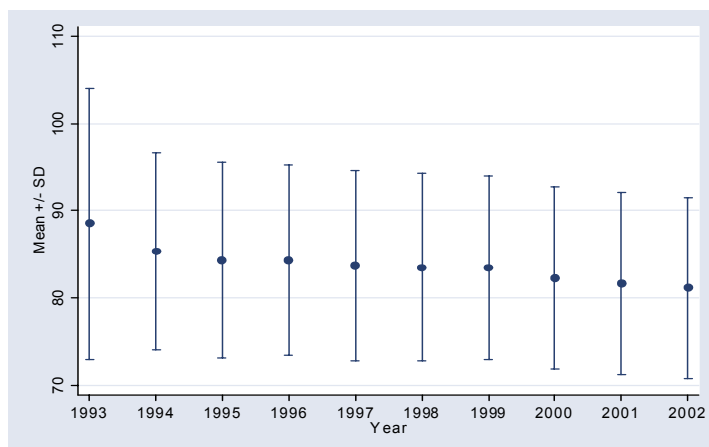
and the median DBP had occurred irrespective of age groups, gender and presence of diabetes.

Unadjusted 5-year patient survival showed that the groups with DBP between 80 to < 100 mmHg had a slightly higher survival compared to those with DBP 100 mmHg or higher or < 80 mmHg. (Table 9.11 and Figure. 9.11). However when adjusted for age, gender, primary diagnosis and time on RRT, five year patient survival was significantly lower only for patients with DBP of > 90 mmHg. This further emphasizes the importance of controlling DBP to < 90 mmHg. (Table 9.12, Figure 9.12 )

**Table 9.7** Distribution of Diastolic Blood Pressure (mmHg), HD patients 1993-2002

Year	No of subjects	Mean	SD	Median	LQ	UQ	% patients <70 mmHg	% patients 70-<80 mmHg	% patients 80-<90 mmHg	% patients 90-<100 mmHg	% patients ≥100 mmHg
1993	715	88.5	15.5	86.7	79.9	95	7	18	34	23	18
1994	937	85.3	11.3	85.3	79	91.9	8	20	38	24	10
1995	1019	84.3	11.2	84.2	77.5	90.9	8	23	38	22	8
1996	1239	84.4	10.9	84.2	77.7	90.8	9	23	37	22	8
1997	1662	83.7	10.9	84.2	77	90.7	10	23	38	22	6
1998	2109	83.5	10.7	83.9	76.9	90.6	10	24	38	23	5
1999	2967	83.5	10.5	83.5	77.1	90	10	24	40	21	6
2000	4312	82.2	10.4	82.3	75.7	89	11	28	39	18	4
2001	5148	81.6	10.4	81.7	75	88.3	12	30	37	17	4
2002	5590	81.1	10.4	81.3	74.4	88	13	30	37	16	3

**Figure 9.7** Distribution of Diastolic Blood Pressure (mmHg), HD patients 1993-2002



**Table 9.8** Distribution of Diastolic Blood Pressure in relation to Age, HD patients 1993-2002

Year		Age group (years)			
		<20	20-39	40-59	≥ 60
1993	Mean ± SD	84.4 ± 16	89.9 ± 15.5	88.2 ± 15.4	82.9 ± 15.2
	Median ± IQR	80 ± 18	89.2 ± 17.9	86 ± 12.7	80.3 ± 11.6
1994	Mean ± SD	82.8 ± 10	87.6 ± 11.7	84.3 ± 10.8	79.6 ± 9.2
	Median ± IQR	82.5 ± 11.6	87.9 ± 15	84.5 ± 10.9	78 ± 12.5
1995	Mean ± SD	81.6 ± 15.5	86.2 ± 11.9	83.6 ± 10.3	79.6 ± 8.8
	Median ± IQR	80.7 ± 19.3	86.7 ± 14.3	84 ± 12.5	79.1 ± 10
1996	Mean ± SD	82.9 ± 12	86 ± 11.7	83.8 ± 10	79.9 ± 9.5
	Median ± IQR	82.4 ± 15.4	86.1 ± 14.5	83.8 ± 11.8	79.7 ± 14.7
1997	Mean ± SD	82.3 ± 12.8	85.4 ± 11.4	83.7 ± 10.1	77.9 ± 9.5
	Median ± IQR	84.4 ± 16.6	86 ± 13.5	84.2 ± 12.3	78.9 ± 13.5
1998	Mean ± SD	81.3 ± 13.3	85.6 ± 11.1	83.6 ± 10	77.2 ± 9.2
	Median ± IQR	81.3 ± 18.9	86.5 ± 13	83.7 ± 12.2	76.9 ± 13.1
1999	Mean ± SD	80.9 ± 13.4	85.8 ± 10.9	83.3 ± 10	79.4 ± 9.2
	Median ± IQR	82.7 ± 20.2	86.1 ± 12.7	83.5 ± 12.7	80 ± 10.9
2000	Mean ± SD	80.6 ± 12.3	85.5 ± 10.5	82.2 ± 9.8	77.5 ± 9.4
	Median ± IQR	80.8 ± 18.9	85.9 ± 12.8	82.5 ± 12.6	77.8 ± 11.7
2001	Mean ± SD	81.2 ± 12.3	85.1 ± 10.8	81.7 ± 9.8	77 ± 9.4
	Median ± IQR	81.7 ± 16	85.6 ± 13.1	81.7 ± 12.6	76.8 ± 11.8
2002	Mean ± SD	81.8 ± 12.8	85.2 ± 10.7	81.3 ± 9.6	76 ± 9.2
	Median ± IQR	83.8 ± 16.4	85.6 ± 13.5	81.5 ± 12.2	75.8 ± 12

**Table 9.9** Distribution of Diastolic Blood Pressure in relation to Gender, HD patients 1993-2002

Year		Gender			
		Male		Female	
1993	Mean ± SD	89.7	± 16.4	86.2	± 13.5
	Median ± IQR	87.5	± 16.3	85.5	± 15.2
1994	Mean ± SD	86.1	± 11.6	83.9	± 10.7
	Median ± IQR	85.8	± 13.8	84.1	± 13.2
1995	Mean ± SD	85.5	± 11.6	82.2	± 10.2
	Median ± IQR	85.5	± 14	81.7	± 13
1996	Mean ± SD	85.1	± 11.2	83.1	± 10.3
	Median ± IQR	85.4	± 13.3	83.1	± 12.8
1997	Mean ± SD	84.5	± 11.1	82.5	± 10.5
	Median ± IQR	85	± 12.8	82.5	± 12.9
1998	Mean ± SD	84.2	± 10.8	82.4	± 10.4
	Median ± IQR	84.8	± 13.7	82.5	± 13.8
1999	Mean ± SD	84.3	± 10.5	82.2	± 10.4
	Median ± IQR	84.3	± 13.1	82.5	± 13.1
2000	Mean ± SD	83.1	± 10.4	81.1	± 10.3
	Median ± IQR	83	± 13.6	81.5	± 12.9
2001	Mean ± SD	82.6	± 10.6	80.4	± 10.1
	Median ± IQR	82.6	± 13.8	80.5	± 12.9
2002	Mean ± SD	82.1	± 10.6	79.9	± 10
	Median ± IQR	82.3	± 14.1	80	± 13.2

**Table 9.10** Distribution of Diastolic Blood Pressure in relation to Diabetes mellitus (DM), HD patients 1993-2002

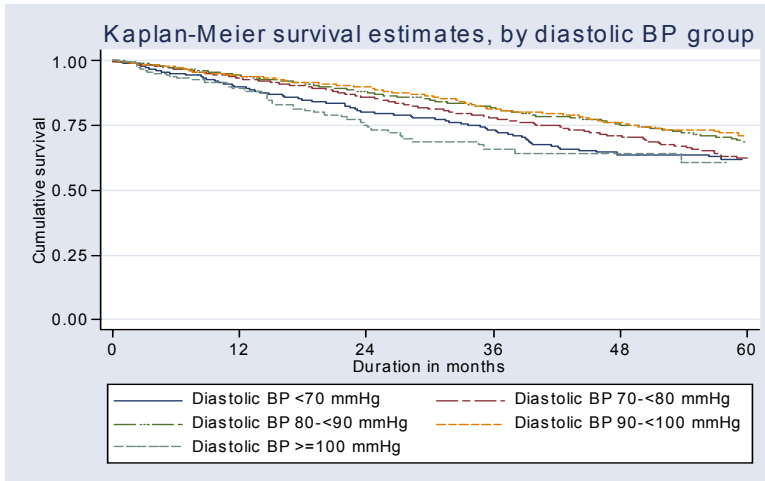
Year		Diabetes mellitus			
		Without DM		With DM	
1993	Mean ± SD	88.5	± 15	88.7	± 19.1
	Median ± IQR	87	± 15.3	84	± 13.8
1994	Mean ± SD	86	± 11.4	81.2	± 9.9
	Median ± IQR	85.8	± 12.8	80.8	± 13.3
1995	Mean ± SD	84.8	± 11.4	81.6	± 9.4
	Median ± IQR	85	± 13.7	80.8	± 13.3
1996	Mean ± SD	84.8	± 11	82.1	± 10
	Median ± IQR	84.9	± 13	82.5	± 14
1997	Mean ± SD	84.2	± 11	81.7	± 10
	Median ± IQR	84.9	± 13.2	82	± 12.8
1998	Mean ± SD	84.3	± 10.7	80.7	± 10.2
	Median ± IQR	85	± 13.7	80.8	± 12.6
1999	Mean ± SD	84.2	± 10.6	81.2	± 10
	Median ± IQR	84.4	± 12.6	81.3	± 12.3
2000	Mean ± SD	83.2	± 10.6	80	± 9.5
	Median ± IQR	83.3	± 13.3	80	± 12.7
2001	Mean ± SD	82.6	± 10.6	79.6	± 9.7
	Median ± IQR	82.9	± 13.8	79.7	± 11.8
2002	Mean ± SD	82.2	± 10.6	79	± 9.5
	Median ± IQR	82.2	± 13.9	79.3	± 12.5

**Table 9.11** Unadjusted five-year patient survival in relation to Diastolic Blood Pressure, HD patients 1997-2002

Diastolic BP	<70 mmHg		70-<80 mmHg		80-<90 mmHg		90-<100 mmHg		≥100 mmHg	
	% survival	SE	% survival	SE	% survival	SE	% survival	SE	% survival	SE
Interval (months)										
6	95	1	97	0	97	0	98	1	94	2
12	90	1	94	1	94	1	94	1	90	2
24	81	2	86	1	88	1	90	1	75	4
36	73	2	78	1	82	1	82	2	66	4
48	64	3	71	2	76	1	76	2	64	5
60	62	3	62	2	69	2	71	2	61	6

