Development of Laparoscopic Surgery in Rural India
A Pilot Study

Abstract
There is controversy as to whether Laparoscopic Surgery (LS) should be promoted in rural surgery, on the assumption that the cost-benefit-ratio is questionable. This study was conducted to explore the present situation in rural India and the prospective development as seen by our surgical colleges. In Summer 2009 a telephone survey was carried out among the members of the Association of Rural Surgeons of India (ARSI). Amongst the 450 members we were able to complete 40 questionnaires. Statistical and descriptive analysis was performed. The lengthy questionnaire partially caused incomplete answers and inconsistent data, so results have to be taken with caution: 80% of the questioned surgeons are practising LS. The median cost of open cholecystectomy is 10000 INR (~140 €) with LS being 40-50% more costly. The main reason given is the invested equipment of 7-10 Lakh (~10 000 to 14 000 €). But there is no correlation to be seen between investment and the higher cost of LS. Difficulties encountered practising LS are financing equipment, repair, acceptance by patients and lack of training. Complications or conversion-rate caused no greater difficulties. The main benefit is seen in short hospital stay and reduced pain with 70% of surgeons seeing a positive cost-benefit-ratio. In the next 5 years investment in LS is planned to be doubled, whereas 30% do not intend to make any investment in LS mainly due to high cost or lack of training. Aspects considered difficult to obtain when installing LS equipment are durable equipment at low cost with easy maintenance. In conclusion, there is an unexpected high development of LS among rural surgeons in India however, there is an extensive need for durable equipment at low cost with easy maintenance and training opportunities.

Background
Since the early 1970's pioneers in India have set mile stones in laparoscopy and later in laparoscopic surgery (LS)[2]. In time many of these hospitals became specialised high volume centres based in major cities. With two thirds of India's population living in rural areas and one third of the population living below the poverty line, access to sophisticated surgery is limited. However these patients benefit most from the early return to work after minimal access surgery[3,4]. The scope of operations in the rural setting is considerable and often cost-cutting, ranging from diagnostic laparoscopy saving CT or MRI scanning or laparoscopic vagotomy saving a life long medication on proton pump inhibitors with cholecystectomy, appendectomy and sterilisation making up the most of operations[5,6,7,8,9]. There is concern whether LS is to be promoted in rural hospitals due to concerns of a greater consumption of resources[10]. Cost effectiveness is a key issue, thus forcing the rural surgeon to improvise[11,12,13]. One of the main cost factors is the investment in surgical instruments and equipment (camera, light, monitor, CO₂-insufflator, etc.).
Methods
This study is to determine the availability of LS in rural India with present investments and the projected development of LS, the need for facilities and financial resources. Special emphasis is placed on the surgeon's needs. For this pilot study a telephone survey [Appendix I] was carried out among the members of the Association of Rural Surgeons of India (ARSI). The members directory of ARSI[^1] listed approximately 450 members. Of these members 140 telephone numbers could be identified through internet research.
In July and August 2009 six students of paramedical technology based in Bhubaneshwar, Orissa, India conducted the telephone survey. Raw data was tabulated there and then sent to Germany, where statistical (Student t-Test) and descriptive analysis was performed.

Results
Of the 140 telephone numbers of ARSI members it was possible to complete 40 questionnaires. The lengthy questionnaire partially caused incomplete answers and inconsistent data, so results have to be taken with caution.

Results Part I: Specification of hospital
85% of surgeons answered that they are practising in hospitals with less than 100 beds and the rest are working in hospitals with more than 400 beds. Per hospital there are 1 to 50 operating doctors (median 2, mean 7,3). 60% of the hospitals are located in rural towns or completely rural and 40% in cities [Fig.1].

Fig. 1: Location of Hospital

Median distance to the next referral hospital is given with 20km (range 0 to 300km). 75% are privately funded, 15% by the government and 10% by NGO's. 68% of the hospitals treat at least 50% of the patients below the poverty line with a median poverty line of 60% (range 7 to 90%). During the course of the telephone survey it was seen that the question of how many operations had been performed in the different ways was to long resulting in only 9 respondents semi-completing this question. So during the survey the question was changed to how many operations are done in total. Total operations in the last year were given between 180 and 7000 (median 400).

