Original Research Article

Predicting the number of Polyvalent Anti snake venom serum in viper bites

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Abstract

Background and Objective: One of the public health hazards has been the Snake bites in the agrarian society of India. Such bites were found to have seasonal pattern during harvesting time. The toxicity of viper venom affects the functions of kidneys and leads to symptoms of cellulites, Disseminated Intra Vascular Coagulation (DIVC), cerebral sign. Serum based polyvalent Anti Snake venom (ASV) vials are commonly injected as antidotes accompanied by dialysis procedure to save life and avoid complications. This paper statistically attempted to predict the number of ASVs for conserving the scarce resource and on the frequency of dialysis. Such sudden snake bites cause debacle in family life of patient socially, economically and therefore prediction of management of procedures would facilitate to counsel patients and their relatives on the cost of treatment and the length of hospital stay as it is unknown, unexpected expenditure in the family.

Material and methods: This was retrospective study. The sample size was decided on the effect up to 2 vials using the Poisson model for prediction per patient. Accordingly, 45 cases were studied against a required sample of 37 cases. Statistical techniques such as Stratified control charts, ANOVA, Matrix plot and Regression were carried out in order to predict the number of vials and frequency of dialysis.

Results: Average number of vials increased from 18 vials (10 to 26) to 30 (19 to 40) significantly per patient when the DIVC symptoms were noticed (67%). Same was the case with cerebral sign increasing the ASV from 22 (12 to 31) to 35 (23 to 47) that increased by of 60% per patient. It was also noticed that, number of vials did not increase due to delay in admission from the time of bite, and as a contrary, the study group revealed the declining trend from 15 to 5 from the same date of admission to delayed by 3 days. The average predicted ASV was determined by the equation considering only 5 terms among 10 terms (Age, BP Sys, BP diastolic, no of admission days, DIVC, Cerebral sign, Gender, CT Minutes, Total dialysis, age x no. of days) as significant predictors and was used for prediction.

Conclusion: BP diastolic increase of 10 mm Hg increased an average by 17 vials. Presence of cerebral sign increases by 13 vials followed by DIVC at 10 vials. As the age and no of days increase there was declining trend in injection of vials. The correlation between no of ASV and no of dialysis was not established and they do not complement each other.

Key words

DIVC, CT, Cerebral sign, ASV, Prediction, Comorbidity.

Introduction

One of the Public Health Hazards has been the Snake bites in the agrarian society of India. Global health statistics remain unknown and misunderstood on the incidence and impact of snake bites. In spite of lack of data, a global estimation of the no of ophidian accidents reaches over one million cases per year accounting for more than 20000 deaths especially along rural areas in Asia, South America and Africa. In addition to mortality, such envenomation causes renal failure having impact on socio economic aspects of one's family life. The loss of life wrinkles many uncertainties in the family such as enigmatical situation be recovered by therapeutic treatment of ASVs [1-3].

Commonly encountered prevailing envenomation was from four types of snakes Saw Scaled Viper, Russell's Viper, Cobra and the Krait of brightly coloured but nonaggressive venomous snakes. Such bites were found to have seasonal pattern during harvesting time and conducive environmental factors of tropical climate become a habitat for snakes in southern Tamil Nadu [4].

The snake venom toxicity affect functions of renal, and the occurrence non protein low molecular weight cardio toxin in bites of Indian cobra, and commonly noted symptoms of varied veracity of neurotoxin component of venom resulting in significant cerebral irritation and the hemotoxin levels of venom in respect of DIVC and Clotting time (CT) including the cellulites' of deformation of skin happened to be the immediate failure modes of snake bites. The Krait bites venom being presynaptic and affects the vesicles and once destroyed take 3 to 5 days to regenerate. Instances of ophthalmic manifestations after snake bite causing opthalomoplegia were also reported [5, 6].

The treatment variants were the extent of bites itself and as such and veracity of plant species at large being applied in rural areas, involving local folk medicine. As such when admitted serum based polyvalent Anti Snake venom (ASV) vials are commonly injected as antidotes for stopping further damage including renal failure saving the life. It is also accompanied with dialysis process by the induction of either peritoneal and hemodialysis [7].

This paper statistically attempted to predict number of ASVs for conserving the scarce resource of ASV (at given levels of dosages) for optimum use, and also its relationship to the requirements of frequency of dialysis. The combined effect of Cellulites, Cerebral sign, Prolong CT along with the co morbidity status of Hypertension and the impact of admission delays and the effect of location of snake bites including the demographic aspects of age and gender were collected and compiled. As such many papers earlier carried out were descriptive proportion analysis of overall cases on dosages of ASV and this paper on prediction for safe and efficient treatment management system in order to facilitate the patients with prior information on cost and duration of treatment for efficient and effective safe recovery process from envenomation of snake bites.

Materials and methods

Objective: Scarce resource of ASV are prudently used with cost minimization as each vial incur an expenses up to Rs 600 and even

the minimum dosage up to 10 vials would cost Rs 6000 plus other IP charges costing up to Rs 50000 and such sudden expenses in a rural family would cause economic upheaval.