SE=standard error

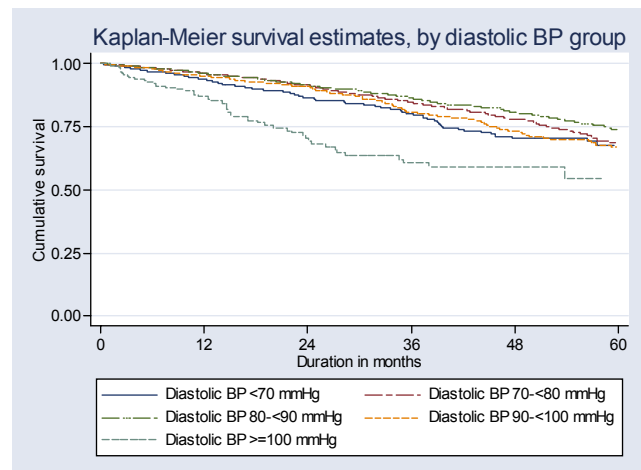
**Figure 9.11** Unadjusted five-year patient survival in relation to Diastolic Blood Pressure, HD patients 1997-2002



**Table 9.12** Adjusted five-year patient survival in relation to Diastolic Blood Pressure, HD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

Diastolic BP	n	Hazard ratio	95% CI	p-value
<70 mmHg	723	1.17	(0.97, 1.41)	0.101
70-80 mmHg	1862	0.93	(0.81, 1.08)	0.364
80-90 mmHg	2307	1.00	-	-
90-100 mmHg	959	1.27	(1.05, 1.53)	0.012
≥100 mmHg	218	2.80	(2.07, 3.80)	0.000

**Figure 9.12** Adjusted five-year patient survival in relation to Diastolic Blood Pressure, HD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)



## CONTINUOUS AMBULATORY PERITONEAL DIALYSIS (CAPD)

### Systolic Blood Pressure – CAPD

The percentage of patients who achieved a SBP of <140 mmHg had increased from 41% to 50% and the percentage of patients who achieved a SBP of <160 mmHg increased from 79% to 84%. Percentage of patients with SBP >160 mmHg decreased from 20% to 16% (Table 9.13).

In 2002, the mean and median SBP in CAPD patients was about 9 mmHg lower than that of HD patients. Fifty percent of CAPD patients achieved SBP of < 140 mmHg compared with only 32% of HD patients demonstrating that BP control is better in CAPD than HD patients.

Both mean SBP and median SBP were higher in older patients, male patients and patients with diabetes. (Table 9.14, Table 9.15, Table 9.16 )

Table 9.17 and Figure 9.17 show the impact of uncontrolled SBP on mortality. Unadjusted five year patient survival for patients on CAPD appears to be better with a SBP of <140 mmHg. However when adjusted for age, gender, primary diagnosis and time on RRT, there was no significant difference in five year survival among the different blood pressure groups as noted in patients on haemodialysis probably because of the smaller number of patients on CAPD especially in the group with SBP 180 mmHg or higher. (Table 9.18, Figure 9.18 )

**Table 9.13** Distribution of Systolic Blood Pressure (mmHg), CAPD patients 1993-2002

Year	No of subjects	Mean	SD	Median	LQ	UQ	% patients	% patients	% patients	% patients	% patients
							<120 mmHg	120-<140 mmHg	140-<160 mmHg	160-<180 mmHg	≥180 mmHg
1993	97	143.1	23.1	144	130	157.1	12	29	38	14	6
1994	112	143.4	23.1	143.5	128.2	155.9	15	27	35	16	7
1995	245	141.3	21.9	140.8	129	155	12	34	34	16	3
1996	358	142.5	21.8	142.9	128	158.3	15	28	34	18	4
1997	469	142.7	20.3	142.9	128.3	156	13	31	37	17	3
1998	519	141	21.2	140	126.4	157.5	16	34	29	18	3
1999	576	141	19.8	140	127.2	156	14	35	34	15	2
2000	638	137.2	20.4	136.1	123.3	150	18	39	29	13	2
2001	739	139	20.2	137.5	125.8	151.7	16	38	30	13	3
2002	841	139.8	20.5	140	127.1	151.8	14	36	34	12	4

**Figure 9.13** Distribution of Systolic Blood Pressure (mmHg), CAPD patients 1993-2002



**Table 9.14** Distribution of Systolic Blood Pressure in relation to Age, CAPD patients 1993-2002

Year		Age group (years)							
		<20		20-39		40-59		≥ 60	
1993	Mean ± SD	119.4	20.3	140	20	149.8	23.1	140.1	15.3
	Median ± IQR	116.7	27.6	145.4	25.2	147.1	35.6	142	10.2
1994	Mean ± SD	116.3	13.7	144.2	17.6	150.5	22.9	134.8	17.7
	Median ± IQR	116	22	141.5	18.3	151	31.9	134	23.7
1995	Mean ± SD	126.9	16.8	139.2	18.1	143.7	23.8	143.1	19.2
	Median ± IQR	125	27.2	137	19.1	145.7	28	138	29.8
1996	Mean ± SD	121.7	14.9	140.4	18.5	149.2	21.9	140.6	19.5
	Median ± IQR	120.9	18.9	140.4	24.3	152	28.8	141	27.2
1997	Mean ± SD	125.4	18.6	142.5	16.6	146.8	20.7	144.4	18.8
	Median ± IQR	123.8	19.3	143.5	21.1	146.9	27	145	27.5
1998	Mean ± SD	120.8	14.3	140.3	18.2	147.5	20.7	142.6	20.5
	Median ± IQR	119.4	20.5	137.1	22.9	148.2	28.7	143.4	28.8
1999	Mean ± SD	124.4	14.9	141.3	18.5	145.6	18.8	144.7	20
	Median ± IQR	121.5	14.2	140.7	27.7	144.5	25.5	145.8	26
2000	Mean ± SD	122.9	14.6	137.1	18	141.5	20.9	141.5	20.9
	Median ± IQR	123.3	14.5	135	21.6	141.1	28.4	145	26.1
2001	Mean ± SD	127.6	16.1	137.9	18.6	142.6	21.7	142.5	18.3
	Median ± IQR	126.7	18.5	134.7	22.2	143.6	26.8	140.2	27.1
2002	Mean ± SD	125.7	17.5	138.9	18.5	144.1	20.4	144.7	19.9
	Median ± IQR	127.2	19.1	139.3	22.1	143.3	24.4	145.8	29.9

**Table 9.15** Distribution of Systolic Blood Pressure in relation to Gender, CAPD patients 1993-2002

Year		Gender			
		Male		Female	
1993	Mean ± SD	146.3	19.8	140.7	25.2
	Median ± IQR	143.4	23.3	144.2	30
1994	Mean ± SD	141.6	21.9	145.4	24.5
	Median ± IQR	141.5	27	145.7	31.7
1995	Mean ± SD	141.3	21.9	141.4	22.1
	Median ± IQR	140.8	25.2	140.8	29.2
1996	Mean ± SD	143.6	22.5	141.3	21
	Median ± IQR	145.6	29.8	140.8	30.6
1997	Mean ± SD	142.1	20.7	143.2	20
	Median ± IQR	143.9	27.7	141.5	28
1998	Mean ± SD	141.4	22.5	140.6	19.9
	Median ± IQR	140	32.8	139	28.9
1999	Mean ± SD	140.4	21.2	141.5	18.4
	Median ± IQR	140	29.2	140	28.7
2000	Mean ± SD	139	21	135.5	19.7
	Median ± IQR	138.3	28.2	134.3	24.9
2001	Mean ± SD	140.7	20	137.5	20.3
	Median ± IQR	140	24.6	134.7	25.9
2002	Mean ± SD	141.7	20.1	138.1	20.8
	Median ± IQR	142.5	22.5	135.9	26.3

**Table 9.16** Distribution of Systolic Blood Pressure in relation to Diabetes mellitus, CAPD patients 1993-2002

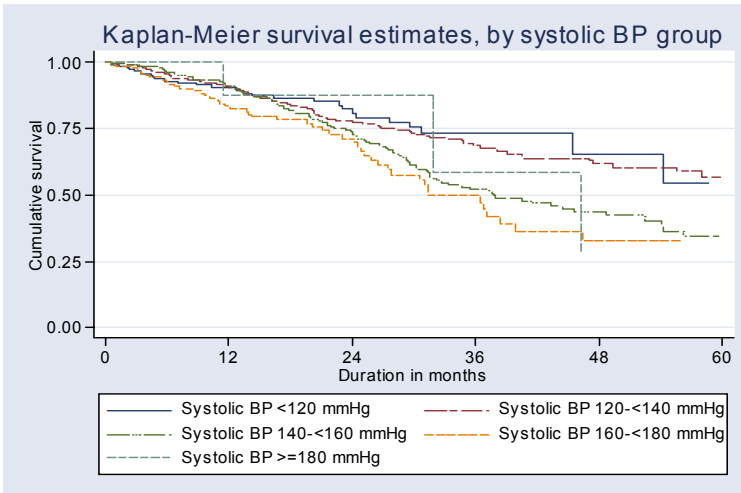
Year		Diabetes mellitus			
		Without DM		With DM	
1993	Mean ± SD	137.9	23.7	155.5	16
	Median ± IQR	135	26.3	150	24.1
1994	Mean ± SD	141.3	24.1	149.6	19.3
	Median ± IQR	142	29.8	150	27.2
1995	Mean ± SD	139.1	22.7	145.6	19.7
	Median ± IQR	138.8	25.2	147.8	27.7
1996	Mean ± SD	138.6	22.1	150.6	19
	Median ± IQR	137.5	29	153.3	23.2
1997	Mean ± SD	138.7	20.4	150.4	17.9
	Median ± IQR	137.6	26.9	152	22
1998	Mean ± SD	137.2	21.2	148.9	19
	Median ± IQR	135.5	27.5	150.8	26.8
1999	Mean ± SD	137.5	19.7	148.7	17.7
	Median ± IQR	136.3	26.7	150	24.3
2000	Mean ± SD	133.5	19.5	145.9	19.8
	Median ± IQR	133.3	23	145.7	28.5
2001	Mean ± SD	135.5	19.6	146.5	19.4
	Median ± IQR	133.8	25.8	146.7	28.4
2002	Mean ± SD	136	19.9	147.7	19.7
	Median ± IQR	135.6	24.1	146.8	26.8

**Table 9.17** Unadjusted five-year patient survival in relation to Systolic Blood Pressure, CAPD patients 1997-2002

Systolic BP	<120 mmHg		120-<140 mmHg		140-<160 mmHg		160-<180 mmHg		≥180 mmHg	
	% survival	SE	% survival	SE	% survival	SE	% survival	SE	% survival	SE
Interval (months)										
6	93	2	95	1	96	1	93	2	100	-
12	91	3	91	1	91	1	84	3	88	12
24	82	4	78	2	74	3	71	5	88	12
36	74	5	69	3	52	4	50	6	58	25
48	65	9	62	4	44	4	33	7	29	24
60	55	12	57	4	35	5	33	7	29	24

