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Alberto Coustasse
Marshall University, coustassehen@marshall.edu

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HOSPITAL COSTS AND CLINICAL CHARACTERISTICS OF CONTINUOUS RENAL REPLACEMENT THERAPY PATIENTS: A CONTINUOUS ETHICAL DILEMMA

Corresponding Author:
Alberto Coustasse-Hencke, MD, DrPH, MBA
Research Assistant Professor,
Health Management and Policy,
School of Public Health
University of North Texas Health Science Center
3500 Camp Bowie Blvd
Fort Worth, TX 76107
acoustas@hsc.unt.edu

ABSTRACT

This study describes the clinical characteristics and examines hospital costs involved in the care of 117 patients undergoing Continuous Renal Replacement Therapy (CRRT) between January 1999 and August 2002. The majority (70.9%) of the patients undergoing CRRT expired in the hospital. Statistically significant differences were found with respect to length of stay for discharge status and gender; and with respect to costs for surgery versus no surgery and gender. Significant differences also were found between discharge status and gender, age, and cardiovascular surgery. The results of this study raise economic and ethical questions related to the cost/benefit of CRRT and futility of the treatment. Hospitals should ensure that they have utilization protocols in place for CRRT, promote cooperation between ICU physicians and nephrologists, and create multidisciplinary CRRT teams in an effort to maximize the effectiveness of therapy and minimize costs.

Key words: Acute renal failure; end of life care; ethics; hospital costs; renal replacement therapy

INTRODUCTION

Continuous renal replacement therapy (CRRT) is the preferential mode of therapy for various critical conditions due to its safety and efficiency (Ronco and Bellomo, 1998). Among the different types of CRRT techniques are continuous arteriovenous hemofiltration (CAVH), continuous arteriovenous hemodialysis (CAVHD), continuous arteriovenous hemodiafiltration (CAVHDF), slow continuous ultrafiltration (SCUF), continuous venovenous hemofiltration (CVVH), continuous venovenous hemodialysis (CVVHD), and continuous venovenous hemodiafiltration (CVVHDF) (Brush and Bilodeau, 2001).

CRRT as renal replacement therapy has some advantages. Perhaps the most important advantage is that this therapy is considered appropriate for intensive care unit/critical care unit (ICU/CCU) patients, given the continuous process involved in the regulation or removing of fluids (Dirkes 2000 and Kellum et al., 2002). Although CRRT may be beneficial in the treatment of a number of conditions, there are also disadvantages that are associated with its use. The cost and time of pharmacies in the preparation of solutions for the replacement of fluids depending on the specific needs of the patient and different groups of physicians with different protocols of treatment is one concern (Dirkes, 2000). Additional cost concerns include the labor of ICU nurses due to high (1:1 or 2:1) staffing requirements. Differences in cost also have been observed when various CRRT techniques have been compared. For example, increased cost and complexity have been linked to CVVH and CVVHD techniques. This is primarily due to equipment requirements, as compared to CAVH and CAVHD (Vanholder, Van Biesen and Lameire, 2001).

The higher cost related to CRRT is one of the factors restricting its use, even when differences are classified as minimal when compared to intermittent hemodialysis (Bellomo and

Ronco, 1999). The importance of CRRT use for the treatment at end of life, as well as the cost concerns related to this technique, prompted us to conduct a cost analysis study. The purpose of the study was to describe the demographic and clinical characteristics and hospital costs involved in the care of patients undergoing CRRT at one Texas hospital and discuss the ethical implications of applying high technology at this stage of life.

METHODS

Patients receiving CRRT between January 1999 and August 2002 at a Texas hospital were identified using the hospital's clinical and accounting system. Data without identifiers were provided by the hospital's Quality Management department. Variables of study were age, gender, race/ethnicity, hospital length of stay, hospital discharge status, surgery, Cardio Vascular Surgery (CVS) and hospital estimated costs. Costs were estimated at 33% of hospital charges based on Friedman et al. (2002) in which costs for investor-owned hospitals of 100+ beds are shown to range from 33% to 64% of charges. T-tests were used to assess differences between hospital length of stay and estimated costs with patient characteristics, including gender, age (<65 versus 65+), discharge status (alive versus expired), surgery versus no surgery, CVS versus no CVS and race/ethnicity. Pearson Chi Square was used to assess differences between patient characteristics (age, discharge status, gender, surgery versus no surgery, CVS versus no CVS and race/ethnicity) were also analyzed. This study protocol sought and received appropriate approvals related to the protection of human subjects from the Institutional Review Board of the University of North Texas Health Science Center.