Aim: To predict ASV vials to prevent mortality and prudently counsel the patient and relatives on the cost and length of treatment to enable decision-making.

Study design: This was retrospective study. As such the data had its currency as the impact of the incident was caused by snake bites and hence past secondary data were sufficient and as such the ASV concentration was standardized for such events. The injection of ASV on the no of vials its relation to the frequency and dialysis according to the symptoms of severity.

The distribution of vials was not normal per patient and was not expected. The skewed distribution was showing mean at 23 vials, median at 20 vials and mode at 15 vials based on 45 cases being reported.

It was decided to assess the impact on the effect size up to 2 vials under different toxic conditions of the patient and decide the scope of sample size for prediction using the poisson model of vials per patient.

The sample size was tabulated as under at 95% confidence interval with the power of 80% for the effect size up to ±2 vials.

Sample Size:
The effect size of samples required minimum of 35 and maximum 37 patients in for the accuracy of $\pm$2 (ASV) vials, but there may be patients' samples increasing 147 from 145 for (ASV) $\pm$1 vials.

Accordingly, it was found sufficient to predict vials having 45 cases (against 37) of snake bites for the planning of effect size of ±2 vials from the average of about 23 vials so that effective results are arrived at minimum time, sample and cost.

The studies apart from collecting demographic details (age, gender), the admission delays, extent of severity of cellulites, DIVC, Prolonged CT with the location of bites along with co morbidity status (BP sys and dials) and the injection of vials were noted, compiled and cleansed for its accuracy and reliability of data along with duration of stay in hospital.

Approach of analysis: The box plot to visualize the variance and Average use of ASV between absence and presence of dichotomy Variables (DIVC, Cerebral sign and cellulites) and poison based stratified 'C' central was used to determine the significance at 95% control limits. The relationship between no. of ASV and the variables were visualized by matrix plot and the variables with patterns were used as predictors using multiple regression models in order to predict the significance using "forward" principles. The non-linear fit was examined in the case of ASV on no. of days of admission delays from the time of snake bites. The combined effect between age x no of days were included in the model.

Results and Discussion

The average no. of vials increased from 18 vials (10 to 26) to 30 (19 to 40) significantly per patient when the DIVC symptoms were noticed (67%). Same was the case with cerebral sign increasing the ASV from 22 (12 to 31) to 35(23 to 47) when noticed with an increase of 60% per patient.

The no. of vials was significantly high mean at 35 $\pm$11 at 95% warning limit. When cerebral was noticed and reduced to 22 $\pm$ 10 when cerebral sign was absence above from **Figure – 1**.

It was also noticed that, no of vials need not be increased due to delay in admission from the time of bite, and as a contrary, the study group revealed the declining trend from 15 to 5 from the same date of admission to delayed by 3 days (**Figure - 2**) and it would be explained that body's own detoxifying mechanism nullifying

the effects of envenomation and also could be attributed to nature and quantity of poison being injected during the bite. Thus, delayed admission need not necessarily increase the number of ASV vials.

Figure – 1: Stratified C chart.

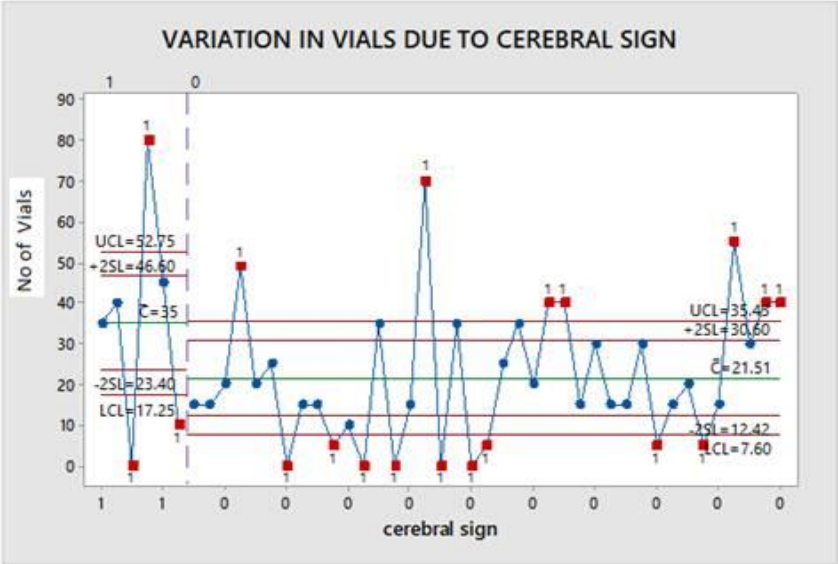

Figure – 2: Variation in no of ASV.