SE=standard error

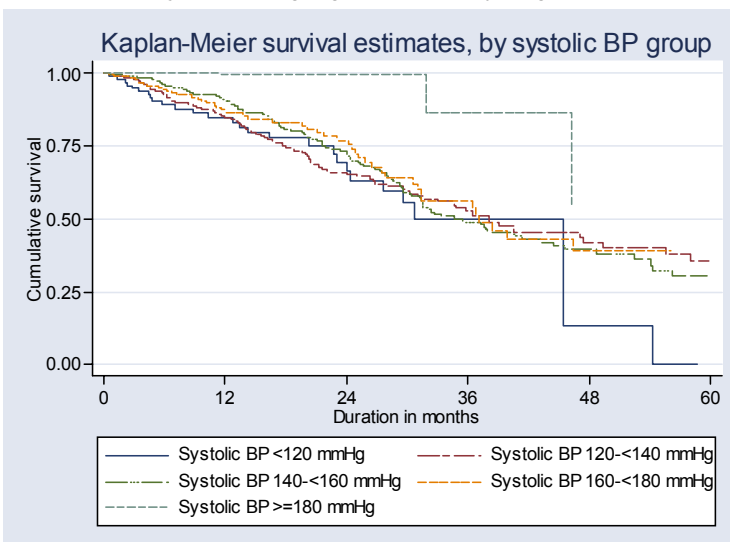
**Figure 9.17** Unadjusted five-year patient survival in relation to Systolic Blood Pressure, CAPD patients 1997-2002



**Table 9.18** Adjusted five-year patient survival in relation to Systolic Blood Pressure, CAPD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

Systolic BP	n	Hazard ratio	95% CI	p-value
<120 mmHg	161	1.33	(0.86, 2.05)	0.203
120-140 mmHg	449	0.94	(0.71, 1.22)	0.627
140-160 mmHg	432	1.00	-	-
160-180 mmHg	147	1.04	(0.75, 1.46)	0.800
≥180 mmHg	18	0.82	(0.26, 2.59)	0.737

**Figure 9.18** Adjusted five-year patient survival in relation to Systolic Blood Pressure, CAPD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)



## Diastolic Blood Pressure – CAPD

The percentage of patients with mean DBP of <90 mmHg had increased from 62% to 76%. (Table 9.19)

Tables 9.20, 9.21 and 9.22 show that older age groups, male gender and presence of diabetes were not associated with a higher DBP.

In contrast to the impact of SBP in CAPD patients, the achievement of DBP control appeared to have no impact on unadjusted five year patient

survival (Table 9.23 and Fig. 9.23). The unadjusted five year patient survival rate ranged from 35% to 54% with no obvious trend to suggest better survival with better DBP control. However, from Table 9.24 and Figure 9.24, it can be seen that when adjusted for age, gender, primary diagnosis and time on RRT, patients with a DBP of > 90 mmHg had a significantly poorer five year patient survival.

**Table 9.19** Distribution of Diastolic Blood Pressure (mmHg), CAPD patients 1993-2002

Year	No of subjects	Mean	SD	Median	LQ	UQ	% patients <70 mmHg	% patients 70-<80 mmHg	% patients 80-<90 mmHg	% patients 90-<100 mmHg	% patients ≥100 mmHg
1993	98	86.5	12.4	85.4	80	93	3	17	42	30	8
1994	112	85.9	10.6	85	78.8	92.4	4	23	36	27	10
1995	244	83.9	10.9	84.2	78	90.3	9	22	39	25	7
1996	358	84.1	10.9	85	76.2	90.2	8	24	37	23	8
1997	468	85.3	10.6	85.9	79.9	91.4	6	19	41	26	8
1998	519	84.3	11.3	85	77.1	90.1	8	24	36	24	8
1999	576	84	10.9	84.2	77.9	90	9	20	44	20	7
2000	638	82.9	11	83.3	76.6	89.6	10	24	41	20	5
2001	739	83.1	10.9	82.7	76.4	89.6	9	29	38	18	6
2002	841	82.8	10.8	83.4	76.1	90	11	24	41	21	5

**Figure 9.19** Distribution of Diastolic Blood Pressure (mmHg), CAPD patients 1993-2002



**Table 9.20** Distribution of Diastolic Blood Pressure in relation to Age, CAPD patients 1993-2002

Year		Age group (years)							
		<20		20-39		40-59		≥ 60	
1993	Mean ± SD	78.7	14.6	91.3	10.9	88.2	12.2	79.5	8.3
	Median ± IQR	75.6	17.8	91.5	12	86.3	11.1	78.4	13.3
1994	Mean ± SD	78	7.1	93.3	10.1	87.2	9	76	10.1
	Median ± IQR	80	6.9	90	11.7	87.8	14.3	78.1	14
1995	Mean ± SD	83.6	9.5	89.5	11.6	84	11.2	79.9	8.5
	Median ± IQR	83.3	8.3	90	7.6	84.5	14.2	79.8	9
1996	Mean ± SD	79.3	8.7	90.1	10.5	85.8	10.5	78.1	9.3
	Median ± IQR	79.2	12.5	90	13.1	87	12.6	79.1	11.9
1997	Mean ± SD	81.7	9.8	90.8	9.8	85.7	10.2	80.1	9.5
	Median ± IQR	81.7	15	90	11.8	86.8	11.3	80	12.7
1998	Mean ± SD	78.2	9.6	90	11	85.4	10.1	78.9	11.2
	Median ± IQR	78.8	13.8	89	12	86.3	11.5	78.4	15.7
1999	Mean ± SD	81.1	11.2	89.5	9.7	83.8	10.3	79.6	10.4
	Median ± IQR	80	14.1	89	11.4	83.5	11.1	80.3	14.2
2000	Mean ± SD	79.3	10.6	87.5	9.8	82.9	11.1	80.1	10.4
	Median ± IQR	79.6	12.2	87.5	11.8	83.5	11.6	80	14
2001	Mean ± SD	82.7	11.9	86.4	10	83.2	10.8	79	10.1
	Median ± IQR	82.4	12.6	86.4	13.4	82.8	12	78.7	12.4
2002	Mean ± SD	80.3	12.2	87	10.6	82.9	9.9	79.1	9.9
	Median ± IQR	82.5	17.8	87.5	11.8	83.3	12.3	80	12.4

**Table 9.21** Distribution of Diastolic Blood Pressure in relation to Gender, CAPD patients 1993-2002

Year		Gender			
		Male		Female	
1993	Mean ± SD	87.7	8.5	85.5	14.8
	Median ± IQR	86.7	9.7	84.2	17.8
1994	Mean ± SD	86.9	10.4	84.7	10.8
	Median ± IQR	86.7	13.2	84.3	12
1995	Mean ± SD	84.7	10.6	83.1	11.2
	Median ± IQR	84	11.7	84.5	14.1
1996	Mean ± SD	84.6	11.1	83.6	10.7
	Median ± IQR	85	13.7	85	14
1997	Mean ± SD	85.5	11	85	10.2
	Median ± IQR	86	11.4	85.9	13.2
1998	Mean ± SD	84.9	12.2	83.8	10.4
	Median ± IQR	85	14.3	85	12.9
1999	Mean ± SD	83.9	11.4	84.1	10.4
	Median ± IQR	84.8	12.8	84	11.8
2000	Mean ± SD	83.8	11.6	82.1	10.3
	Median ± IQR	84.5	11.9	82.2	14
2001	Mean ± SD	83.5	11.2	82.8	10.7
	Median ± IQR	83.7	13.2	82.5	13.1
2002	Mean ± SD	83.5	10.7	82.1	10.9
	Median ± IQR	84.3	13.1	82.3	13.7

**Table 9.22** Distribution of Diastolic Blood Pressure in relation to Diabetes mellitus, CAPD patients 1993-2002

Year		Diabetes mellitus			
		Without DM		With DM	
1993	Mean ± SD	86.9	13.9	85.4	8
	Median ± IQR	86.3	12.5	85	10
1994	Mean ± SD	86.4	10.7	84.3	10.5
	Median ± IQR	85.7	13.1	85	15.4
1995	Mean ± SD	84.6	11.5	82.7	9.5
	Median ± IQR	85	13.1	82.1	14.7
1996	Mean ± SD	84.8	11.4	82.8	9.8
	Median ± IQR	85.3	15.4	84	14.7
1997	Mean ± SD	86	11.2	83.8	9.1
	Median ± IQR	86.4	13.2	84.6	10.3
1998	Mean ± SD	85.4	11.9	82.2	9.6
	Median ± IQR	85.9	14.2	83.3	11.5
1999	Mean ± SD	85.2	11.4	81.6	9
	Median ± IQR	85.8	11.9	82	11.1
2000	Mean ± SD	83.6	11.8	81.4	8.8
	Median ± IQR	83.7	12.9	82.9	12.6
2001	Mean ± SD	84.4	11.1	80.3	10
	Median ± IQR	85	12.8	80	10.9
2002	Mean ± SD	84.3	11.1	79.6	9.5
	Median ± IQR	85	11.9	79.8	12.3

**Table 9.23** Unadjusted five-year patient survival in relation to Diastolic Blood Pressure, CAPD patients 1997-2002

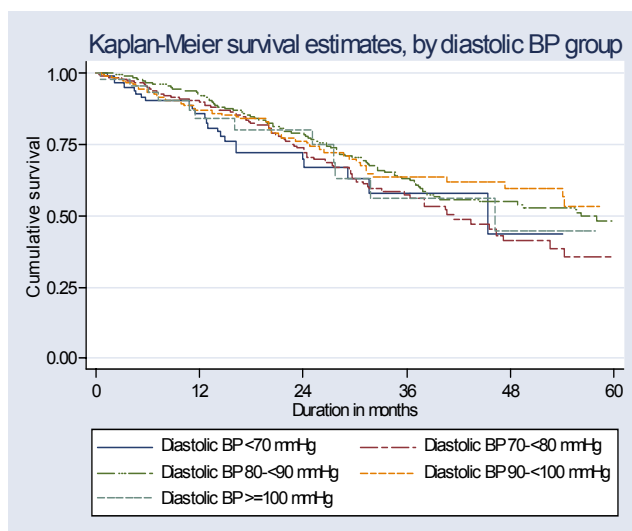
Diastolic BP	<70 mmHg		70-<80 mmHg		80-<90 mmHg		90-<100 mmHg		≥100 mmHg	
	% survival	SE	% survival	SE	% survival	SE	% survival	SE	% survival	SE
Interval (months)										
6	91	3	95	1	97	1	94	2	96	3
12	86	4	90	2	93	1	87	2	84	6
24	70	6	74	3	79	2	77	3	80	7
36	58	8	57	4	63	3	64	5	56	11
48	44	14	41	5	55	4	60	5	45	14
60	44	14	35	6	48	4	54	6	45	14

SE=standard error

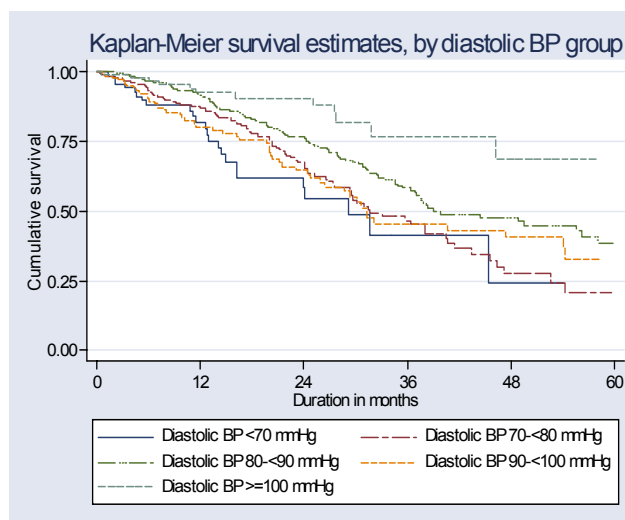
**Table 9.24** Adjusted five-year patient survival in relation to Diastolic Blood Pressure, CAPD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

Diastolic BP	n	Hazard ratio	95% CI	p-value
<70 mmHg	99	1.32	(0.85, 2.07)	0.218
70-<80 mmHg	332	0.94	(0.71, 1.25)	0.684
80-<90 mmHg	495	1.00	-	-
90-<100 mmHg	227	1.43	(1.03, 1.98)	0.035
≥100 mmHg	53	2.05	(1.12, 3.74)	0.019

**Figure 9.23** Unadjusted five-year patient survival in relation to Diastolic Blood Pressure, CAPD patients 1997-2002



**Figure 9.24** Adjusted five-year patient survival in relation to Diastolic Blood Pressure, CAPD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)



## Pulse Pressure

Hypertension is a recognized risk factor for cardiovascular morbidity and mortality in the dialysis population. Components of blood pressure including systolic, diastolic and mean arterial pressure have been used in various studies as parameters to show association between blood pressure and cardiovascular outcome. However there is increasing evidence that the oscillating pulsatile nature of the cardiac cycle can also provide important information about the cardiovascular risk conferred by hypertension, particularly in middle aged and elderly populations. [8] This pulsatile component is clinically described as the difference between the systolic and diastolic blood pressure or better known as the pulse pressure.