RESULTS

One hundred seventeen patients underwent CRRT during the study period. Most of them (59.8%) were 65 years and older. Females were more frequently observed (56.4%) and 59% of

patients were self-classified as non-Hispanic White, 25.6%, non-Hispanic Black, and 13.7% Hispanic (Table 1). Discharge disposition ranged from expired (71.8%) to home (11.1%), long term acute care (8.5%) transfer to another facility (4.3%) and hospice/home health (4.3%). The majority (62.3%) of the patients who underwent CRRT also had a surgical procedure, with 41% having surgery other than CVS, 16.2% having only CVS, and 5.1% having CVS along with other surgery (Table 1).

Table 1 about here

Table 2 shows patient with CRRT and their Length of Stay (LOS) by gender, being older than 65 years, discharge disposition, having surgery, having Cardio Vascular Surgery (CVS) and ethnic/ racial classification. The mean age of patients was 64.8 years with a range between 27 and 96 years. The average length of hospital stay was 17 days, ranging from 1 to 74 days. The LOS was statistically significant higher with being female, and patients which were discharge alive with 19.8 and 23. 3 days respectively, ($p<0.05$) (Table 2).

Table 2 about here

Three patients with total costs of $150,000 or greater were excluded from the analysis, as they were identified as outliers based on cost. Average estimated costs, based on 33% of total hospital charges, were $50,762, with a range of $3,518 to $147,856. The estimated cost was statistically significant higher with being female and having surgery with $ 56,407 and $56,006 respectively and ($p<0.05$) (Table 3).

Table 3 about here

More females less than 65 years old were discharge alive ($p < 0.05$) and not having cardiovascular surgery was found to be statistically significant ($p < 0.05$). In addition more indiviuals who were younger than 65 years old were found to be discharge alive from the hospital ($p < 0.05$) (Table 4).

Table 4 about here

DISCUSSION AND CONCLUSION

The statistically significant difference observed between length of stay and discharge status suggests that those who expire do so early in the hospitalization and those who survive have longer lengths of stay. Females were found to have a longer length of stay and better survival rate. The difference in survival based on gender (36.4% of females survived versus 17.6% of males) may be explained by may be to an age difference between the gender groups. An analysis by gender and age indicated a significant difference between males and females ($p = 0.037$). Similarly, the significant difference between survival and age showed that patients 65 years and older had a higher probability of not surviving. Based on the results of this analysis, we observed that among patients undergoing CRRT, increased costs were incurred for patients <65 years old that undergo surgery and who did not expire in the hospital. Being a female <65 years old was associated with better survival. In addition, patients undergoing CVS had a greater risk of expiring in the hospital.

Continuous renal replacement therapy (CRRT) continues to be a proven mode of therapy for various critical conditions due to its safety and efficiency. In this paper we reviewed the

demographic and clinical characteristics and hospital costs involved in the care of patients undergoing CRRT at one southwestern hospital. The statistically significant difference between estimated costs with individuals who had CVS compared to those without CVS was expected in that surgical procedures tend to increase cost. However, it is interesting that there was not a corresponding significant difference between length of stay and whether or not a patient had surgery, which suggests that surgery does not affect the length of stay. A minority of the patients who underwent CRRT were discharged to the home or other long term living arrangement. The statistically significant differences between discharge status and gender, age and CVS suggests further study to determine the cost/benefit of CRRT at the end of life. Clearly this raises ethical as well as economic questions in conjunction with the treatment decision making process.

End of life decisions regarding the withdrawal or withholding of life support and futile care have become commonplace within the ICU/CCUs. The concept of futile care is controversial and difficult to define. Efforts to prolonging life once considered an outcome of healing may be viewed by some as harmful acts of prolonging suffering (Romesberg, 2003). The costs of futile care for the dying are enormous. Futility can present challenges because of the monetary cost of such care, its negative effect on staff members and the burden it creates on the patient family and the clinicians (Coppa, 1996). Zamperetti et al. (2000) reported in a study of the first international course of critical nephrology, that only 55% of nephrologists believed that informed consent was necessary for initiating CRRT and 25 % would start or maintain unwanted CRRT.

In this study it was found two patients with a Do-Not-Resuscitate (DNR) who were connected to CRRT by the same nephrologists. One of these cases was referred to the hospital ethics committee and the only outcome was a recommendation to the critical care committee to

develop family conferences early in the patient process of dying. Both patients died and no changes were made in the ICU/CCU policies or in the behavior of the nephrologists, except not to connect DNR patients to CRRT. The American Medical Association Council on Ethics and Judicial Affairs recommends a process-based approach to futility determination, which includes all involved parties (AMA, 1999). I believe that early family conferences should by part of the EOL and should involve not only the nephrologists, but also the critical care physician of the ICU, nurses, social workers and case managers who are at the bedside. This multidisciplinary team should be equipped with the ethical knowledge and communication skills necessary to care for patients and families facing the ethical dilemmas of futile care. Consideration of futility during EOL did not receive adequate attention in this unit which incurred an additional human and material burden. According to Bellomo and Ronco (1999), the structural organization of both the ICU and the hospital is among the important variables related to cost in renal replacement therapy. Teamwork and effective communication between ICU/CCU physicians and nephrologists is vital for the adequate use of CRRT (Bellomo and Ronco 2000, Hansard and Haseeb 2001).

