

A Novel and Cost Effective Technique of Remote Monitoring of Burn Patients

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Abstract

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Management of burn patients is a challenging task because of involvement of multiple systems and high risk of complications. Acute major burns presents with significant physiological and metabolic changes and are associated with high risk of sudden, multiple organ failure. Early, timely and appropriate management of altered physiology based on intensive monitoring findings can significantly reduce burn morbidity and mortality. Another serious threat to these patients is burn wound infection due to compromised immunity, associated co morbidities, extreme ages, cross infection from patients or care givers, inappropriate infection control protocols etc. Hence effective intensive monitoring and simultaneously not breaching the barrier nursing practice can reduce burn related complications and improve outcomes. Usually for burn monitoring nursing staff or doctors comes frequently in contact with the patients, which increases chances of cross infection. Here with this article we would like to share the role of PTZ-IP camera as an effective technique in burn monitoring.

Keywords: Burn; Monitoring; PTZ-IP Camera.

Introduction

Burn patients always require extra attention and effort in order to provide effective treatment, as burn is known for significantly greater morbidity and mortality. As a result various studies have been done to improve the protocols at different centers. Other than routine patient's care burn patients require special attention to effectively manage the altered physiological state, to improve respiratory support, to provide ideal environment for burn wound, early burn wound closure, early enteral nutrition and control of catching or transmission of infection [1,2].

Early burn wound care is effective resuscitation to treat and avoid burn shock, in terms of adequate intravenous fluid transfusion, which constitutes the most effective and challenging step in improving the outcome. In early post burn period, Intensive, frequent and adequate monitoring is necessary to avoid hypervolemia or hypovolemia as both are dreaded complications of fluid replacement, which involve myocardial edema, pulmonary edema, worsening of burn wound, compartment syndrome, need for fasciotomy even in unburned limb etc [3,4]. Effective

monitoring plays vital role in making decisions to continue/change the treatment and results in overall improvement of outcomes [5].

Burn wound sepsis is another known complication of burn wound which directly affects morbidity and mortality. Patients are prone to develop hospital acquired infections due to reduced immunity and loss of protective barrier of skin. Sepsis and infection have many criteria routinely found in patients with extensive burns e.g., fever, tachycardia, tachypnea, leukocytosis. Primordial prevention for effective prevention of infection involves adequate wound management and timely and appropriate antibiotics [6,7]. Tele-barrier nursing plays a crucial role as an adjunct to avoid sepsis and related complications.

As monitoring of burn patient involves frequent contact of patient with nursing staff, treating doctors and patient's relatives, simple measures taken to control the transmission of infection can produce significant improvement in outcomes. Remote monitoring is becoming an important technique for monitoring while maintaining barrier nursing [8]. Through this article we would like to present a simple and cost effective technique of monitoring of burn

patients which simultaneously helps in prevention of infection by maintaining the barrier nursing.

Methodology

This is a retrospective observational study performed in the tertiary burn care centre of our institute from November 2015 to April 2016. Patients with major burn were admitted in burn ICU and managed according to standard protocols followed in institute. Apart from those protocols we started using an audiovisual monitoring aid comprising wall mounted IP camera (Macroplus Robot Ball HR101-W wireless camera) with a resolution of 720 p with live HD streaming (Figure 1). The camera was synchronized to the mobile phone of the consultant, duty doctors, nursing staffs and also through an application installed on a tablet that provides video chat and voice call services using the IP address. Consultants can watch patient's vitals on bed side monitor any time on their smart phone through freely downloaded mobile software (Figure 2). Consultant can watch all patients of the ward by virtue of rotation property of the camera, he/she can watch patient's position, dressing status, splints etc (Figure 3). As the system is provided with speaker, consultant can provide on line advice to the duty doctor or staff nurse. The device also has inbuilt audio and video recording in addition to online transmission facility. Apart from patient's monitoring from outside, attendants were also allowed to interact with their patients through the tablet/ mobile to promote barrier nursing (Figure 4a, b). Apart from usual bed side monitoring, all patients were monitored intensively by wall mounted IP camera after initial resuscitative measures were completed.

All nursing staffs, resident duty doctors and consultants were in on-line contact by synchronizing the mobile/ tablet through voice/ video calls using IP address.

Apart from usual rounds consultants were in almost continuous contact with the patients by using online audio visual modalities, and instructions were given accordingly to duty doctors or nurses. Another tablet was kept outside the ICU and patient's relatives were allowed to see/talk to their patients. Satisfaction of patient and relatives was assessed on a five point scale using the parameters of Availability of basic amenities, satisfaction with cost of services, information and communication, relationship between patient and health providers. Level of satisfaction was recorded by selecting responses ranging from poor=1, fair=2, good=3, very good=4

and excellent=5. Point 1 and 2 was considered dissatisfied while points 3, 4 and 5 were considered satisfied [9].