Patients with ESRD exhibit vascular abnormalities that contribute to elevated pulse pressure, including increased arterial stiffness, pulse-wave velocity and early wave deflection. [9] There is now evidence to suggest that pulse pressure particularly the post dialysis reading may be a predictor of cardiovascular outcome. In an observational study [6], it was shown that pulse pressure was associated with risk of death in a large sample of patients undergoing maintenance haemodialysis. Data submitted to the National Renal Registry was analysed to determine the trend and association if any between the pulse pressure and survival for both HD and CAPD patients.

## Pulse Pressure - Haemodialysis

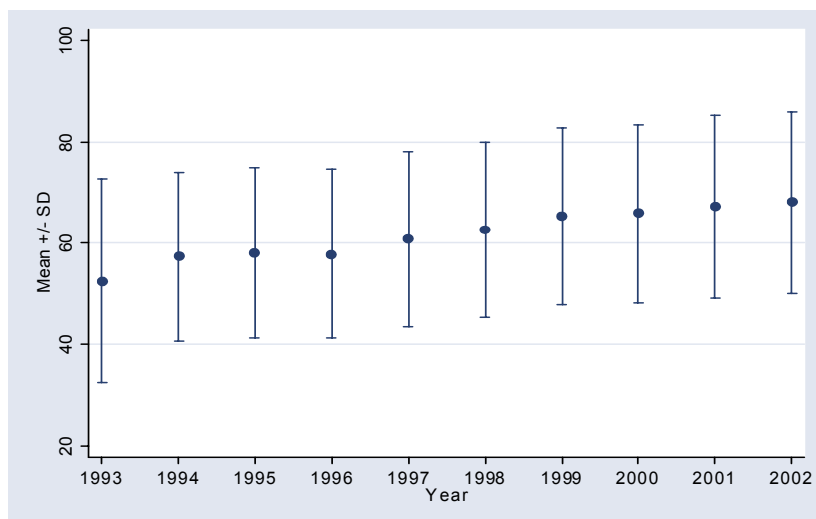
The mean pulse pressure in haemodialysis patients rose from  $52.5 \pm 20$  mmHg in 1993 to  $68 \pm 17.9$  mmHg in 2002. This represents an increase of 15.5 mmHg. This increase may be contributed by the increasing number of elderly patients receiving dialysis in the later years. (Table 9.25, Figure 9.25) Pulse pressure was also noted to be influenced by age and diabetes but not with gender. (Table 9.26). There was a trend towards higher pulse pressure readings in the older age group ( $\geq 60$  years) as compared to the younger ages. Diabetes also affected the pulse pressure with diabetic patients having a higher pulse pressure compared to non diabetic patients. Both these data support the finding of increase vessel wall stiffness in elderly and diabetic patients.

Table 9.27 shows that patients with a pulse pressure  $\geq 80$  mmHg appeared to have poorer five year survival compared to patients with pulse pressure of  $< 80$  mmHg. However when adjusted for age, gender, primary diagnosis and time on RRT the difference was not significant. Instead, those with pulse pressure  $< 50$  mmHg had a significantly higher risk of mortality. (Table 9.28, Fig 9.28) A possible explanation may be that pulse pressure in our analysis was based on pre-dialysis blood pressure while most studies looked at the post-dialysis pulse pressure[3].

**Table 9.25** Distribution of Pulse Pressure (mmHg), HD patients 1993-2002

Year	No of subjects	Mean	SD	Median	LQ	UQ	% patients < 50 mmHg	% patients 50- <60 mmHg	% patients 60-<70 mmHg	% patients 70-<80 mmHg	% patients ≥80 mmHg
1993	715	52.5	20	51.8	41.8	64.3	43	24	15	9	9
1994	937	57.3	16.7	55.2	45	67.5	35	25	19	11	11
1995	1019	58.1	16.8	56.7	45.8	68.8	35	23	19	12	11
1996	1239	57.8	16.6	55.8	46	68.1	35	24	20	11	11
1997	1661	60.8	17.3	59.2	48.3	71.7	28	23	22	13	14
1998	2109	62.6	17.3	61.1	50	73.3	24	23	21	16	16
1999	2967	65.2	17.4	63.5	53	76.2	19	22	23	17	20
2000	4312	65.8	17.5	64.3	53	77.3	19	22	22	17	21
2001	5148	67.1	18	65.5	53.8	79.3	17	21	21	17	24
2002	5590	68	17.9	66.5	55	79.9	16	20	21	18	25

**Figure 9.25** Distribution of Pulse Pressure (mmHg), HD patients 1993-2002



**Table 9.26** Distribution of Pulse Pressure in relation to Age, HD patients 1993-2002

Year		Age group (years)							
		<20		20-39		40-59		≥60	
1993	Mean ± SD	44.1	11.2	46.6	17.4	57.2	20.8	66.6	19.8
	Median ± IQR	42.5	13.5	47.5	16.1	57	25.8	66.7	23.1
1994	Mean ± SD	48.2	10.2	51	13.7	61.9	17	69.9	16.9
	Median ± IQR	48.1	12	49.8	18.3	60.9	21.7	68	27.6
1995	Mean ± SD	47.4	10.2	52.1	13.9	62	16.8	70.6	17.9
	Median ± IQR	46.1	13.8	50.4	17.6	61.4	23	70.6	26.1
1996	Mean ± SD	47.5	12	51.7	13.1	61.3	17	72	16.2
	Median ± IQR	46.6	15.2	50	17	60	21.4	72.6	23.6
1997	Mean ± SD	49	11.1	52.7	13.1	65.4	17.4	71.6	17.2
	Median ± IQR	49.2	17.2	51.7	16.7	64.4	24.3	70	25.2
1998	Mean ± SD	49.9	11.6	54.5	13.4	66.6	17.1	73.5	17.7
	Median ± IQR	48.3	17.4	53.3	17.3	66.7	22.3	72.8	22.8
1999	Mean ± SD	51.4	12.5	56.8	13.3	68.8	16.8	74.9	18.6
	Median ± IQR	50.8	17.3	55.8	17.3	67.8	23	74.8	24.4
2000	Mean ± SD	51.6	12.8	57	13.6	68.4	17	74.5	17.9
	Median ± IQR	49.8	15.7	56.3	17.5	67.5	24	74.2	25.8
2001	Mean ± SD	51.1	11.1	58.1	14	69.7	17.5	74.6	18.4
	Median ± IQR	50.3	16.4	56.7	18	68.6	25	74.2	24.5
2002	Mean ± SD	51.8	12.5	58.5	13.5	70.5	17.4	75.3	18.6
	Median ± IQR	49.2	17	57.9	18	69.8	24.3	74.5	25.8

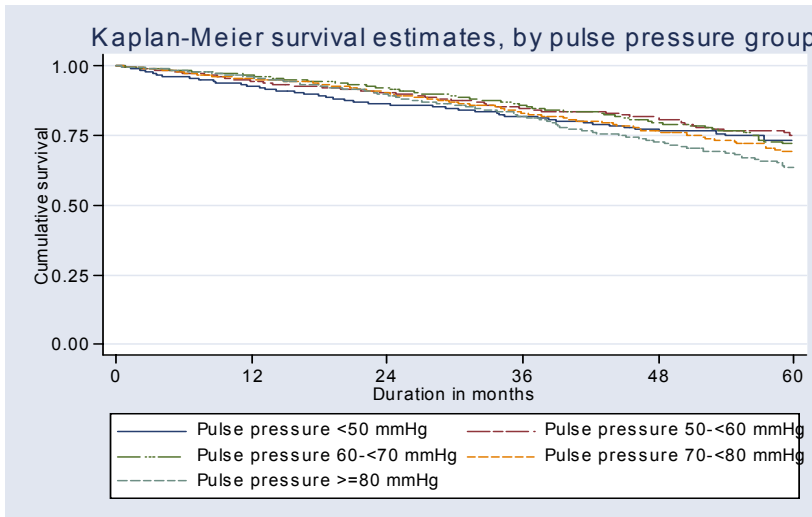
**Table 9.27** Unadjusted five year patient survival in relation to Pulse Pressure, HD 1997-2002

Pulse Pressure Interval (months)	<50 mmHg		50-<60 mmHg		60-<70 mmHg		70-<80 mmHg		≥80 mmHg	
	% survival	SE	% survival	SE	% survival	SE	% survival	SE	% survival	SE
6	96	1	97	0	98	0	97	1	97	0
12	92	1	94	1	95	1	93	1	93	1
24	86	1	89	1	89	1	87	1	82	1
36	82	2	84	1	82	1	78	2	72	2
48	78	2	81	2	76	2	71	2	62	2
60	75	2	76	2	70	2	64	2	53	2

**Table 9.28** Adjusted five-year patient survival in relation to Pulse Pressure, HD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

Pulse Pressure	n	Hazard ratio	95% CI	p-value
<50 mmHg	772	1.33	(1.06, 1.65)	0.012
50-<60 mmHg	1235	1.04	(0.85, 1.26)	0.718
60-<70 mmHg	1399	1.00	-	-
70-<80 mmHg	1214	0.95	(0.79, 1.13)	0.550
≥ 80 mmHg	1449	1.05	(0.88, 1.24)	0.581

**Figure 9.28** Adjusted five-year patient survival in relation to Pulse Pressure, HD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

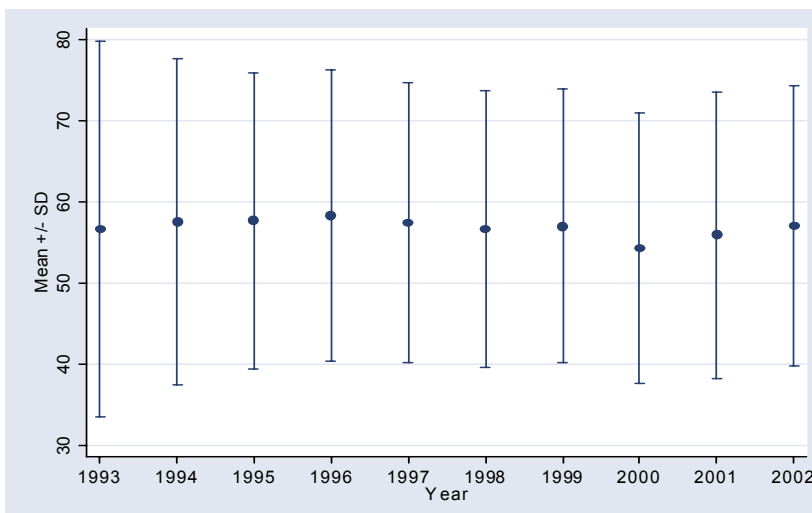


### Pulse Pressure - CAPD

The mean pulse pressure for patients receiving CAPD remained constant through the years. (Figure 9.29) Gender did not appear to have any effect on pulse pressure however age and diabetes status influenced the pulse pressure. There was a trend towards higher pulse pressure readings in the older age group ( $\geq 60$  years) as compared to the younger ages. Diabetes also affected the pulse pressure with diabetic patients having a higher pulse pressure compared to non diabetic patients.

