

Monitoring of Membrane Function using Machine Pressures during Continuous Renal Replacement Therapy

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Background

In operating continuous renal replacement therapy (CRRT), monitoring of filter function is an important process for the effective delivery of CRRT. Transmembrane pressure (TMP) and filter pressure drop are known to reflect membrane status, however clinical data that shows these relations are rare.

Methods

308 filters used in CRRT at UCSD from January 1st, 2017 to December 31st, 2017 were included. All participants were treated with regional citrate anticoagulants (RCA) with calcium-containing dialysate. Underperforming filter was defined as filters changed due to clotting or low efficacy in 48 hours. Low efficacy was defined as the FUN/BUN ratio falls below 0.85. Control filter was defined as the filter that was changed due to time limits or events non-related to the therapy. Chronological changes of TMP and filter pressure drop were compared between the underperforming and control filters.

Results

A total of 69 underperforming and 239 control filters were identified (Fig. 1 and Table 1).

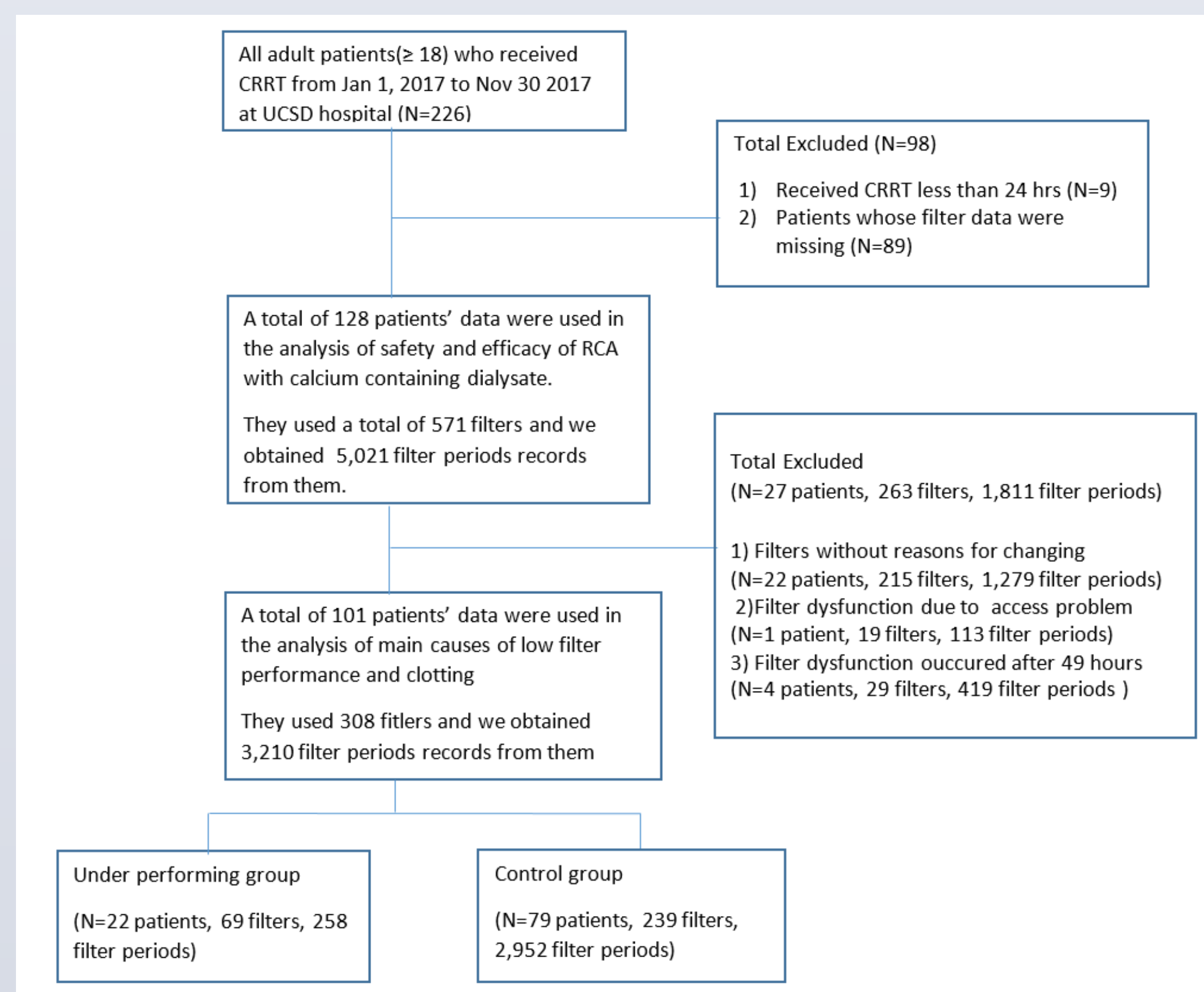


Figure 1. Flow diagram of included filters

Table 1. Filter Changing reasons according to the filter longevity

Reason to change the filter	Filter Life Group				Total
	1 (n=227) ≤ 24h	2 (n=145) 25-48h	3 (n=104) 49-96h	4 (n=95) >96h	
Not recorded	98	68	49	0	215
Recorded	129	77	55	95	356
Unrelated to therapy	76 (58.9%)	46 (59.7%)	35 (63.6%)	24 (25.3%)	181(50.8%)
Time	0	0	0	58 (61%)	58(16.3%)
Access	11 (8.5%)	4 (5.2%)	1 (1.8%)	3 (3.1%)	19(5.3%)
Clotting	33 (25.6%)	19 (24.7%)	14 (25.5%)	5 (5.3%)	71(19.9%)
Low efficacy	9 (7%)	8 (10.4%)	5 (9.1%)	5 (5.3%)	27(7.6%)

Cases (underperforming filters)
Controls

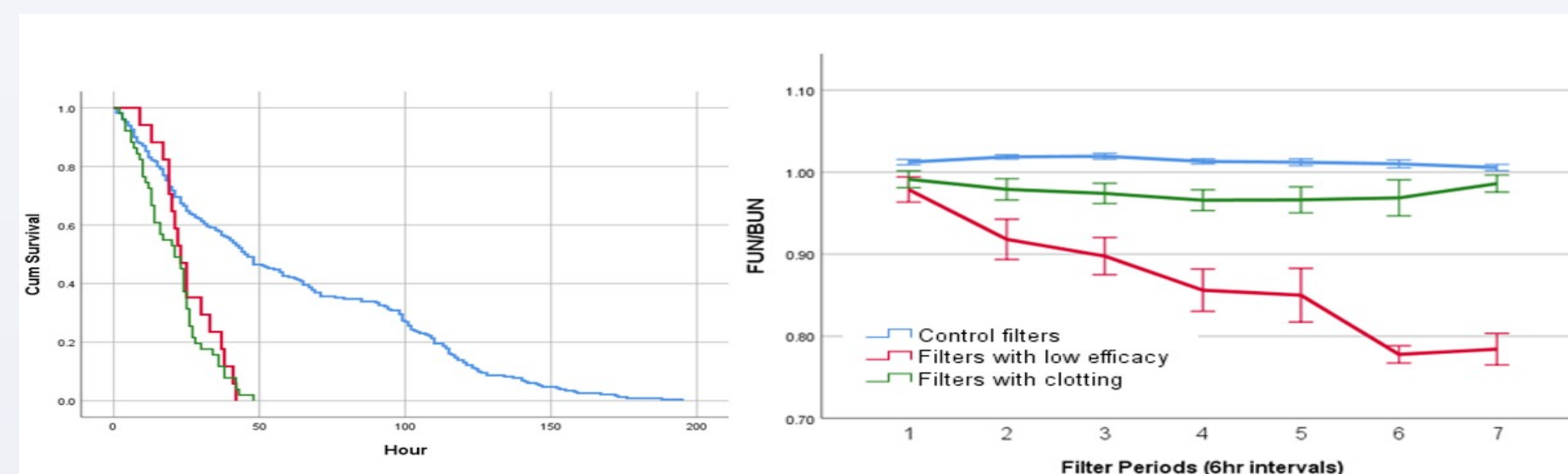


Figure 2. Filter longevity and efficacy of underperforming and control filters

When we compared machine pressures between the underperforming and control filters, TMP and pressure drop were significantly higher in the underperforming filters from the initial 6 hours of CRRT (Figure 1). However, there were no significant differences in machine pressures between the filters with clotting and low efficacy.