The median cost of open cholecystectomy is 10 000 INR ranging from 3 000 to 20 000 INR. Laparoscopic cholecystectomy is 40-50% more costly (range 5 000 to 30 000 INR, median 12 500 INR) where to answers are more than double as costly and one is cheaper. Wilcoxon Signed Ranks Test gives a p=0,002 highly significant difference, demonstrated in box plot [Fig. 2].
80% of the questioned surgeons are practising LS. Of the 20% not doing any LS the main reason given was lack of training followed by high cost and no benefit.

Results Part II: Laparoscopic surgery at present in the questioned hospital
The main factor given for making LS more expensive is the invested equipment (n= 22 answers), followed by operating time (n= 9) and resources needed (n= 8) [Fig.3].

The investment in LS equipment and instruments is given at a mean of 9 62 500 INR (range 5 Lakh to 25 Lakh INR, mean 7,5 Lank INR). There is no correlation to be seen between the stated invested equipment and the higher cost of LS [Fig. 4].
26 surgeons use CO₂ for pneumoperitoneum, 10 use air, no one mentioned abdominal wall lift. 16 use conventional halogen, 15 use cold light source. A total of 16 use disposable products like harmonic scalpels, endostaplers or endobags, where as only 13 are using 'self made' material such as endo-loops, self made sutures or condoms as endo-bags. All questioned surgeons still use ether, with 66% using more sophisticated anaesthetics. Difficulties encountered practising LS are especially financing equipments, repair of equipments and acceptance by patients followed by training. There were no greater difficulties seen due to complications or conversion rate. 20% of hospitals had trained a total of 60 (range 1-50) surgeons in the past year in LS. Difficulties encountered practising LS are financing equipment, repair, acceptance by patients and lack of training. Complications or conversion-rate were no greater difficulties [Fig. 5].
Results Part III: Prospecteded development in the next 5 years
The judged development of LS and open surgery in the next 5 years is seen that Appendectomy and Cholecystectomy are important laparoscopic procedures. Where as Colon resection and Hernia repair are seen to be the area of open surgery [Fig. 6].

![Fig. 6: Prospected Developement](image)

In the next 5 years 8 surgeons stated on planed investment in LS which doubles their investment on average up to date. Where as 30% do not intend to make any investment in LS mainly due to high cost and lack of training.
Over 70% of the interviewed see a positive cost benefit ratio. The main benefit is seen in short hospital stay and reduced pain [Fig. 7].

![Fig. 7: Benefit of Laparoscopic Procedure](image)

Aspects considered important when installing laparoscopic equipment and difficult to obtain are durable equipment at lows cost, with easy maintenance [Fig. 8].
Conclusion and Discussion

Concluding, there is an unexpected high development of LS among rural surgeons in India. But there is a big need for durable equipment at low cost, with easy maintenance and training!

Future questionnaires via telephone should be short and with simple answers. Email-contact and online survey might be able to acquire more precise data.

There are incomplete questionnaires due to the length and inconclusive data to be found. One example is that surgeons state to be using circular endostaplers, but not doing laparoscopic colon resection, the main area used for this kind of instruments. One explanation can be the use in open surgery or that there is misunderstanding via telephone interrogation. Another explanation can be that there are sophisticated laparoscopic surgeons working in major centres doing extra work on the side in rural areas, so serving both 'worlds' in India.

Through the search for telephone numbers via the internet and being dependent on reaching the surgeon by phone, there probably is a strong disturbance of representativity of the reached rural surgeons. Probably surgeons in very remote areas will have bad telephone and internet connection and so being under-represented in this survey, explaining the high (80%) usage of LS. So for these colleges a personal or postal questionnaire could be a good opportunity.

The small sample (n=40) gives a bias too. Future studies with approximately 12800 ASI\textsuperscript{15} and 1800 IAGES\textsuperscript{16} members add up to a total of over 14000 potential recipients of a questionnaire, which would give a better base for statistical analysis.

