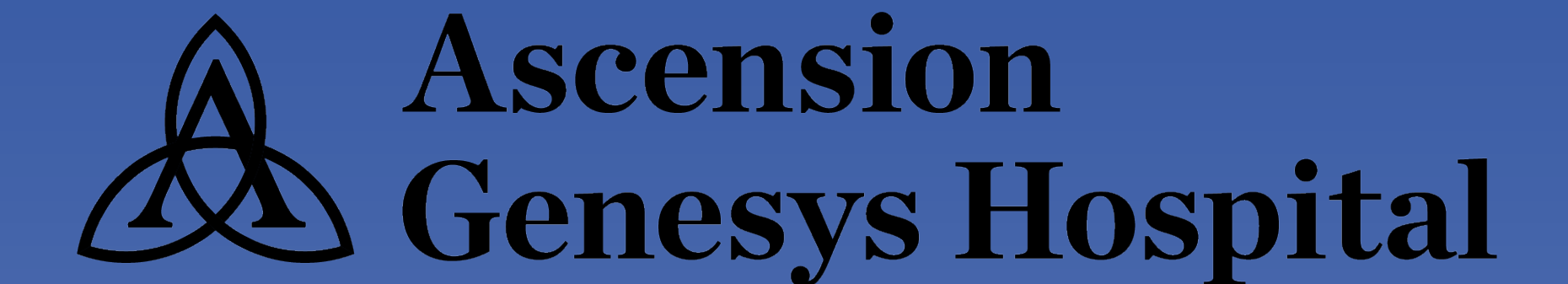


# Cytosorb Filter: An Adjunct for Survival in the COVID-19 Patient in Cytokine Storm? A Case Report

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## Introduction

COVID-19 is a pandemic that has overwhelmed the entire world's healthcare system, from the unknown carrier status, poor testing capabilities, to hospitals running out of ventilators for severely ill patients.<sup>1</sup> Presentations of infected individuals range from asymptomatic to critical life-threatening illness.<sup>2</sup> Severe cases of COVID-19 have a variety of systemic signs however, the most critical cases demonstrate the development of ARDS (Acute Respiratory Distress Syndrome), followed by an acute kidney injury (AKI) and then liver dysfunction.<sup>3</sup> There has been a variety of potential treatment modalities including anti-inflammatory medications, antibiotics, immune-modulators, convalescent plasma, and others. The cytokine storm that inflicts some patients can be devastating to the vital organs of the human body. Cytosorbents® is a filter device approved in Europe in 58 different countries and being used as a trial basis in the United States to treat patients in a cytokine storm.<sup>2</sup> Currently there are open trials in Germany and Italy enrolling patients and we hope to soon have more information on a global scale that may be applied to more patients. It has been used in over 500 critically ill patients infected with COVID-19 in Italy, China, Germany, and France with preliminary data that is very positive in reduction of cytokine levels.<sup>1</sup>

## Hypothesis

Cytosorbents® cytokine filter is a potential treatment methodology aimed at reducing the cytokine storm, thus serving as a bridge for therapy in the acutely ill patients infected with COVID-19.

## History & Physical

- 51-year-old diabetic male presented for dyspnea, lethargy, myalgias and fever after COVID-19 exposure.
- Febrile and hypoxic at 70% on room air with improvement on nasal cannula to 97%.
- Admitted and empirically treated with ceftriaxone, azithromycin and hydroxychloroquine.
- Intubated on hospital day 4 and developed Acute Respiratory Distress Syndrome.
- Disease process progressed to cytokine storm and eventual mortality
- Care team considered applying a cytokine filter before the cytokine storm became insurmountable.
- Approval from the IRB for compassionate use and family occurred on Hospital day 11.
- Initiation of the Cytosorbents® filter included a live educational webinar to the ICU team and live video assistance from the manufacturer of installation of the device to the standard CRRT machine.
- Upon initiating cytokine filter therapy, his respiratory status, hemodynamics, inflammatory markers, and labs were monitored.

## Results

**Table 1: Daily ABG, Vent Settings, and Lab Results While on Cytosorbent Filter**

Hospital Day	11	12	13	14	15	16	17	18	19	20	21	22
Cytosorb Day	1	2	3	4	5	6	7	8	9	10	11	12
Respiratory Rate	30	30	30	26	26	26	26	35	35	35	28	28
PEEP	14	12	8	8	8	8	8	8	5	5	5	5
FiO2	50%	50%	40%	40%	50%	40%	40%	50%	50%	50%	40%	40%
pH	7.25	7.39	7.36	7.31	7.26	7.2	7.24	7.09	7.31	7.373	7.4	7.41
PCO2	52	39	46.9	47.6	47.8	46	49	64	43.3	42.3	39.5	40.6
PaO2	80	81	75.7	92.3	98	71	79.7	111	70.6	158	101	113
O2 Sat	94%	94	91%	94	94	88	91	93.9	91.5	96.8	94.9	95.5
Pressors	no	no	no	yes	yes	yes	yes	yes	yes	yes	no	no
I/O		1470	220	-446	603	4868	1380	5028	4039	4498	-1002	-1231
D dimer	0-500 ng/ml	>7650	>7650	>7650	>7650	>7650	>7650	>7650	>7650	7277		>7650
CRP	0-5 mg/L	72.22	48.9	29	66.89		162.7	160.2	282	146.8		
Creatinine	0.61-1.25 mg/dL	3.07	1.51	1.25	1.15	2.9	4.48	2.91	2.48	1.9	1.5	1.4

## Observations from Table 1:

- Initial PEEP requirement of 14.
- Fluctuations during therapy which improved overtime.
- D-dimer remained persistently elevated coinciding with hypercoagulable state.
- His-renal function on the day of initiation was poor with Creatinine of 3.07 which improved daily with therapy.
- His-CRP which was initially downtrending subsequently rose higher than the value on the day of initiation.
- By the last day of therapy, his CRP was within normal range, renal function had improved.

## Discussion

- This patient had hypoxic respiratory requiring ventilator support, renal failure on dialysis and evidence of cytokine storm.
- Cytosorbents® required severe lung disease and multi-system organ dysfunction.
- Overall, the cytokine filter was by no means a curative therapy. We believe it was a bridge for the patient to prevent imminent death due to severe inflammatory response and extend his life.
- Patient survived cytokine storm allowing for additional therapy.
- Tocilizumab 400 mg.
- Convalescent plasma.
- Began to communicate with hand motions and facial gestures.
- He had a very long hospital course and was discharged to a subacute rehab facility on hospital day 60.
- Upon discharge, he was tracheostomy dependent, required enteral feedings due to persistent dysphagia and aspiration risk. He was also dialysis dependent renal failure.

## Conclusion

- Speculate that earlier application of blood filtering could potentially mitigate cytokine storm before the possibly irreversible damage occurs.
- The application of a cytokine filter therapy has shown great potential benefit and it would be worthwhile to obtain more studies in regard to this therapy for future use.
- The cytokine filter successfully completed the goal of prolonging his life to bridge definitive therapy in cytokine storm.

## References

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