Table 9.30 shows a poorer five year survival outcome for CAPD patients with a pulse pressure 70 to <80 mmHg as compared to the other age groups. However when adjusted for age, gender, primary diagnosis and time on RRT, there were no significant differences between the different groups including the group with pulse pressure 70 to < 80 mmHg when compared to the reference group with pulse pressure 60 to <70 mmHg. (Table 9.31, Figure 9.31)

**Figure 9.29** Distribution of Pulse Pressure (mmHg), CAPD patients 1993-2002



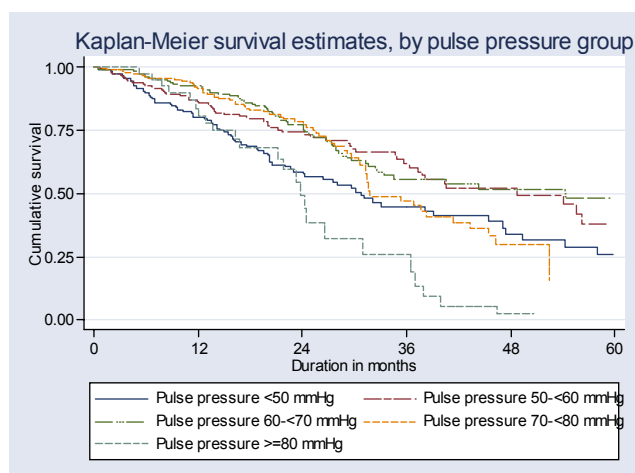
**Table 9.30** Unadjusted five-year patient survival in relation to Pulse Pressure, CAPD patients 1997-2002

Pulse Pressure Interval (months)	<50 mmHg		50-<60 mmHg		60-<70 mmHg		70-<80 mmHg		≥80 mmHg	
	% survival	SE	% survival	SE	% survival	SE	% survival	SE	% survival	SE
6	96	1	95	1	95	1	93	2	99	1
12	92	1	89	2	90	2	86	3	91	4
24	82	2	79	3	70	4	67	5	70	7
36	76	3	68	4	45	5	31	6	56	9
48	70	4	59	5	41	5	16	5	28	10
60	65	4	46	7	37	6	8	6	28	10

SE=standard error

**Table 9.31** Adjusted five-year patient survival in relation to Pulse Pressure, CAPD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

Pulse Pressure	n	Hazard ratio	95% CI	p-value
<50 mmHg	446	0.97	(0.68, 1.38)	0.872
50-<60 mmHg	294	0.83	(0.59, 1.16)	0.273
60-<70 mmHg	227	1.00	-	-
70-<80 mmHg	146	1.05	(0.75, 1.49)	0.763
≥80 mmHg	93	0.63	(0.39, 1.01)	0.055

**Figure 9.31** Adjusted five-year patient survival in relation to Pulse Pressure, CAPD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

## Treatment of Hypertension

There was a 10% increase in the number of patients on anti hypertensive drugs in haemodialysis patients. The number of patients requiring two or more antihypertensive has increased from 21% in 1994 to 32% in 2002. (Table 9.32)

Similarly, the number of CAPD patients on antihypertensive drugs had increased by 10% in 10

years studied. (Table 9.33) More patients on CAPD (50%) required two or more antihypertensives.

There had been consistently higher proportion of CAPD patients on antihypertensive drugs compared to haemodialysis. This may explain the better BP control achieved in CAPD patients.

**Table 9.32** Treatment for hypertension, HD patients 1993-2002

Year	No.	% on anti-hypertensives	% on 1 anti-hypertensives	% on 2 anti-hypertensives	% on 3 anti-hypertensives
1993	718	57	57	0	0
1994	963	57	36	16	5
1995	1034	59	34	19	6
1996	1256	58	34	18	6
1997	1697	61	34	21	6
1998	2142	63	36	20	7
1999	2998	67	36	23	8
2000	4395	67	39	21	7
2001	5196	67	37	23	7
2002	5674	67	35	24	8

**Table 9.33** Treatment for hypertension, CAPD patients 1993-2002

Year	No.	% on anti-hypertensives	% on 1 anti-hypertensives	% on 2 anti-hypertensives	% on 3 anti-hypertensives
1993	102	70	70	0	0
1994	122	76	33	32	11
1995	256	79	39	28	13
1996	371	82	38	25	20
1997	477	83	32	33	18
1998	541	88	34	31	23
1999	610	82	30	33	19
2000	662	78	31	27	20
2001	781	76	31	28	18
2002	889	81	31	31	19

## DYSLIPIDAEMIA

### Introduction

Over the past few decades, epidemiological studies have convincingly identified hyperlipidaemia as a modifiable major risk factor for cardiovascular disease in the general population. In the Framingham study, the risk for myocardial reinfarction was increased about 9 times in women and about 3 times in men with total cholesterol >270 mg/dl compared with individuals with total cholesterol lower than 190 mg/dl [13]. The Multiple Risk Factor Intervention Trial (MRFIT) showed that a male smoker with serum cholesterol and systolic blood pressure in the highest quartiles is 20 times more likely than a male non-smoker with cholesterol and systolic blood pressure in the lowest quartiles to die of coronary heart disease during a 12 year period[14]. The relationship between hypertriglyceridemia and coronary risk is complex. Renal failure is associated with altered lipoprotein metabolism. The characteristic plasma lipid abnormality is a moderate hypertriglyceridemia although this is not manifested in all patients with renal failure [18].

### Results & Discussion

#### Serum Cholesterol

The data on lipid in this study is limited to total cholesterol levels and triglyceride levels.

The mean cholesterol levels in both

haemodialysis patients and CAPD patients were relatively stable over the past 10 years (Table 9.34, Figure 9.34 and Table 9.35, Figure 9.35). CAPD patients appear to have higher mean cholesterol levels compared to haemodialysis patients over the past 10 years. In 2002, 37% of haemodialysis patients and 57% of CAPD patients have elevated total cholesterol levels (> 5.3 mmol/l)

Not unexpectedly, young haemodialysis patients (< 20 years) generally had lower total cholesterol levels than older patients (Table 9.36). For CAPD population, patients older than 40 years showed a decreasing cholesterol level over the ten years studied resulting in similar cholesterol levels in all age groups in the last two years of 2001 to 2002 (Table 9.37). Female patients had consistently higher cholesterol levels in both dialysis modalities (Table 9.38, Table 9.39). Mean cholesterol levels were similar in diabetics and nondiabetics in both dialysis modalities (Table 9.40, Table 9.41)

Dialysis patients with very low total cholesterol levels (< 3.5 mmol/l) had a lower unadjusted and adjusted 5 year patient survival compared to those with normal or high cholesterol levels in both dialysis modalities (Table 9.42, Table 9.43, Table 9.45, Figures 9.42, 9.43, 9.44). Cholesterol in our dialysis population possibly is more a nutritional marker and malnutrition led to low cholesterol level. Malnutrition has an adverse impact on the survival of dialysis patients.

**Table 9.34** Distribution of Cholesterol (mmol/L), HD patients 1993-2002

Year	No of subjects	Mean	SD	Median	LQ	UQ	% patients <3.5 mmol/L	% patients 3.5-<5.3 mmol/L	% patients 5.3-<6.2 mmol/L	% patients ≥6.2 mmol/L
1993	319	5.2	1.8	4.9	4.2	5.9	8	48	25	19
1994	461	4.9	1.3	4.9	4.1	5.7	10	52	23	15
1995	559	5.1	1.4	5	4.2	5.8	8	50	26	16
1996	661	5.1	1.4	5	4.2	5.9	10	49	22	19
1997	1160	5.1	1.4	5.1	4.2	5.9	8	49	24	19
1998	1167	5.1	1.3	5	4.2	5.8	8	53	22	17
1999	1873	5	1.3	4.9	4.1	5.7	10	54	20	15
2000	2959	5	1.2	4.9	4.2	5.8	8	53	23	16
2001	3900	5.1	1.3	4.9	4.2	5.8	8	52	24	16
2002	4417	5	1.2	4.9	4.2	5.7	9	54	24	13

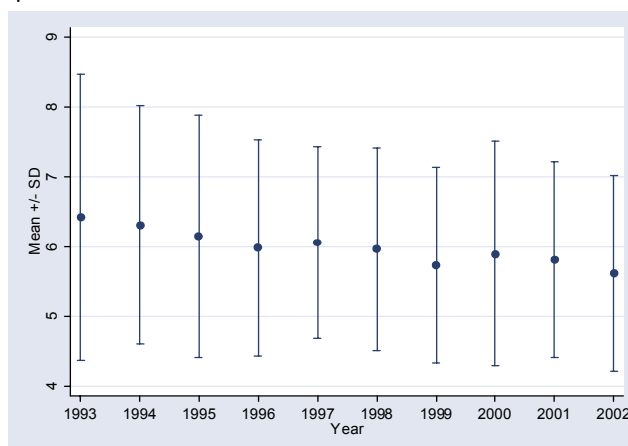
**Table 9.35** Distribution of Cholesterol (mmol/L), CAPD patients 1993-2002