Further these results need to be submitted to industry demonstrating the needs of rural surgeons in India and probably all around the world: sturdy equipment at low cost with a reliable maintenance.
## Appendix

### Questionnaire: Development of Laparoscopic Surgery in India

<table>
<thead>
<tr>
<th>= Interviewer</th>
<th>= Doctor</th>
</tr>
</thead>
</table>

**Starting the interview**

When reaching the desired Doctor please confirm identity of Doctor for example:

1. **“Hello. Am I speaking with Doctor .......?“ or “Hello. Can I please speak to Doctor .......?“**
   
   **Yes.**

2. **“My name is Mrs. .......**
   
   I am calling on behalf of the International Leadership and Business Society, Germany. We are conducting a survey to determine what rural surgeon's needs. Please give me just 10 minutes of your valuable time for some questions.”
   
   **Yes.** If answer is NO ➔ give reason: __________________________

3. **“Thank you Sir. Are the contact details I have here correct?“**
   
   - Your Name is (Surgeon's Name) __________________________
   - The Hospital Name / Institution _________________________
   - Your Address _________________________________________
   - Telephone number _____________________________________
   - Email to forward the results of the survey ______________
   - Your year of birth 19____

4. **“Are you MBBS or MS?“**
   
   - MBBS
   - MS

5. **“Do you have a specialisation?“**
   
   - Specialisation __________________________

6. **“I believe your are a member of ARSI?“**
   
   - ARSI (Association of Rural Surgeons of India)
   - ASI (Association of Surgeons of India)
   - IAGES (Ind. Ass. of Gastrointestinal Endosurgeons)
   - Other __________________________

**Part I: Specifications of hospital**

1. **“What is the total number of beds in your hospital (incl. medicine and other specialities)“**
   
   **Number of beds ______**

2. **“How many operating doctors (surgeons, gynaecologists, orthopaedists, etc.) are posted in your institution?“**
   
   **Number of operating doctors ______**
“In what environment in the hospital located?

In a  □ 5a city with more than 1 million population
□ 5b city less than 1 million population
□ 5c rural town
□ 5d completely rural?”

“How far away is the next referal hospital?”

□ In _____ km 6a.

“What is the main funding?”

□ 7a Government
□ 7b Private
□ 7c NGO/Missionary etc

“What percentage of patients are below the poverty line?”

□ Patients below poverty _____ % 8a of total patients.

“How many operations were performed in the last year? Please give approximate number for the following procedures and state if open or laparoscopic surgery:”

□ Approximate number of surgical procedures for the last year:

<table>
<thead>
<tr>
<th>Procedure</th>
<th>open surgery</th>
<th>laparoscopic surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic laparotomy/laparoscopy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appendectomy</td>
<td>10a</td>
<td>10b</td>
</tr>
<tr>
<td>Cholecystectomy</td>
<td>11a</td>
<td>11b</td>
</tr>
<tr>
<td>Hernia repair</td>
<td>12a</td>
<td>12b</td>
</tr>
<tr>
<td>Colon resection</td>
<td>13a</td>
<td>13b</td>
</tr>
<tr>
<td>Vagotomy</td>
<td>14a</td>
<td>14b</td>
</tr>
<tr>
<td>Sterilisation</td>
<td>15a</td>
<td>15b</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>16a</td>
<td>16b</td>
</tr>
<tr>
<td>Ovarial cyst</td>
<td>17a</td>
<td>17b</td>
</tr>
<tr>
<td>Ectopic rupture</td>
<td>18a</td>
<td>18b</td>
</tr>
</tbody>
</table>

“What is the all over cost for a cholecystectomy including charges for surgeon, anaesthetist, medication and hospital stay? Please give cost both for open procedure and as laparoscopic procedure.”

□ Approximate cost for cholecystectomy as open procedure _______INR 9a

□ and as laparoscopic cholecystectomy _______INR 9b.

*!*!*! If the hospital has not done any laparoscopic surgery up to date ➔ ask this question:

“What are the main reasons that your hospital has not done any laparoscopic surgery to date?”