CONCLUSIONS

The creation of a CRRT team with specific functions and the development of detailed CRRT protocols are recommendations that could help in optimizing the use of the therapy and at the same time reducing costs. It is likely that hospitals may find the best cost/benefit ratio for CRRT using this approach.

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Table 1: Demographic Characteristics, Discharge Status and Kind of Surgery of Patients Undergoing CRRT (n=117)

Characteristic	N	%
Age Group		
< 65	47	40.2
65+	70	59.8
Gender		
Female	66	56.4
Male	51	43.6
Race		
NHW*	69	59
NHB**	31	26.5
Hispanic	16	13.7
Other	1	0.9
Discharge Status		
Expired	84	71.8
Home	13	11.1
Transfer	4	3.4
Nursing Home	1	0.9
Long-term Acute Care	10	8.5
Home Health/Hospice	5	4.3
Surgery		
No surgery	44	37.6
Non-CVS† with other surgery	48	41
CVS only	19	16.2
CVS with other surgery	6	5.1

* Non Hispanic White, ** Non Hispanic Black
† CVS = Cardiovascular surgery

Table 2: Length of Stay and demographic characteristics of individuals with CRRT with and without Cardiovascular Surgery

Variable	Group	N	Mean	Std Dev	t	df	p
Length of Stay	Female	66	19.83	15.089			0.007***
	Male	51	13.25	9.389	-2.73	115	
	Age < 65	47	18.06	12.3	0.731	115	0.466
	Age 65+	70	16.23	13.935			
	Expired	84	14.46	11.104			
	Living	33	23.33	16.159	3.396	115	0.001***
	Surgery	73	16.85	11.922	-0.122	115	0.903
	No Surgery	44	17.16	15.414			
	CVS†	25	12.76	9.536	1.803	115	0.074
	No CVS	92	18.11	13.949			
	NHW	69	16.91	12.221	-0.428	98	0.67
	NHB	31	18.16	16.002			
	NHW	69	16.91	12.221	0.65	83	0.517
	Hispanic	16	14.69	12.852			
	NHB	31	18.16	16.002	0.751	45	0.457
	Hispanic	16	14.69	12.852			

* Non Hispanic White, ** Non Hispanic Black * **p < 0.05

† CVS = Cardio Vascular Surgery

Table 3: Estimated Cost and demographic characteristics of individuals with CRRT with and without Cardiovascular Surgery

			Mean Cost	Std Dev	t	df	p
Estimated Cost	Female	66	56407	35513			0.043*
	Male	51	43458	31743	-2.047	115	
	Age < 65	47	53394	35752			
	Age 65+	70	48996	33588	0.677	115	0.5
	Expired	84	49507	31438			
	Living	33	53958	41338	0.628	115	0.531
	Surgery	73	56006	34045			
	No Surgery	44	42064	33549	2.157	115	.033*
	CVS	25	47225	28090			
	No CVS	92	51724	35987	0.578	115	0.564
	NHW	69	51662	32553			
	NHB	31	51777	38770	-0.015	98	0.988
	NHW	69	51662	32553			
	Hispanic	16	43901	35520	0.845	83	0.401
	NHB	31	51777	38770			
	Hispanic	16	43901	35520	0.678	45	0.501

* Non Hispanic White, ** Non Hispanic Black * **p < 0.05

† CVS = Cardiovascular surgery

Table 4: Discharge Disposition by Gender, Age Status, Cardiovascular Surgery, and Having Surgery of Individuals with CRRT

	Alive	**Expired**	**Total**	χ^2	**df**	**Sig**
Female	24	42	66	4.977		0.026*
Male	9	42	51		1	
CVS†	30	62	92			
No CVS	3	22	25	4.123	1	0.042*
Age <65	19	28	47			
Age 65+	14	56	70	5.793	1	0.016*
Surgery	18	55	73			
NS**	15	29	44	1.206	0.272	0.272
	Age <65	**Age 65+**	**Total**	χ^2		**Sig**
Male	15	36	51			
Female	32	34	66	4.355	1	0.037*
CVS	7	18	25			
No CVS	40	52	92	1.96	0.162	0.162
Surgery	32	41	73			
NS**	15	29	44	1.085	0.298	0.298
	CVS	**No CVS**	**Total**	χ^2		**Sig**
Male	11	40	51			
Female	14	52	66	0.002	0.963	0.963
	Surgery	**No Surgery**	**Total**	χ^2		**Sig**
Male	29	22	51			
Female	44	22	66	1.178	0.278	0.278

* $p < 0.05$ ** NS= No Surgery †CVS = Cardiovascular Surgery