Year	No of subjects	Mean	SD	Median	LQ	UQ	% patients <3.5 mmol/L	% patients 3.5-<5.3 mmol/L	% patients 5.3-<6.2 mmol/L	% patients ≥ 6.2 mmol/L
1993	86	6.4	2.1	6	5.1	7.3	2	28	23	47
1994	113	6.3	1.7	6	5.3	6.9	0	26	28	46
1995	220	6.1	1.7	6	5	6.9	3	28	25	43
1996	318	6	1.5	5.9	5	6.8	3	30	29	39
1997	421	6.1	1.4	6	5.1	6.9	2	27	28	43
1998	348	6	1.4	5.9	5	6.8	3	29	28	41
1999	434	5.7	1.4	5.6	4.9	6.4	3	37	30	31
2000	526	5.9	1.6	5.7	4.9	6.7	3	31	30	36
2001	581	5.8	1.4	5.7	4.8	6.6	2	36	27	35
2002	764	5.6	1.4	5.5	4.6	6.5	4	38	28	29

**Figure 9.34** Distribution of Cholesterol (mmol/L), HD patients 1993-2002



**Figure 9.35** Distribution of Cholesterol (mmol/L), CAPD patients 1993-2002



**Table 9.36** Distribution of Cholesterol in relation to Age, HD patients 1993-2002

Year		Age group (years)							
		<20		20-39		40-59		≥60	
1993	Mean ± SD	5.2	3.4	5.1	1.9	5.3	1.5	5.2	1.8
	Median ± IQR	4.3	0.8	4.8	1.8	5.2	1.6	5.3	2.4
1994	Mean ± SD	4.2	1	4.9	1.2	5	1.3	5.2	1.4
	Median ± IQR	4.1	1.2	4.8	1.4	5.1	1.5	5.1	1.7
1995	Mean ± SD	4.5	0.9	4.8	1.2	5.3	1.6	5.3	1
	Median ± IQR	4.5	0.8	4.8	1.6	5.2	1.7	5.4	1.6
1996	Mean ± SD	4.4	0.9	4.8	1.3	5.4	1.5	5.4	1.3
	Median ± IQR	4.2	0.4	4.8	1.7	5.2	1.7	5.3	2.1
1997	Mean ± SD	4.4	1.5	5	1.4	5.3	1.4	5.3	1.2
	Median ± IQR	4.1	1.7	4.9	1.6	5.2	1.8	5.1	1.5
1998	Mean ± SD	4.5	1.5	4.9	1.2	5.3	1.3	5.3	1.3
	Median ± IQR	4.1	1.3	4.8	1.5	5.2	1.7	5.2	1.5
1999	Mean ± SD	4.4	1	4.8	1.2	5.1	1.3	5.1	1.3
	Median ± IQR	4.3	1.6	4.8	1.4	4.9	1.7	5	1.5
2000	Mean ± SD	4.3	1.5	4.9	1.2	5.1	1.2	5.1	1.3
	Median ± IQR	3.9	1.2	4.8	1.5	5	1.6	5	1.7
2001	Mean ± SD	4.5	1.4	4.9	1.2	5.1	1.3	5.1	1.3
	Median ± IQR	4.3	1.3	4.8	1.4	5.1	1.6	5.1	1.7
2002	Mean ± SD	4.4	1	4.8	1.2	5.1	1.2	5	1.2
	Median ± IQR	4.3	1.2	4.7	1.4	5	1.6	5	1.5

**Table 9.37** Distribution of Cholesterol in relation to Age, CAPD patients 1993-2002

Year		Age group (years)							
		<20		20-39		40-59		≥60	
1993	Mean ± SD	5.2	1	5.7	2.2	6.8	2.1	6.7	1.8
	Median ± IQR	5.1	1.5	5.1	2.1	6.5	2.4	6	3.1
1994	Mean ± SD	5.8	1	5.8	1.1	6.4	1.7	6.9	2.5
	Median ± IQR	5.9	1.6	5.8	1.5	6	1.9	6.6	1.3
1995	Mean ± SD	6	1.7	5.5	1.4	6.4	1.9	6	1.4
	Median ± IQR	5.8	2.5	5.3	1.7	6.2	2	6.2	1.7
1996	Mean ± SD	5.8	1.8	5.7	1.5	6.1	1.6	5.9	1.4
	Median ± IQR	5.2	1.8	5.6	1.9	6	1.7	5.9	1.9
1997	Mean ± SD	5.9	1.3	5.7	1.3	6.2	1.4	6.3	1.4
	Median ± IQR	5.6	2	5.8	1.6	6.1	1.8	6.1	1.7
1998	Mean ± SD	6.3	1.7	5.8	1.2	6	1.6	5.8	1.3
	Median ± IQR	5.9	1.7	5.7	1.6	5.9	1.8	5.9	1.9
1999	Mean ± SD	5	1.7	5.7	1.4	5.9	1.3	5.7	1.3
	Median ± IQR	5.2	1.7	5.6	1.5	5.8	1.5	5.5	1.9
2000	Mean ± SD	5.4	2.4	5.9	1.6	6	1.4	5.9	1.6
	Median ± IQR	5.2	2.1	5.7	1.7	5.8	1.7	5.6	2.1
2001	Mean ± SD	5.9	1.4	5.8	1.6	5.9	1.4	5.6	1.1
	Median ± IQR	5.6	1.8	5.6	1.9	5.8	1.7	5.6	1.6
2002	Mean ± SD	5.7	1.7	5.6	1.3	5.6	1.3	5.6	1.4
	Median ± IQR	5.5	1.8	5.4	1.9	5.5	1.8	5.5	1.7

**Table 9.38** Distribution of Cholesterol in relation to Gender, HD patients 1993-2002

Year		Gender			
		Male		Female	
1993	Mean ± SD	5	1.4	5.7	2.2
	Median ± IQR	4.8	1.7	5.4	2.1
1994	Mean ± SD	4.8	1.2	5.2	1.3
	Median ± IQR	4.8	1.6	5.2	1.3
1995	Mean ± SD	4.9	1.4	5.4	1.4
	Median ± IQR	4.8	1.6	5.3	1.5
1996	Mean ± SD	5	1.4	5.3	1.5
	Median ± IQR	4.8	1.6	5.2	1.8
1997	Mean ± SD	5	1.4	5.4	1.4
	Median ± IQR	4.9	1.6	5.3	1.7
1998	Mean ± SD	5	1.3	5.3	1.4
	Median ± IQR	4.9	1.5	5.2	1.6
1999	Mean ± SD	4.8	1.2	5.3	1.3
	Median ± IQR	4.7	1.5	5.1	1.6
2000	Mean ± SD	4.8	1.2	5.3	1.2
	Median ± IQR	4.8	1.6	5.2	1.6
2001	Mean ± SD	4.9	1.2	5.3	1.3
	Median ± IQR	4.8	1.5	5.2	1.6
2002	Mean ± SD	4.8	1.2	5.2	1.2
	Median ± IQR	4.7	1.4	5.2	1.5

**Table 9.39** Distribution of Cholesterol in relation to Gender, CAPD patients 1993-2002

Year		Gender			
		Male		Female	
1993	Mean ± SD	6.2	2.5	6.6	1.6
	Median ± IQR	5.6	2.1	6.5	2.5
1994	Mean ± SD	6	1.5	6.7	1.8
	Median ± IQR	5.8	1.8	6.3	1.8
1995	Mean ± SD	5.8	1.7	6.4	1.8
	Median ± IQR	5.8	2.2	6.2	2.2
1996	Mean ± SD	5.8	1.4	6.2	1.6
	Median ± IQR	5.9	1.9	5.9	2.2
1997	Mean ± SD	5.8	1.3	6.2	1.4
	Median ± IQR	5.7	1.7	6.2	1.8
1998	Mean ± SD	5.8	1.4	6.1	1.5
	Median ± IQR	5.7	1.6	6	1.7
1999	Mean ± SD	5.5	1.3	5.9	1.4
	Median ± IQR	5.3	1.6	5.8	1.5
2000	Mean ± SD	5.5	1.5	6.2	1.6
	Median ± IQR	5.5	1.7	6.1	1.8
2001	Mean ± SD	5.5	1.2	6.1	1.5
	Median ± IQR	5.3	1.5	6	1.8
2002	Mean ± SD	5.2	1.3	6	1.4
	Median ± IQR	5.1	1.7	5.9	1.8

**Table 9.40** Distribution of Cholesterol in relation to Diabetes mellitus, HD patients 1993-2002

Year		Diabetes mellitus			
		Without DM		With DM	
1993	Mean ± SD	5.3	1.9	5.1	1.2
	Median ± IQR	4.9	1.8	5.1	1.6
1994	Mean ± SD	4.9	1.3	5	1.3
	Median ± IQR	4.8	1.5	5.1	1.6
1995	Mean ± SD	5.1	1.4	5.3	1.6
	Median ± IQR	4.9	1.6	5.3	1.8
1996	Mean ± SD	5.1	1.4	5.2	1.4
	Median ± IQR	4.9	1.7	5.2	1.9
1997	Mean ± SD	5.1	1.3	5.4	1.6
	Median ± IQR	5	1.7	5.3	1.7
1998	Mean ± SD	5.1	1.3	5.3	1.3
	Median ± IQR	4.9	1.6	5.2	1.6
1999	Mean ± SD	4.9	1.2	5.2	1.3
	Median ± IQR	4.8	1.6	5.1	1.8
2000	Mean ± SD	5	1.2	5.1	1.3
	Median ± IQR	4.9	1.6	5	1.7
2001	Mean ± SD	5	1.2	5.1	1.3
	Median ± IQR	4.9	1.5	5	1.7
2002	Mean ± SD	4.9	1.2	5	1.3
	Median ± IQR	4.9	1.4	4.9	1.6

**Table 9.41** Distribution of Cholesterol in relation to Diabetes mellitus, CAPD patients 1993-2002

Year		Diabetes mellitus			
		Without DM		With DM	
1993	Mean ± SD	6.3	2.2	6.7	1.7
	Median ± IQR	5.9	2	6.3	2.7
1994	Mean ± SD	6.2	1.5	6.7	2
	Median ± IQR	5.9	1.7	6.3	1.6
1995	Mean ± SD	6.1	1.9	6.1	1.4
	Median ± IQR	6	2.2	6.2	1.8
1996	Mean ± SD	6	1.6	5.9	1.5
	Median ± IQR	5.9	1.9	5.9	1.9
1997	Mean ± SD	6.1	1.3	6.1	1.5
	Median ± IQR	6	1.7	5.9	1.9
1998	Mean ± SD	6	1.4	5.9	1.5
	Median ± IQR	5.9	1.7	5.9	1.8
1999	Mean ± SD	5.8	1.4	5.6	1.4
	Median ± IQR	5.8	1.6	5.4	1.5
2000	Mean ± SD	6	1.7	5.7	1.3
	Median ± IQR	5.8	1.8	5.5	1.8
2001	Mean ± SD	5.9	1.4	5.7	1.4
	Median ± IQR	5.7	1.8	5.6	1.7
2002	Mean ± SD	5.7	1.4	5.4	1.4
	Median ± IQR	5.6	1.8	5.3	1.6

**Table 9.42** Unadjusted five-year patient survival in relation to Cholesterol, HD patients 1997-2002

Cholesterol Interval (months)	<3.5 mmol/L		3.5-<5.3 mmol/L		5.3-<6.2 mmol/L		≥6.2 mmol/L	
	% survival	SE	% survival	SE	% survival	SE	% survival	SE
6	98	1	98	0	99	0	99	0
12	94	1	96	0	97	0	96	1
24	80	3	90	1	93	1	92	1
36	72	3	83	1	87	1	86	2
48	66	4	77	1	81	2	77	3
60	55	5	71	1	74	2	72	3