□ 20a high cost
□ 20b lack of training
□ 20c no benefit
□ 20d complication rate
□ 20e or other reasons: __________________________________________ (please specify)

⇒ *!*!*! in this case (no laparoscopic surgery) please continue with part III
Part II: Laparoscopic surgery at present in your hospital

“What is the main factor making the laparoscopic procedure more expensive?”

☐ 21a invested equipment
☐ 21b operating time
☐ 21c more resources needed
☐ 21d disposable products
☐ 21e or other reasons: ____________________________ (please specify)

“How much has been investment in laparoscopic surgery equipment and instruments in your hospital to date?”

☐ Approximate investment in laparoscopic surgery equipment and instruments in total to date ______________ INR.

“What is used to create pneumo-peritoneum?”

☐ 23a CO
☐ 23b air
☐ 23c abdominal wall lift
☐ 23d or other: ____________________________ (please specify)

“What is used as a light source?”

☐ 24a conventional halogen
☐ 24b cold light source
☐ 24c or other: ____________________________ (please specify)

“Do you regularly use disposable products like:

☐ 25a harmonic scalpel
☐ 25b linear endostaplers
☐ 25c circular endostaplers
☐ 25d endo-bags
☐ 25e or other: ____________________________ (please specify)

“What kind of 'self made' instruments and materials do you use?”

☐ 26a endo-loops
☐ 26b self made sutures
☐ 26c condoms as endo-bags
☐ 26d or others: (please specify!!!)

“What kind of anaesthesia is used for laparoscopic surgery?”

☐ all mainly some never

general anaesthesia with ether
☐ 27a 27b 27c 27d

general anaesthesia with other
☐ 28a 28b 28c 28d

spinal anaesthesia
☐ 29a 29b 29c 29d

local anaesthesia
☐ 30a 30b 30c 30d
“What kind of difficulties do you encounter practising laparoscopic surgery? Please state if none, some, often or major difficulties”

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>none</th>
<th>some</th>
<th>often</th>
<th>major difficulties</th>
</tr>
</thead>
<tbody>
<tr>
<td>finding adequate equipment</td>
<td>31a</td>
<td>31b</td>
<td>31c</td>
<td>31d</td>
</tr>
<tr>
<td>financing equipment</td>
<td>32a</td>
<td>32b</td>
<td>32c</td>
<td>32d</td>
</tr>
<tr>
<td>repair of equipment</td>
<td>33a</td>
<td>33b</td>
<td>33c</td>
<td>33d</td>
</tr>
<tr>
<td>adequate power supply</td>
<td>34a</td>
<td>34b</td>
<td>34c</td>
<td>34d</td>
</tr>
<tr>
<td>training</td>
<td>35a</td>
<td>35b</td>
<td>35c</td>
<td>35d</td>
</tr>
<tr>
<td>time consuming</td>
<td>36a</td>
<td>36b</td>
<td>36c</td>
<td>36d</td>
</tr>
<tr>
<td>complications</td>
<td>37a</td>
<td>37b</td>
<td>37c</td>
<td>37d</td>
</tr>
<tr>
<td>conversion rate</td>
<td>38a</td>
<td>38b</td>
<td>38c</td>
<td>38d</td>
</tr>
<tr>
<td>acceptance by patients</td>
<td>39a</td>
<td>39b</td>
<td>39c</td>
<td>39d</td>
</tr>
<tr>
<td>unqualified paramedical staff</td>
<td>40a</td>
<td>40b</td>
<td>40c</td>
<td>40d</td>
</tr>
<tr>
<td>lack of diagnostic facilities</td>
<td>41a</td>
<td>41b</td>
<td>41c</td>
<td>41d</td>
</tr>
<tr>
<td>legal problems</td>
<td>42a</td>
<td>42b</td>
<td>42c</td>
<td>42d</td>
</tr>
<tr>
<td>other, (please specify)</td>
<td>43a</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

“Has your hospital trained any surgeons in laparoscopic surgery in the last year?”

