CORRELATION BETWEEN NUMERICAL RATING SCALE (NRS) AND VISUAL ANALOGUE SCALE (VAS) IN ASSESSMENT OF PAIN IN POST OPERATIVE PATIENTS

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38 consecutive consenting patients undergoing donor nephrectomy via loin incision were studied and assessed for the severity of pain by using both NRS and VAS at the beginning of commencing post-operative analgesia and then 2, 6, 12 and 24 hour intervals respectively. Data were analyzed to identify the correlation between the scales.

157 readings for NRS and VAS were analyzed which showed Beta coefficient of 0.87 ($p < 0.01$) in linear regression. Pearson correlation for the association was 0.904($p < 0.01$). Pearson correlation for the NRS and VAS values taken at 2 and 6 hour intervals were higher than the overall Pearson correlation (0.904), while the values taken at other intervals were lower.

NRS which is less pain inducing in post-operative period has a strong linear association with VAS, thus can substitute for VAS in assessment of post-operative pain. The reliability of NRS is higher at the commencement of analgesia, at 2 and 6 hour intervals.

Postoperative pain is an expected phenomenon. However, its passage beyond acceptable limits is a common and costly experience. This is a challenge to surgical teams all around the world. The main problem in management of pain is the difficulty in assessment of the severity of pain as it is a subjective feeling. There are many pain scales used to assess pain worldwide. Visual Analogue Scale (VAS), Numerical Rating Scale (NRS) and Verbal Rating Scale (VRS) are the three widely used pain scales to assess acute pain. From these three scales VAS is recognized as most appropriate to assess acute pain[1, 2].

VAS is mostly but not necessarily a vertical line of 10cm in length. One (bottom) end of the line is marked as zero pain and the other (top) end of the line is marked as maximum pain. After instructing the patient that the bottom end of the line represents no pain and severity of pain increases as you go along the line and reaches maximum pain that you can imagine (not the maximum pain you

have felt before) when you reach the top of the line, the patient will be asked to mark the point in the line which represents the severity of his current pain. Then distance from the bottom end of the line to the point marked by the patient is measured in millimeters and the value is taken as the pain score. This is the basis of VAS and there are various instruments using these principles.

NRS is a vocal scoring method where score of zero is taken as no pain and score of 10 is taken as maximum pain that you can imagine (not the maximum pain you have felt before). The patient is asked to give a score according to the severity of his or her current pain. The score is taken as the pain score.

Both VAS and NRS has a comparable range but VAS is relatively complex compared to NRS. Use of VRS is uncomfortable to the patients, specially in the post operative period as they have to move to put the mark on the line but in NRS they only have to say a number. VAS needs few instruments while NRS needs only a few seconds. These

reasons interested us to look for the possibility of NRS to supplement VAS to assess acute pain in our setting.

Our objectives were to
Assess the correlation between numerical rating scale and visual analogue scale in assessing post-operative pain in the first 24 hours.

Identify the most reliable time period for assessing post-operative pain using NRS.

Materials & Methods
The prospective analytical study was carried out on 38 consecutive consenting patients undergoing donor nephrectomy via loin incision in ward 28 and 30 of National Hospital of Sri Lanka, Western Infirmary and Apollo private hospitals. Data collection instrument was an interviewer administered questionnaire which includes both VAS and NRS as pain assessment tools. Participants were well instructed on how to use/ the VAS and NRS on the preoperative day and they were assessed for the severity of pain by using both NRS and VAS at the commencement of post-operative analgesia and then 2, 6, 12 and 24 hour intervals respectively.

Results
Thirty eight volunteer participants produced 157 valid pairs of readings. One pair of reading includes one VAS reading and the NRS reading taken at the same time interval from the same patient. All NRS values were multiplied by ten to make both scales to have a similar range (0 to 100). Linear regression and Pearson's correlation coefficient were used to assess the correlation between the two scales.