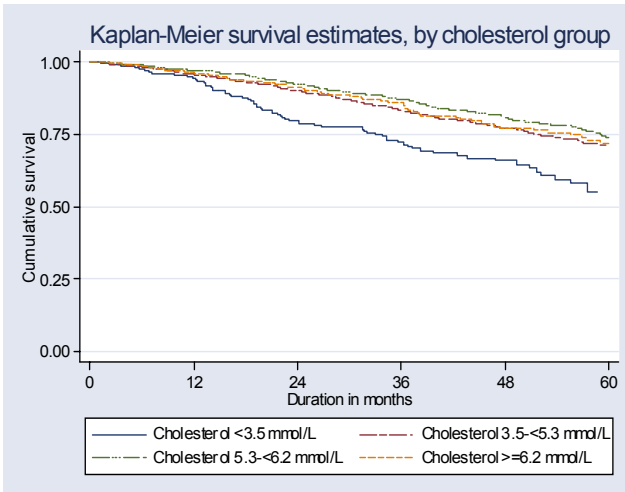
SE=standard error

**Table 9.43** Unadjusted five-year patient survival in relation to Cholesterol, CAPD patients 1997-2002

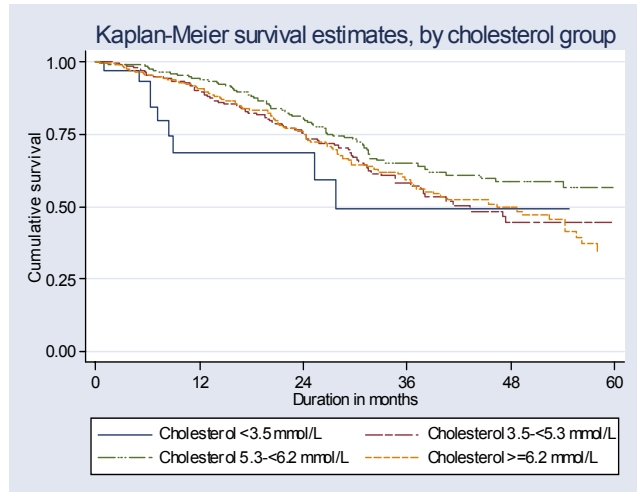
Cholesterol Interval (months)	<3.5 mmol/L		3.5-<5.3 mmol/L		5.3-<6.2 mmol/L		≥6.2 mmol/L	
	% survival	SE	% survival	SE	% survival	SE	% survival	SE
6	93	5	96	1	98	1	96	1
12	69	10	90	2	95	1	91	2
24	69	10	76	3	81	3	76	3
36	49	14	58	4	65	4	59	4
48	49	14	45	5	59	4	50	4
60	-	-	45	5	57	4	34	6

SE=standard error

**Figure 9.42** Unadjusted five-year patient survival in relation to Cholesterol, HD patients 1997-2002



**Figure 9.43** Unadjusted five-year patient survival in relation to Cholesterol, CAPD patients 1997-2002



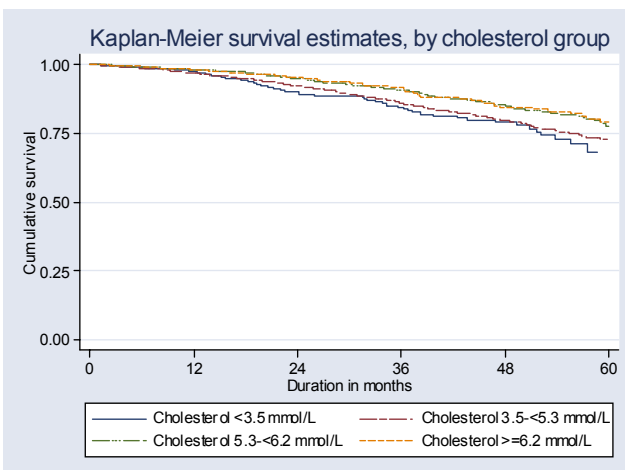
**Table 9.44** Adjusted five-year patient survival in relation to Cholesterol, HD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

Cholesterol	Hazard ratio	95% CI	p-value
<3.5 mmol/L	1.76	(1.39, 2.24)	0.000
3.5-<5.3 mmol/L	1.00	-	-
5.3-<6.2 mmol/L	0.76	(0.63, 0.91)	0.003
≥6.2 mmol/L	0.82	(0.65, 1.04)	0.100

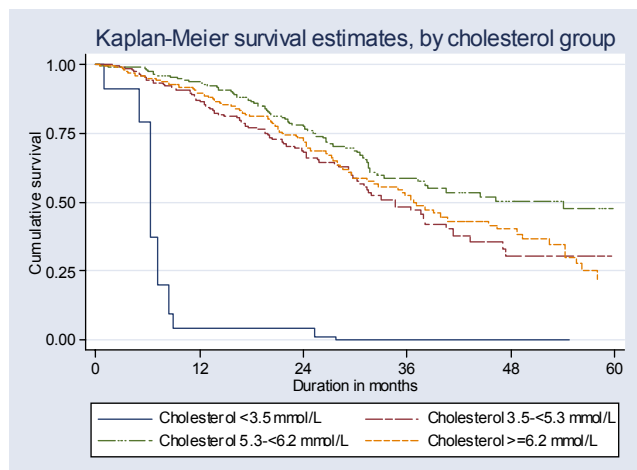
**Table 9.45** Adjusted five-year patient survival in relation to Cholesterol, CAPD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

Cholesterol	n	Hazard ratio	95% CI	p-value
<3.5 mmol/L	34	2.24	(1.10, 4.54)	0.026
3.5-<5.3 mmol/L	350	1.00	-	-
5.3-<6.2 mmol/L	331	0.82	(0.60, 1.12)	0.219
≥6.2 mmol/L	365	1.14	(0.84, 1.54)	0.403

**Figure 9.44** Adjusted five-year patient survival in relation to Cholesterol, HD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)



**Figure 9.45** Adjusted five-year patient survival in relation to Cholesterol, CAPD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)



## Serum triglyceride

Mean triglyceride levels remained relatively stable over the past 10 years in both dialysis modalities (Table 9.46, Table 9.47 ). There was a higher proportion of patients with elevated triglyceride levels (> 2.3 mmol/l) in CAPD patients compared to haemodialysis patients (40% versus 30% in 2002) (Table 9.46, Table 9.47). There was no definite effect of age on triglyceride levels. (Table 9.48) There was no difference in the mean triglyceride levels between male and female patients in both dialysis modalities (Table 9.49, Table 9.50 ). Diabetics had slightly higher mean triglyceride levels compared to non-diabetics in both dialysis modalities (Table 9.51, Table 9.52 ).

In both CAPD and HD patients very high triglyceride levels (> 3.5 mmol/l) were associated

with better adjusted 5 year patient survival (Table 9.54, Table 9.55). In addition very low triglyceride levels (<1.7 mmol/l) was associated with poorer adjusted 5 year patient survival in haemodialysis patients only and not in CAPD. These results are difficult to explain. Perhaps serum triglyceride like cholesterol in our dialysis population may be more a nutritional marker than a cardiovascular risk factor.

Hence further studies are needed on the effect of cholesterol and triglyceride on dialysis patient outcome. Till then, caution is needed to extrapolate evidence from the general population to the dialysis population.

**Table 9.46** Distribution of Triglyceride (mmol/L), HD patients 1993-2002

Year	No of subjects	Mean	SD	Median	LQ	UQ	% patients <1.7 mmol/L	% patients 1.7-<2.3 mmol/L	% patients 2.3-<3.5 mmol/L	% patients ≥3.5 mmol/L
1993	316	2.3	2	1.8	1.3	2.6	48	22	17	12
1994	411	2.2	1.6	1.8	1.3	2.6	46	21	19	13
1995	504	2.1	1.4	1.7	1.3	2.6	48	22	17	12
1996	570	2.2	1.6	1.8	1.3	2.7	43	23	21	12
1997	1076	2.1	1.4	1.8	1.3	2.5	45	24	18	12
1998	1090	2.2	1.5	1.8	1.3	2.6	42	26	20	12
1999	1635	2.1	1.3	1.7	1.2	2.5	49	22	18	11
2000	2396	2.1	1.4	1.7	1.3	2.6	48	22	19	12
2001	3164	2.1	1.4	1.7	1.2	2.5	48	22	17	13
2002	3595	2.1	1.4	1.8	1.2	2.5	47	23	18	12

**Table 9.47** Distribution of Triglyceride (mmol/L), CAPD patients 1993-2002

Year	No of subjects	Mean	SD	Median	LQ	UQ	% patients <1.7 mmol/L	% patients 1.7-<2.3 mmol/L	% patients 2.3-<3.5 mmol/L	% patients ≥3.5 mmol/L
1993	92	3.4	2.8	2.6	1.7	3.7	24	20	28	28
1994	115	3	2.5	2.4	1.5	3.5	30	18	26	25
1995	216	2.8	2	2.2	1.5	3.4	32	21	23	24
1996	318	2.7	2.1	2	1.4	3.3	37	21	19	22
1997	414	2.6	1.9	2.2	1.4	3	36	21	25	18
1998	344	2.4	1.8	1.8	1.3	3	42	22	17	19
1999	421	2.4	1.6	2	1.4	3	38	25	18	19
2000	520	2.7	2.2	2.1	1.5	3	33	24	23	21
2001	576	2.6	1.8	2	1.4	3	36	22	22	20
2002	765	2.5	1.7	2	1.4	3	39	21	22	18

**Table 9.48** Distribution of Triglyceride in relation to Age, HD patients 1993-2002

Year		Age group (years)							
		<20		20-39		40-59		≥60	
1993	Mean ± SD	2.9	3.5	2.2	2.1	2.4	1.8	2	0.7
	Median ± IQR	1.6	1	1.6	1.1	1.9	1.4	1.9	1
1994	Mean ± SD	2	1	2	1.2	2.4	1.9	2.2	1.5
	Median ± IQR	1.7	1.1	1.7	1.2	1.8	1.4	1.7	1.6
1995	Mean ± SD	2	0.9	2	1.3	2.3	1.5	2.1	1.3
	Median ± IQR	2.1	1.1	1.6	1.1	1.9	1.4	1.6	1.6
1996	Mean ± SD	1.9	0.8	2	1.3	2.5	1.8	2	1.3
	Median ± IQR	2.1	1.4	1.7	1.3	1.9	1.6	1.8	1.3
1997	Mean ± SD	1.8	1.1	2	1.1	2.3	1.6	2.2	1.3
	Median ± IQR	1.6	0.8	1.7	1.2	1.8	1.4	1.9	1.2
1998	Mean ± SD	2.1	1.3	2.1	1.4	2.4	1.7	2.2	1.2
	Median ± IQR	1.7	1.1	1.7	1.2	1.9	1.4	1.9	1.3
1999	Mean ± SD	1.8	1	1.9	1.1	2.2	1.4	2.1	1.3
	Median ± IQR	1.5	1	1.6	1.3	1.8	1.3	1.8	1
2000	Mean ± SD	1.8	0.7	2	1.3	2.2	1.4	2.1	1.3
	Median ± IQR	1.6	1	1.6	1.2	1.8	1.5	1.8	1.3
2001	Mean ± SD	1.6	0.6	2	1.4	2.2	1.4	2.1	1.5
	Median ± IQR	1.6	0.8	1.6	1.3	1.8	1.4	1.8	1.5
2002	Mean ± SD	1.6	0.7	1.9	1.3	2.2	1.5	2.2	1.5
	Median ± IQR	1.5	0.9	1.6	1.1	1.8	1.4	1.8	1.4