<table>
<thead>
<tr>
<th></th>
<th>no</th>
<th>yes</th>
<th>“How many?”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>44a</td>
<td>44b</td>
<td>Number surgeons trained 44c</td>
</tr>
</tbody>
</table>

III Prospected development in the next 5 years in your Hospital

“Please judge the development of laparoscopic procedures in your hospital in the next 5 years: Will appendectomies be open surgery (all or mainly) or laparoscopic surgery (all or mainly)? How is this with cholecystectomies? With hernia repairs? With colon resections?”

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Open Surgery</th>
<th>Laparoscopic Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendectomy</td>
<td>all 45a</td>
<td>mainly 45b</td>
</tr>
<tr>
<td>Cholecystectomy</td>
<td>all 46a</td>
<td>mainly 46b</td>
</tr>
<tr>
<td>Hernia repair</td>
<td>all 47a</td>
<td>mainly 47b</td>
</tr>
<tr>
<td>Colon resection</td>
<td>all 48a</td>
<td>mainly 48b</td>
</tr>
</tbody>
</table>

“What is the planned investment in laparoscopic equipment and instruments in the next 5 years?”

<table>
<thead>
<tr>
<th>Planed investment</th>
<th>INR 49a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>!<em>!</em>!*!</td>
</tr>
<tr>
<td>If planed investment is none, ask this question:</td>
<td></td>
</tr>
</tbody>
</table>

“Why is there no intention to expand laparoscopic surgery? What are the main reasons?”

<table>
<thead>
<tr>
<th>Reason</th>
<th>50a</th>
</tr>
</thead>
<tbody>
<tr>
<td>high cost</td>
<td>50b</td>
</tr>
<tr>
<td>lack of training</td>
<td>50c</td>
</tr>
<tr>
<td>no benefit</td>
<td>50d</td>
</tr>
<tr>
<td>complication rate</td>
<td>50e</td>
</tr>
<tr>
<td>other reasons, (please specify)</td>
<td>50f</td>
</tr>
</tbody>
</table>
“Do you see a positive cost-benefit ratio for laparoscopic surgery for “under privileged” patients (rural, below poverty line, low caste, etc.)?

☐ 51a none
☐ 51b to some extent
☐ 51c definitively

*!*!*! If “to some extent” or “definitely”, ask this question:

“What is the main benefit?”

☐ 52a short hospital stay
☐ 52b early onset of work
☐ 52c aesthetic
☐ 52d reduced pain
☐ 52e less wound infections
☐ 52f other, (please specify)

“What aspects do you consider important when installing laparoscopic equipment? What is difficult to obtain?

☐ important     ☐ difficult to obtain

low cost       ☐ 53a       ☐ 53b
durability     ☐ 54a       ☐ 54b
easy maintenance ☐ 55a       ☐ 55b
compatibility  ☐ 56a       ☐ 56b
reusable       ☐ 57a       ☐ 57b
high definition camera and monitor ☐ 58a       ☐ 58b
high quality optics ☐ 59a       ☐ 59b
CO₂-insufflator rather than air ☐ 60a       ☐ 60b
cold light source rather than halogen ☐ 61a       ☐ 61b
video documentation system ☐ 62a       ☐ 62b
other _____________________________ ☐ 63a       ☐ 63b  SPECIFY!

“What have you always wanted to tell designers and industry about their products, what do they need to change, what is great?”

☐ 64a ___________________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________


“Have we missed anything important in this questionnaire?”

☐ 65a ___________________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

“Sir, thank you very much for your patience and your detailed answers!”

Date 66a ___________________  Interviewer Name 66b ___________________

Comments from interviewer:

_____________________________________________________________________________

_____________________________________________________________________________

E. Engelking: Development of Laparoscopic Surgery in Rural India. Printed 26 September 2009
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Corresponding Author
Dr. Elias Engelking*
Hugstetter Str. 19
79106 Freiburg
Germany
email: eliasengelking@yahoo.com

*Resident in Surgery at the Evangelisches Diakonie Krankenhaus, Freiburg, Germany. www.diak-fr.de