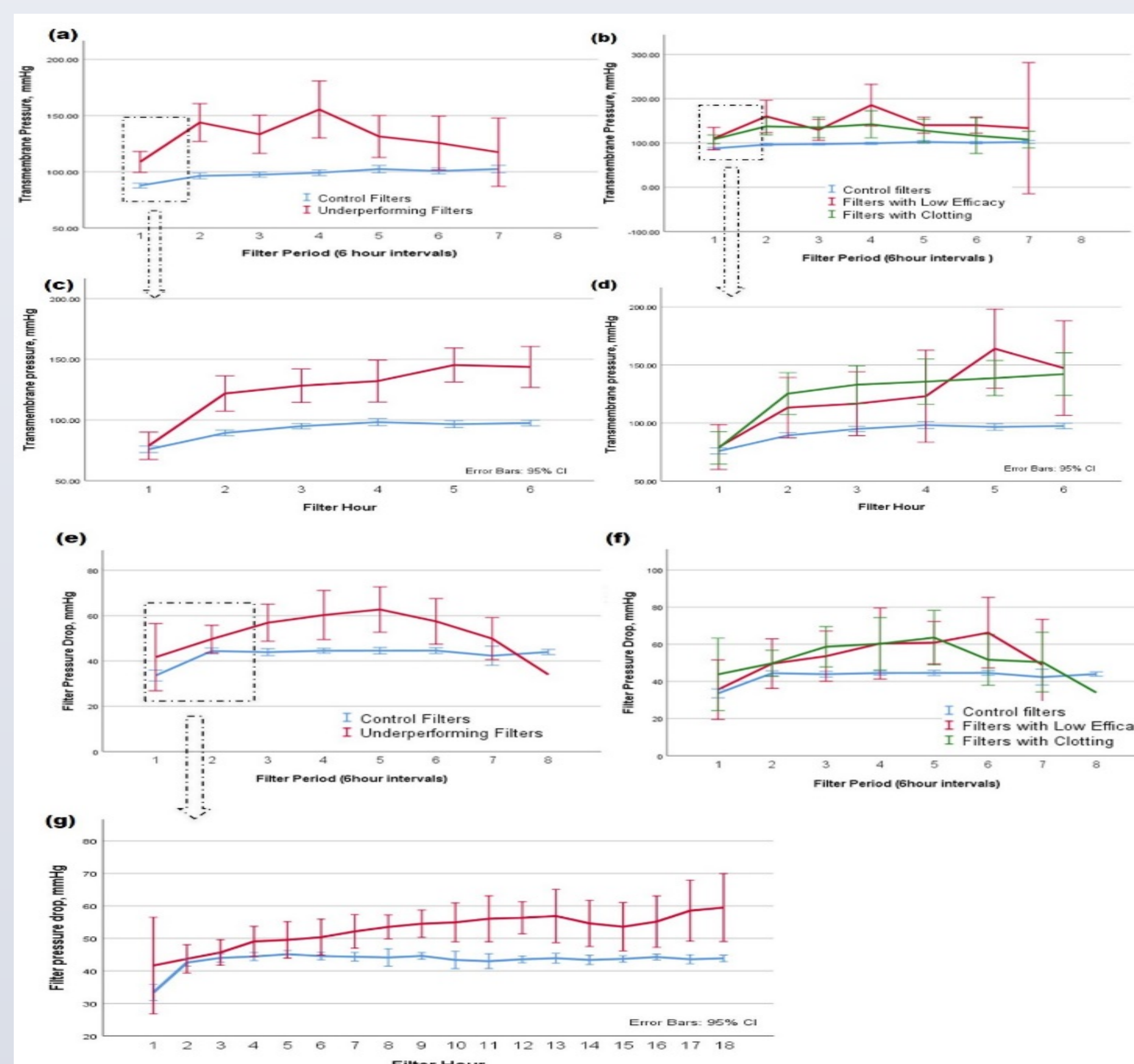


Figure 3. Transmembrane (a, c) and pressure drop changes (e, g) between underperforming (red line) and control (blue line) filters. Underperforming filters were further divided into clotted (green) and low efficacy (red) filters for the changes of transmembrane pressure (b, d) and filter pressure drop (f).

In the multivariable analysis adjusted with post-filter ionized calcium and other variables, sepsis and TMP gap in the first 6 hours of CRRT were significant for