**Table 9.49** Distribution of Triglyceride in relation to Gender, HD patients 1993-2002

Year		Gender			
		Male		Female	
1993	Mean ± SD	2.3	1.9	2.3	2.1
	Median ± IQR	1.8	1.3	1.8	1.3
1994	Mean ± SD	2.2	1.5	2.3	1.8
	Median ± IQR	1.8	1.3	1.8	1.2
1995	Mean ± SD	2.1	1.2	2.2	1.7
	Median ± IQR	1.7	1.4	1.7	1.2
1996	Mean ± SD	2.2	1.4	2.2	1.8
	Median ± IQR	1.8	1.4	1.8	1.4
1997	Mean ± SD	2.2	1.4	2.1	1.4
	Median ± IQR	1.8	1.3	1.7	1.2
1998	Mean ± SD	2.2	1.5	2.2	1.7
	Median ± IQR	1.9	1.3	1.8	1.3
1999	Mean ± SD	2	1.3	2.1	1.3
	Median ± IQR	1.6	1.3	1.8	1.2
2000	Mean ± SD	2.1	1.4	2.1	1.3
	Median ± IQR	1.7	1.3	1.8	1.4
2001	Mean ± SD	2.1	1.5	2.1	1.3
	Median ± IQR	1.7	1.3	1.7	1.3
2002	Mean ± SD	2.1	1.4	2.2	1.4
	Median ± IQR	1.7	1.3	1.8	1.3

**Table 9.50** Distribution of Triglyceride in relation to Gender, CAPD patients 1993-2002

Year		Gender			
		Male		Female	
1993	Mean ± SD	3.6	3.4	3.2	2.2
	Median ± IQR	2.3	2.3	2.7	1.7
1994	Mean ± SD	2.9	2.7	3	2.2
	Median ± IQR	2.2	1.9	2.6	1.8
1995	Mean ± SD	2.6	1.9	3	2.1
	Median ± IQR	2	1.9	2.3	1.9
1996	Mean ± SD	2.5	1.9	2.9	2.2
	Median ± IQR	2	1.9	2.1	2
1997	Mean ± SD	2.5	2	2.7	1.8
	Median ± IQR	2	1.8	2.3	1.7
1998	Mean ± SD	2.3	1.9	2.6	1.8
	Median ± IQR	1.7	1.3	2	1.8
1999	Mean ± SD	2.4	1.8	2.4	1.5
	Median ± IQR	1.9	1.7	2	1.6
2000	Mean ± SD	2.5	2.1	2.9	2.3
	Median ± IQR	2	1.4	2.3	1.9
2001	Mean ± SD	2.3	1.6	2.8	1.9
	Median ± IQR	1.9	1.4	2.3	2
2002	Mean ± SD	2.2	1.5	2.7	1.9
	Median ± IQR	1.8	1.3	2.2	1.8

**Table 9.51** Distribution of Triglyceride in relation to Diabetes mellitus, HD patients 1993-2002

Year		Diabetes mellitus			
		Without DM		With DM	
1993	Mean ± SD	2.2	1.9	2.9	2.3
	Median ± IQR	1.6	1.2	2.2	1.3
1994	Mean ± SD	2.1	1.5	2.6	1.9
	Median ± IQR	1.7	1.2	2.1	1.9
1995	Mean ± SD	2	1.2	2.5	1.9
	Median ± IQR	1.7	1.1	2.1	2.3
1996	Mean ± SD	2.2	1.4	2.5	2.2
	Median ± IQR	1.8	1.3	2	1.7
1997	Mean ± SD	2	1.2	2.6	1.8
	Median ± IQR	1.7	1.1	2.1	1.7
1998	Mean ± SD	2.1	1.4	2.5	2
	Median ± IQR	1.8	1.2	2	1.5
1999	Mean ± SD	2	1.2	2.3	1.4
	Median ± IQR	1.6	1.2	1.9	1.4
2000	Mean ± SD	2	1.3	2.3	1.5
	Median ± IQR	1.7	1.3	1.9	1.6
2001	Mean ± SD	2	1.3	2.3	1.5
	Median ± IQR	1.6	1.2	1.9	1.7
2002	Mean ± SD	2	1.3	2.4	1.6
	Median ± IQR	1.7	1.2	2	1.7

**Table 9.52** Distribution of Triglyceride in relation to Diabetes mellitus, CAPD patients 1993-2002

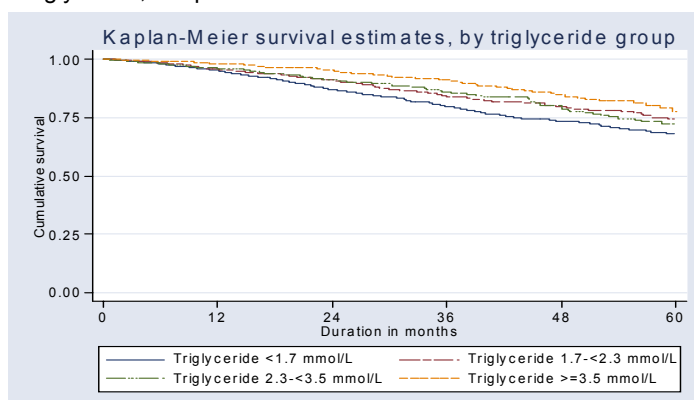
Year		Diabetes mellitus			
		Without DM		With DM	
1993	Mean ± SD	3.4	2.9	3.4	2.5
	Median ± IQR	2.6	2.3	2.8	1.8
1994	Mean ± SD	2.9	2.5	3.1	2.5
	Median ± IQR	2.4	1.8	2.3	1.9
1995	Mean ± SD	3	2.3	2.5	1.3
	Median ± IQR	2.2	2	2.2	1.8
1996	Mean ± SD	2.7	2.2	2.7	1.8
	Median ± IQR	2	1.5	2.1	2
1997	Mean ± SD	2.6	2	2.6	1.7
	Median ± IQR	2.1	1.7	2.2	1.7
1998	Mean ± SD	2.3	1.8	2.6	1.9
	Median ± IQR	1.7	1.3	2	2.2
1999	Mean ± SD	2.4	1.6	2.5	1.6
	Median ± IQR	1.9	1.5	2.1	1.8
2000	Mean ± SD	2.7	2.4	2.7	1.8
	Median ± IQR	2.1	1.5	2.2	1.8
2001	Mean ± SD	2.4	1.7	2.8	1.9
	Median ± IQR	2	1.5	2.2	2
2002	Mean ± SD	2.4	1.6	2.7	1.9
	Median ± IQR	1.9	1.6	2.1	1.9

**Table 9.53** Unadjusted five-year patient survival in relation to Triglyceride, HD patients 1997-2002

Triglyceride Interval (months)	<1.7 mmol/L		1.7-<2.3 mmol/L		2.3-<3.5 mmol/L		≥ 3.5 mmol/L	
	% survival	SE	% survival	SE	% survival	SE	% survival	SE
6	98	0	99	0	98	0	99	0
12	95	1	96	1	96	1	98	1
24	87	1	91	1	91	1	96	1
36	80	1	84	1	86	2	91	2
48	74	1	80	2	80	2	85	2
60	68	2	74	2	72	3	78	3

SE=standard error

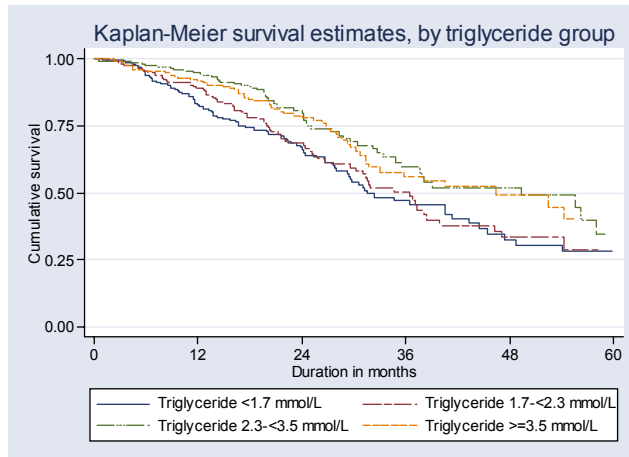
**Figure 9.53** Unadjusted five-year patient survival in relation to Triglyceride, HD patients 1997-2002



**Table 9.54** Adjusted five-year patient survival in relation to Triglyceride, HD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

Triglyceride	n	Hazard ratio	95% CI	p-value
<1.7 mmol/L	1640	1.37	(1.12, 1.66)	0.002
1.7-<2.3 mmol/L	962	1.00	-	-
2.3-<3.5 mmol/L	720	0.90	(0.70, 1.16)	0.427
≥ 3.5 mmol/L	486	0.60	(0.44, 0.82)	0.001

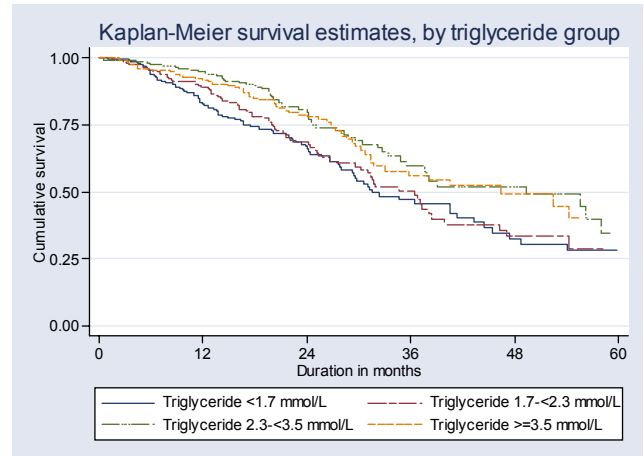
**Figure 9.54** Adjusted five-year patient survival in relation to Triglyceride, HD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)



**Table 9.55** Adjusted five-year patient survival in relation to Triglyceride, CAPD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)

Triglyceride	n	Hazard ratio	95% CI	p-value
<1.7 mmol/L	356	0.91	(0.66, 1.24)	0.535
1.7-<2.3 mmol/L	278	1.00	-	-
2.3-<3.5 mmol/L	255	0.73	(0.52, 1.03)	0.077
≥ 3.5 mmol/L	189	0.69	(0.49, 0.98)	0.040

**Figure 9.55** Adjusted five-year patient survival in relation to Triglyceride, CAPD patients 1997-2002 (Adjusted for age, gender, primary diagnosis and time on RRT)



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