At the end of the study period, the feedback was taken from consultants, residents and staff nurse was analysed to evaluate the effectiveness.

Audit result of HICC was used to assess the efficacy of this modality in infection control (Figure 5a, 5b).



Fig. 1: Wall mounted IP camera



Fig. 2: Synchronized mobile and tablet showing monitor reading

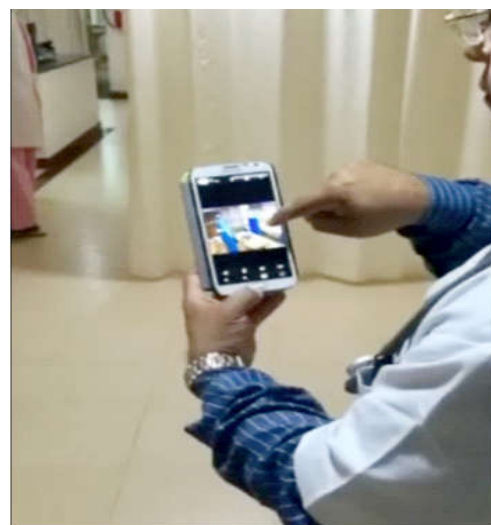


Fig. 3: Consultant watching patient's status on mobile by synchronizing with IP camera



Fig. 4a: Relative communicating with her

Result

Total 18 patients were included in the study (Table 1). 4 (22.22%) patients were pediatric and 14 patients (77.77%) were adult patients. 8 patients (44.44%) were male and 10 (55.55%) patients were female. Male female ratio was 4:5.

11 patients (61.11%) were having TBSA more than 50%. While 7 patients (38.88%) were having TBSA less than 50%. Mean TBSA involved was 63.33%. 10 (55.55%) patients had thermal burn, 4 (22.22%) patients had scald burn and 4 (22.22%) patients had electric burn. 2 patients (11.11%) were presented within 3 hours of burn. 4 patients (22.22%) were presented within 6 hours of burn, whereas 11 patients (61.11%) were presented beyond 6 hours of burn with inadequate resuscitation.

3 patients (16.66%) were presented delayed as old and infected burn wound with features of sepsis. 5 patients (27.77%) were having associated co morbidities. 10 patients (55.55%) presented with components of inhalational burn. Out of which 7 patients underwent prophylactic life saving emergency tracheostomy with informed consent. All patients required intra venous fluid via central line or venous cut down or peripheral line. 5 patients were kept on ventilatory support.

All patients were monitored intensively by wall mounted IP camera after initial resuscitation.

4 consultants, 6 resident doctors and 12 nursing staffs were involved in the study. Consultant doctors, duty doctors, staff nurses were patients and their relatives were found to be satisfied with the score ≥ 3 . Average satisfaction score for consultants was 4.5,



Fig. 4b: Patient communicating from inside patient via synchronized tablet kept outside

for resident doctors was 4 and for nursing staff was 4.5. Patient-relative interaction was made for all patients. Average satisfaction score for relatives was 4.2. Patient-relative interaction was found to effective in relieving depression in patients and counseling of relatives regarding severity and prognosis of their patients. As a result relatively less number of in person contacts were made between patient and relatives/ hospital staffs which showed a drop in infection rate, declared in HICC (Hospital Infection Control Committee) report (Figure 5a, 5b).

Discussion

Tele monitoring is a branch of telemedicine. The call for medical help remotely marks the first event in modern TM. Historically African villagers were using smoke signals to warn the people in case of serious diseases. In early 1900s people of remote areas used two-way radios to communicate with Royal Flying service of Australia. While first interactive telemedicine system was launched in America, which was performed to diagnose and treat patients requiring cardiac resuscitation [10]. Telemedicine can be broadly classified into. Store and forward (SAF) or pre-recorded (asynchronous) TM, Real-time or video conference (VC) (synchronous) TM, Hybrid TM, Mobile or cellular TM, Integration model [11].

Remote monitoring involves self monitoring and testing, doctor can monitor a patient remotely using various technological devices. These services are primarily used for monitoring chronic diseases like, diabetes mellitus, heart disease, and hypertension or asthma [12].

