Antibiotic Use in the Intensive Care Unit

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Abstract

On a background of a number of antibiotics in hand and no governing laws for their rational use, we have attempted to get a snapshot of the current trends of use of antibiotics in critically ill patients with infection as a primary cause, in our hospital.

This was a prospective observational study carried over a period of 1 year.

Critical cases arising from Infection as a primary cause were selected.

Demographic data, parameters to mark severity and corresponding list of Empiric, response related and culture driven changed antibiotics were noted.

Data of 50 patients, with a mean age of 62.2 years were analyzed.

In the 64% community and 34% hospital-acquired infections, Lung was the major source of infection. Mean APACHE score of the group was 18.

There were 37 survivals and 13 deaths in the group.

There is a trend of using Piperacillin Tazobactum and Third Generation Cephalosporins as Empiric antimicrobials. Fluoroquinolones are also found to be used frequently.

The frequency of third generation cephalosporins drops in the response related changes and the dependence on Carbapenems significantly rises.

The major finding here is that colistin sensitivity is frequently being indicated in Culture reports. This has resulted in significant increase in its use post culture reports.

The total cost incurred on antimicrobial agents in the entire group was Rs 14,55,160/- Thus the approximate amount of expenditure on microbials alone to save one life in our Intensive Care Unit was (1455160 / 37) Rs 39328/-

Further study conducted for a longer time with a larger data size needs to be done to perform a multivariate analysis of Severity of Illness, Generation of Antimicrobial as empiric therapy and Outcome.

A significant variation in the costs of the various brands of the same molecule is noted.

A vigilant approach to reduce unnecessary costs while treating critical patients is necessary.

Background

The discovery of antimicrobial therapy stands as a major breakthrough in modern medicine in the last Century. Ever since, the battle between the microbes and antimicrobials has continued with man developing further generations in antimicrobial therapy to combat the instinctive resistance being offered by the microbes from time to time.

With a number of antimicrobials as weapons in hand and no governing laws towards their rational use, there is a wide variation in the use of these in disease states. Through this study, we have attempted to obtain a snapshot of the current trends in the use of antimicrobials in the Intensive care unit of our hospital. The major intention in performing this study was to find out the cost the society is currently bearing in saving one individual suffering from an Illness arising from serious infections.

Though we did not want to prove or disprove the rationality in the use of antimicrobials in our ICU, we did collect data in an attempt to find the trends in use of generations of antimicrobials vis-à-vis the severity of the illness of the corresponding patient, measured in terms of several objective parameters.

Methodology

This was a prospective observational study carried out at the 72 bedded Intensive Care Unit of Deenanath Mangeshkar Hospital. It was performed over a period of one year between 1 Jan 2009 and 31 December 2009.

Cases requiring critical care for diseases arising from infection as a primary cause were selected in this study. Data were collected under the headings of Demography, Community or Hospital borne infections, Source of infection, Severity of Illness in terms of APACHE score at 24 hours, Number of organs failed, Relevant laboratory parameters, Duration of ICU stay, Outcome, Time required for defervescence, normalization of organ failures and laboratory abnormalities. The use of antimicrobials was charted under 3 main headings: Empirically started antimicrobials, Response related changes, Culture driven changes. The numbers of days of the administration of individual agents were noted along with the average costs of the individual agents in the current market. Thus we could obtain the cost borne by the patient on antimicrobials for his/her illness.
6.37 (74%) of patients could be discharged out of ICU while 13 (26%) died due to their illness (Figure 2).

7. The trends of the use of antimicrobials as Empiric treatment, response related Treatment and Culture driven treatment are as follows:
   Thus, there is a trend of using Piperacillin Tazobactum and Third Generation Cephalosporins as Empiric antimicrobials. Fluoroquinolones are also found to be used frequently. The decision of starting other antimicrobials is usually based on clinically driven suspicion of infective agents. For example, Vancomycin was used when meningitis was suspected, Macrolides were used when atypical pneumonia was suspected (Figure 3).

The frequency of third generation cephalosporins drops

**Observations**

50 cases satisfying the inclusion criteria could be studied in detail.