the filter underperformance, and the TMP gap higher than 60.7 mmHg predicted filter underperformance with the sensitivity and specificity of 55.9 and 91.8%.

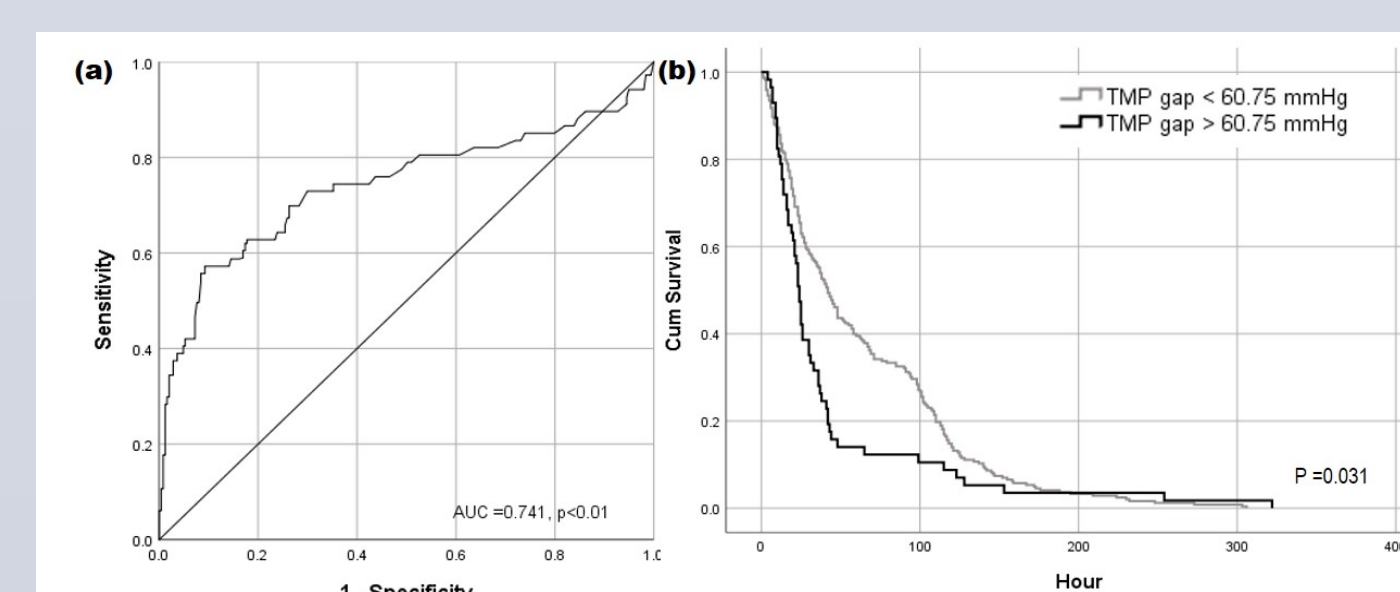


Figure 4. ROC curve for TMP gap and Kaplan-Meier survival curve of filters

Conclusions

Both of the TMP and pressure drop reflected membrane function well and they were good markers of decreasing membrane efficacy or ongoing clotting. However, machine pressures did not discriminate clotting from low efficacy.