Hospital Infection Control Committee Jipmer Hospital, Acquired Infection servellance report October 2015

Block	ICU	VAP Rate	CLABSI Rate	CAUTI Rate	SSI Rate	Burn Wound Infection Rate	Bed sore rate	Sheath
		NHSN 75 Percentile	JIPMER NHSN 75 Percentile	JIPMER NHSN 75 Percentile	JIPMER	JIPMER	JIPMER	JIPMER
EMS	Burns	0.00	0.00	11.49	0.00	12.50	0.00	0.00
	CCCU	0.00	0.00	0.00	0.00	-	0.00	0.00
	CCU	22.73	0.00	0.00	0.00	-	59.60	0.00
	TCICU	34.88	0.00	0.00	0.00	-	0.00	0.00
	MICU	20.74	0.00	2.16	0.00	-	0.00	0.00
	Ward 43 Step down ICU	0.00	0.00	6.54	0.00	-	0.00	0.00
	SIICU	0.00	0.00	0.00	7.14	-	8.73	0.00
	32-A ICU	31.25	0.00	13.70	100.00	-	0.00	0.00
	EMT	0.00	0.00	0.00	0.00	-	0.00	0.00
	CIVS ICU	30.30	8.13	0.00	4.00	-	0.00	0.00
MAIN	KIP	0.00	0.00	58.82	0.00	-	0.00	0.00
	NUEROMED ICU	33.90	27.52	20.41	0.00	-	0.00	0.00
	Nutromed ICU	38.82	0.00	27.59	0.00	-	0.00	0.00
	PAED SURG ICU	52.63	48.78	27.78	21.05	-	0.00	0.00
	PL SURG ICU	0.00	0.00	0.00	0.00	-	0.00	0.00
	RCC ICU	0.00	19.23	0.00	0.00	-	0.00	0.00
	SGE ICU	0.00	0.00	0.00	0.00	-	0.00	0.00
	URO ICU	0.00	0.00	0.00	0.00	-	0.00	0.00
	SURGICAL	0.00	0.00	0.00	0.00	-	0.00	0.00
	ONCOLOGY ICU	0.00	0.00	0.00	0.00	-	0.00	0.00
WCH	NICU	10.93	3.153	0.00	0.00	-	0.00	0.00
	PICU	0.00	13.89	0.00	1.45	-	0.00	0.00
	JIPMER (ICU AVERAGE)	14.10	7.10	8.02	6.36	12.50	3.25	0.00

Fig. 5a: Committee report showing burn wound infection rate before application of remote monitoring.

Hospital Infection Control Committee Jipmer Hospital, Acquired Infection servellance report October 2015

Block	ICU	VAP Rate	CLABSI Rate	CAUTI Rate	SSI Rate	Burn Wound Infection Rate	Bed sore rate	Sheath
		NHSN 75 Percentile	JIPMER	NHSN 75 Percentile	JIPMER	JIPMER	JIPMER	JIPMER
EMS	Burns	0.00	0.00	12.35	0.00	-	0.00	0.00
	CCCU	0.00	0.00	0.00	0.00	-	0.00	0.00
	CCU	20.98	0.00	5.88	0.00	-	0.00	0.00
	TCICU	0.00	0.00	0.00	0.00	-	0.00	0.00
	MICU	10.05	3.75	4.39	0.00	-	0.00	0.00
	Ward 43 Step down ICU	0.00	0.00	6.10	0.00	-	0.00	0.00
	SICU	31.58	0.00	0.00	4.35	-	8.89	0.00
	32-A ICU	20.83	0.00	0.00	100.00	-	0.00	0.00
	EMT	0.00	0.00	0.00	0.00	-	0.00	0.00
	CIVS ICU	18.87	0.00	9.17	3.45	-	11.30	0.00
MAIN	KIP	0.00	0.00	0.00	0.00	-	0.00	0.00
	NUEROMED ICU	61.22	12.05	52.24	0.00	-	0.00	0.00
	Nueromed ICU	21.51	0.00	6.71	9.52	-	9.52	0.00
	PAED SURG ICU	58.82	0.00	14.49	15.00	-	0.00	0.00
	PL SURG ICU	0.00	0.00	0.00	0.00	-	32.61	0.00
	RCC ICU	0.00	11.36	0.00	0.00	-	0.00	0.00
	SGE ICU	111.11	0.00	0.00	17.86	-	0.00	0.00
	URO ICU	0.00	0.00	27.27	5.26	-	0.00	0.00
	SURGICAL ONCOLOGY ICU	0.00	0.00	0.00	10.53	-	0.00	0.00
	WCH	NICU	0.00	17.96	0.00	0.00	-	0.00
PICU		0.00	4.06	5.62	0.00	-	0.00	0.00
JIPMER (ICU AVERAGE)		16.90	2.34	6.87	7.90	12.69	2.97	0.00

Fig. 5b: Committee report showing reduced burn wound infection after application of remote monitoring

Cellular TM is an effective tool in modern practice of medicine because tools are portable, easy to handle, relatively low cost, incorporation of modern technologies in smart phones. They provide immediate image access and direct interaction, and it is possible to obtain clarification. Quality, speed of image transmission and live video streaming is no longer an obstacle due to availability of higher band width networks. New generation cellular phones allow taking good-quality images and transmitting them directly to other cellular phones/ tablets (via multimedia messages) and computers (via e-mail or blue tooth-wireless connection) with diagnosis agreement of 82% compared to face-to-face consultation. Mobile technology has helped significantly in the field of telemedicine [13].