1. Mean age of the population studied was 62.2 years with a range between 19 and 90 years with a standard Deviation of 17.95.
2. The distribution between males and females was 26 : 24.
3. 64% of the infections were community acquired whilst 36% were hospital borne.
4. Lung was the source organ for infection in a majority (Figure 1), with the distribution for various organs was as follows:
5. Mean APACHE score in the group was 18 with a range between 5 and 34 and a standard deviation of 5.82.
in the response related changes and the dependence on Carbapenems significantly rises.

The major finding here is that colistin sensitivity is frequently being indicated in Culture reports. This has resulted in significant increase in its use post culture reports. One point to note is that Piperacillin Tazobactum use is seen to be dropped significantly based on culture reports. Whether we are encountering increased resistance to this group needs further study.

The above graph visually depicts the trend of the use of common antimicrobials in the 3 categories (Figures 4, 5, 6).

8. The distribution of the expenditure by the patient on antimicrobials alone was as follows. The total cost incurred in the entire group was ₹14,55,160/-

<table>
<thead>
<tr>
<th>Empiric Response-Related</th>
<th>C/S -Driven</th>
<th>Total (INr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>590470</td>
<td>507480</td>
<td>357210</td>
</tr>
</tbody>
</table>

9. The distribution of costs incurred on individual antimicrobial groups were as follows:

1. Thus the approximate amount of expenditure on antimicrobials alone to save one life in our Intensive Care Unit was (1455160 / 37) ₹39,328/- (Figures 7, 8).

2. The average ICU stay in the group was 8.8 days. Considering the minimal ICU bed charges of Rs 1100/ day of our hospital the common additional amount in each patient is Rs 9600/-

3. Apart from this the need of Oxygen, Infusion pumps, Ventilators, IV lines, Hemodynamic monitoring lines on an average escalates the price patient to around Rs 1,00,000/-

4. It was also found that there is a significant variation in the price of the Antimicrobials from Brand to Brand. For eg. Levofloxacin of a Brand X was Rs 50/- per dose while the same of Brand Y was Rs 250 per dose. While considering the cost per patient, we have taken the median of the range of the costs for the same molecule.

Limitations of the Study

We wished to correlate the severity of the illness and the generations of antimicrobials used with the outcome through a multivariate analysis. This would have helped us in understanding whether a higher generation antimicrobial used empirically in a severe disease really affects outcome significantly as against an approach of stepwise up gradation in the generation of antimicrobial based on response or culture report.

But the data obtained were insufficient to facilitate this analysis. Insufficient Data size was chiefly due to number of factors interfering in patient management. The major factors among these were, a decision of non aggressive management, especially in old patients and decision of transfer out of the hospital.

A larger data size would definitely enable this analysis which would be possible if it were collected over a longer period of time.

Conclusions and Recommendations

1. We spend approximately ₹39000 only on antimicrobial therapy alone to make one patient of disease from infection requiring ICU survive.

2. Third Generation Cephalosporins and Piperacillin Tazobactum are frequently being used as empiric therapy in the critically ill. However the use of Piperacillin Tazobactum as a culture driven change is almost nil. Are we facing resistance to this agent or its use is already exhausted, needs further study.

3. Carbapenems are being frequently depended upon as rescue if there is no response to empiric therapy.

4. Colistin use significantly increases after culture reports.
5. Further study conducted for a longer time with a larger data size needs to be done to perform a multivariate analysis of Severity of Illness, Generation of Antimicrobial as empiric therapy and Outcome.

6. Attempts should be made to reduce the cost burden of the patient suffering from serious infections. Some of these include:

7. Checking the brand wise cost of same molecules.

8. Avoiding unnecessary therapies which continue by default unless omitted, for eg. Oxygen therapy which costs almost Rs 50-100 per hour.

Appendix

Short forms used for antibiotics

- PEN: Penicillin and congeners
- CS3: 3rd Generation Cephalosporins
- CS4: 4th Generation Cephalosporins
- PIT: Piperacillin Tazobactum
- CRB: Carbapenems
- TCO: teicoplanin
- VAN: vancomycin
- AMG: Aminoglycoside
- MAC: macrolide
- FLQ: Fluoroquinilone
- FUN: anti-Fungal
- LIN: Linezolid
- CHL: Chloramphenicol
- TET: Tetracycline and congeners
- CLIN: Clindamycin

References