Use of linear regression on any data set is possible only if the data set fulfill three requirements. First one is scatter plot of the values for two variables should show linear association. Second one is scatter of the points in the scatter plot around the line should be similar throughout the length of the line. Lastly residuals of the points in the scatter plot meaning the difference between the expected points and observed points should have a normal distribution.
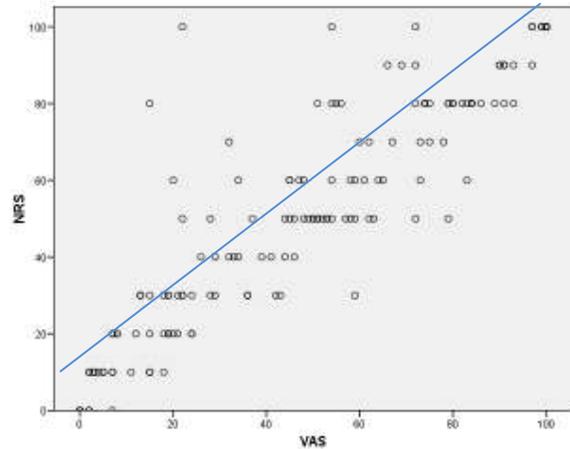
This is the scatter plot drawn for the findings in the study. The plot shows linear association (follow the line on the plot) between values for two variables. Points also show similar distribution throughout the length of the line representing the linear association. Assessment of the distribution of residuals needs a histogram between regression standardized residuals and their frequency.
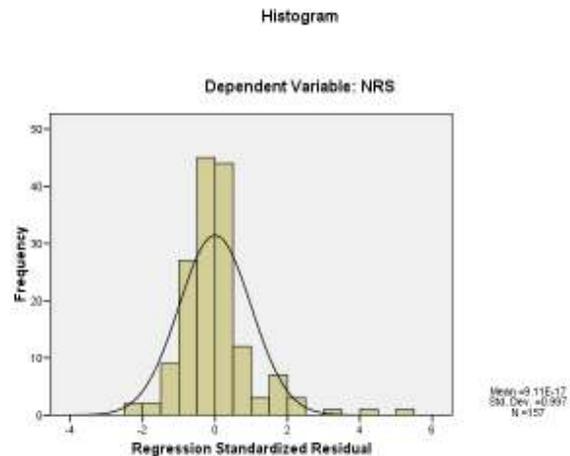
Although this histogram shows some skew towards right side of Y axis, it has a distribution similar to normal distribution. This qualifies the data set to be used for linear regression.
Findings in linear regression are as follow.
β_0 coefficient (Intercept) - 10.18
Standard error of β_0 coefficient - 1.93
β coefficient (Slope) - 0.87 (standardized value - 0.90)
Standard error of β coefficient - 0.03
t value for β coefficient - 26.32
Degree of freedom – 155

P value for β coefficient – <0.01
Confidence interval for β coefficient – 0.81 to 0.94

These findings show a β coefficient of 0.87 for the sample. Standard error of β coefficient is 0.03 which means that the β coefficient of the population lies between 0.84 to 0.90 with 95% confidence level. Ideal β coefficient value to have in a relationship between two scale type variables with similar range is 1. 0.87 is close to one and 'P value' of <0.01 shows that the relationship is significant. Strength of the relationship can be assessed with Pearson's correlation. Pearson's correlation value for this linear relationship is 0.904 (P value is <0.01), which is close to the strongest value and confirms strong linear relationship between two scales.

	β coefficient	Standard error of β coefficient	Pearson's correlation
At the commencement of analgesia	**0.93**	0.1	0.87
At 2 hours from the commencement of analgesia	**0.96**	0.07	**0.93**
At 6 hours from the commencement of analgesia	**0.99**	0.08	**0.91**
At 12 hours from the commencement of analgesia	0.84	0.08	0.89
At 24 hours from the commencement of analgesia	0.71	0.12	0.78

Table 1. β coefficient and Pearson's correlation values for VAS and NRS values taken at different time intervals

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Discussion
Linear regression model and Pearson's correlation statistics of the two scales show stronger linear relationship between VAS and NRS. This relationship can be explained by the following formula
$y = (m)x + (c)$ NRS = (β)VAS + (β₀) NRS = (0.87)VAS + (10.18)

This formula can be used to calculate comparative values between two scales. β coefficient value is 0.87 means one unit of VAS equal to 0.87 units of NRS. This also explains why we said the ideal value for this type of association is 1.

Analysis of 157 pairs of values had overall β coefficient value of 0.87 and overall and Pearson's correlation value of 0.904. Comparison of these values with β coefficient and Pearson's correlation values at different time intervals will identify the time intervals with best association between the two scales. β coefficient values taken at the commencement of analgesia, at 2 hours from the commencement of analgesia and at 6 hours from the commencement of analgesia were more close to 1 than the overall β coefficient value of 0.87. These findings show more preferable linear relationship between VAS and NRS at the commencement of analgesia, at 2 hours from the commencement of analgesia and at 6 hours from the commencement of analgesia compared to other time intervals. Pearson's correlation values taken at 2 hours from the commencement of analgesia and at 6 hours from the commencement of analgesia were more close to 1 than the overall and Pearson's correlation value of 0.904. These findings show more strong linear relationship between VAS and NRS at 2 hours from the commencement of analgesia and at 6 hours from the commencement of analgesia compared to other time intervals.

Conclusions
NRS which is less pain inducing and more user friendly in the post-operative period has a strong linear association with VAS, thus can be substituted for VAS in assessment of post-operative pain. The reliability of NRS is higher at the commencement of analgesia, at 2 hours from the commencement of analgesia and at 6 hours from the commencement of analgesia compared to other time intervals.

References
1. Anne Marie, Jamal R.M. Ameen, Mead Donna,: Postoperative pain assessment tools in day surgery: literature review Journal of Advanced Nursing 46 (2) , 124–133.
2. Goddard, Greg; Karibe, H.; McNeill. C.; Reproducibility of visual analog scale (VAS) pain scores to mechanical pressure. escholarship.org.
http://escholarship.org/uc/item/77k572s