Telemonitoring is another form of telemedicine where sick patients are being monitored intensively and more frequently by using electronic media [14].

It may not be possible for the consultant to be present every time near the patients to advice or guide the duty doctors or staff, telemonitoring enables the clinician to be in contact with their patients all the time without compromising his duties towards other patients in the hospital. Hence monitoring of one patient should not deprive other patients from the care givers. Remote Patient Monitoring is a system which uses electronic media to collect and transfers medical or health related data from the point of care and transfers to another health care provider locate at distance to assess and advice for management. The time saved by utilizing remote patient monitoring allows the health care provider to provide more time to remotely communicate and educate the patients and relatives [15].

Ideal monitoring of major burn patients should be reliable, frequent, intensive, preventing transmission of infection, support barrier nursing. Remote patient monitoring is also an important part of home based monitoring of chronically ill patients like COPD, chronic kidney diseases, chronic heart disease etc.

Need of Remote Monitoring of Burn Patients

Burn is one of the commonest emergencies in plastic surgery. Major burn patient require significant amount of attention and care by doctors, nurses and family members. Acute burns are almost always associated with significant physiological changes at the time of presentation and hence their prognosis and course of disease is highly unpredictable. Any failure of timely intervention to a critical alteration can lead to fatal complications. Hence early recognition and timely intervention can

prevent complications and save patient's life. Shortage of man power and increased patient load in burn centers hinders the effectiveness of monitoring, a remote monitoring tool may be very helpful for burn patients so that limited number of health care providers can monitor more patients simultaneously without compromising care to other patients. Our article highlights the use of cost effective, reliable and user friendly remote monitoring tool for monitoring of burn patients.

Conclusion

Based on our experience, PTZ-IP camera is a cost effective, easy to install and user friendly tool for monitoring of burn patients.

References

1. Papini R. Management of burn injuries of various depths. *BMJ*. 2004 Jul 17; 329(7458):158-60.
2. Broussard KC, Powers JG. Wound dressings: selecting the most appropriate type. *Am J Clin Dermatol*. 2013 Dec; 14(6):449-59.
3. Pham TN, Cancio LC, Gibran NS. American Burn Association Practice Guidelines Burn Shock Resuscitation. *J Burn Care Res* 2008; 29:257-266.
4. Judkins K. Current consensus and controversies in major burns management. *Trauma* 2000; 2:239-251.
5. Holm C, et al: A clinical randomized study on the effects of invasive monitoring on burn shock resuscitation. *Burns* 2004; 30:798-807
6. Greenhalgh DG, Saffle JR, Holmes JH, et al: American Burn Association consensus conference to define sepsis and infection in burns. *J Burn Care Res* 2007; 28:776-790.
7. King B, Schulman CI, Pepe A, et al: Timing of central venous catheter exchange and frequency of bacteremia in burn patients. *J Burn Care Res* 2007; 28:859-860
8. Vassallo DJ et al. Experience with a low-cost telemedicine system in three developing countries. *Journal of Telemedicine and Telecare*, 2001; 7(Suppl. 1):S56-S58.
9. Qadri S, Pathak R, Singh M, Ahluwalia SK, Saini S, Garg P K. An Assessment of Patients Satisfaction with Services Obtained From a Tertiary Care Hospital in Rural Haryana; *International Journal of Collaborative Research on Internal Medicine & Public Health* 2012; 4(12).
10. Perednia DA, Allen A. Telemedicine technology and clinical applications. *JAMA* 1995; 273:483-8.

11. Chittoria RK, Singh U, Muralidhar A. *Telemedicine for Doctors*. 1st ed. New Delhi (India): AITBS Publishers; 2009.
 12. Blyth, W. John. *Telecommunications, Concepts, Development, and Management*; Second ed. Glencoe/McCraw-Hill. pp. 280-282.
 13. Vassallo DJ et al. Experience with a low-cost telemedicine system in three developing countries. *Journal of Telemedicine and Telecare*, 2001; 7(Suppl. 1):S56-S58.
 14. Ikhu NA, Ayo CK, Ehikioya SA. A deployable framework for mobile telemedicine applications. *Stud Health Technol Inform*. 2006; 121:36-41.
 15. Coye M, Haskelkorn A, Demello S. 2009. Remote patient management: technology-enabled innovation and evolving business models for chronic disease care. *Health Affair*, 2009; 28(1): 126-135.
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