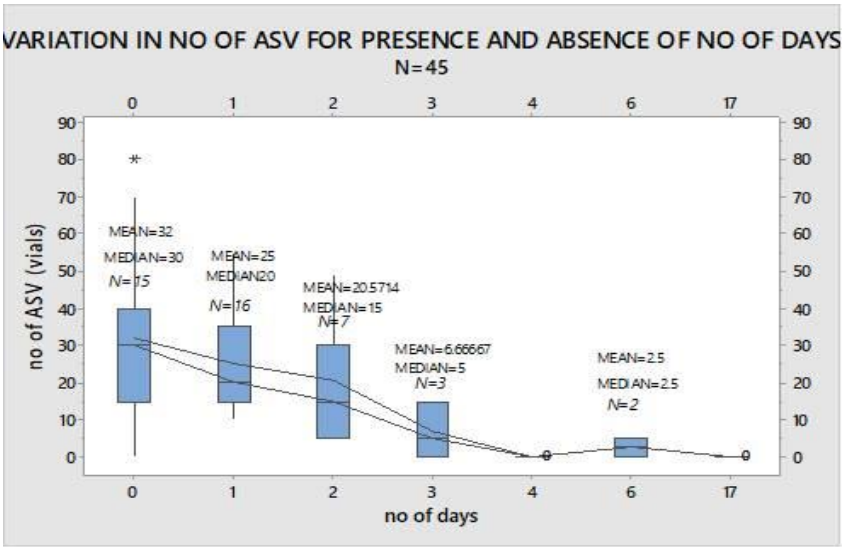

Table - 1: Forward Selection model of Regression Analysis ASV on continuous and categorical predictors.

	Step 1	**Step 2**	**Step 3**	**Step 4**	**Step 5**
BP (Diastolic)	0.2477 (0.000)	0.2915 (0.000)	0.2736 (0.000)	0.2393 (0.000)	0.1678 (0.005)
age*no of days		-0.0581 (0.002)	-0.0700 (0.000)	0.0692 (0.000)	-0.0744 (0.000)
Cerebral sign			21.46 (0.002)	17.63 (0.012)	13.31 (0.071)
DIVC (curding) CT Minutes				8.03 (0.079)	9.55 (0.040) 0.513 (0.134)

Table - 2: Analysis of Variance.

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	5	31826.2	80.06%	31826.2	6365.2	32.13	0.000
BP DYS	1	25448.4	64.02%	1756.7	1756.7	8.87	0.005
DIVC (curding)	1	1387.2	3.49%	891.0	891.0	4.50	0.040
Cerebral sign	1	598.9	1.51%	683.1	683.1	3.45	0.071
CT MINUTES	1	59.9	0.15%	462.8	462.8	2.34	0.134
Age x no of days	1	4331.7	10.90%	4331.7	4331.7	21.86	0.000
Error	40	7924.8	19.94%	7924.8	198.1		
Total	45	39751.0	100%				

The average predicted ASV was determined as under:
= 0.1678BP diastolic + 9.55 DIVC (present) + 13.31(cerebral sign present) + 0.513 CT Minutes - 0.0744 age x no. of days to admit

The Diagnostic clinical investigation for no. of vials were patients digest depicts the SV vials injected and its relationship to various variables and was noticed a pattern in respect of no of days, DIVC, Cerebral sign, and BP diastolic and accordingly the multiple linear regression analysis was carried out as per **Table – 1**.

It was noticed that as the BP diastolic increased by 10 mm of Hg the vials would be increased by 17 vials, followed by cerebral sign increase by 13 vials, DIVC by 10 vials on its predictors of symptoms. The above factors could explain up to 78% (R^2 adj 77.57%) and Mallow's cp for prediction error was minimum at 2.36. The contribution to variation was significant as shown in **Table - 2** explained by sequential sum of squares in the order of predictors.

The above equation considers only 5 terms among 10 terms (Age, BP Sys, BP diastolic, no of admission days, DIVC , Cerebral sign, Gender, CT Minutes, Total dialysis, age x no. of days) in prediction as significant predictors and is used for prediction.

- The correlation between no of ASV and no of dialysis was not established and they do not complement each other
- As such, the total dialysis per person was varying from zero to 11 and with limits of 0 to 8 shown an average of 4 dialysis per person.
- Since the correlation R^2 (R^2 adj 1.3%) the total dialysis was not considered as the predictor for deciding ASV.
- This may be technically explained by extend of renal damage which varies between patients.

Conclusion

BP diastolic increase of 10 mm Hg increases an average by 17 vials. Presence of cerebral sign increases by 13 vials followed by DIVC at 10 vials. As the age and no of days increase there was declining trend in injection of vials.

The no of vials for critical significant factor carried out and depicts the nomograph of contour plot of vials an no of days (y axis) and age (axis) and is revealed that higher age above 30 and no of days to admit beyond 3 days reduced the vials.

It was noticed that one of the patients who was referred after 17 days who received ASV and Dialysis from the referred hospitals, was not given ASV, since he had dialysis support for renal failure and is also explained by the findings that, body's own detoxifying mechanism and the nature and quantity of envenomation reduce the requirement of further ASV.

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