ABDOMINAL WALL INCISIONS AND CLOSURE TECHNIQUES: DO THEY AFFECT HERNIA RATES?

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SUMMARY

Incisional Hernia rates after laparotomy are probably in the range of 10-20% though many studies report higher rates in high-risk patients. Technical Factors account for the biggest proportion of potentially modifiable risk factors. The following recommendations should be considered at every abdominal surgery.

The lowest risk for incisional hernia is associated with minimally invasive surgery. If open surgery is required the surgeon should implement “Best Care Always” Surgical Site Infection (SSI) bundles, should avoid midline incisions where possible, and should close the abdomen with a continuous suture, including the fascia and peritoneum alone. The suture should be slowly absorbable monofilament of the smallest needle size and diameter to provide adequate tensile strength. The sutures should have small bites and be close together and a suture length to wound length ration of 4:1 is the minimum acceptable ratio. Prophylactic mesh reinforcement should be considered for all high risk patients.

INTRODUCTION

There is no data on the numbers and outcomes of abdominal surgery in South Africa although the SASOS study will soon provide some insights on audited cases.
In the USA, there are approximately two million laparotomies performed per annum and at least 100 000 incisional hernia repairs. Most authors agree that the Incisional Hernia (IH) rate at two years is between 10 and 20%.

Some longer-term studies in high-risk patient populations with long-term follow-up quote numbers up to 69%.
Cost analysis from the Eurozone puts the average cost of standard IH repair to be the equivalent of R100 000 per case. Though minimally invasive surgery has gained much traction, midline laparotomy is still the most commonly performed approach to abdominal pathology and the cost implications, associated mortality, morbidity, quality of life factors and body image consequences should not be underestimated.

FACTORS AFFECTING INCISIONAL HERNIA RATES
The potential factors affecting IH rates can be grouped broadly:
- Patient factors, such as obesity and immunosuppression
- Factors related to the pathology such as malignancy and sepsis
- Technical factors.

Of these, the only really modifiable factors are the technical factors and those surrounding peri-operative care. For the purposes of this discussion we will focus on these modifiable technical and management strategies.

PERI-OPERATIVE CARE
The association between SSI rates and IH rates is well documented. There are no direct studies looking at IH rates as an end point of implementation of surgical site infection prevention bundles, an example of which is the “Best Care Always Initiative”. Patients whose wounds are complicated by SSI are twice as likely to develop IH than those without.

Logic therefore dictates that implementation of “Best care Always” SSI bundles may also decrease IH rates as well as decreasing mortality, length of stay, readmission rates and cost.

Surgeons are encouraged to implement four key elements:
1. Appropriate use of prophylactic antibiotics
2. Correct method of hair removal
3. Post-operative glucose control
4. Post-operative normothermia.
POST-OPERATIVE MANAGEMENT
Abdominal Binders – Abdominal binders have been proposed as a solution for a myriad of post-incision complications though their successes have been limited. There are no data to suggest that the use of abdominal binders reduce the incidence of SSI or IH, though they are effective in reducing postoperative pain.

Restricted Post-Operative Activity – despite the worldwide trend towards early mobilisation and adherence to ERAS principles, some surgeons still suggest limiting activity in the early post-op period in the hope that less tension on the wound may reduce complication rates. There is no data to support this strategy though equally there is none refuting it.

LAPAROSCOPY VS. OPEN SURGERY
Information relating to incisional hernia rates after laparoscopic surgery may be confusing and conflicting. Authors reporting rates after laparoscopic colorectal surgery discuss incision sizes ranging from 3-11cm, which are likely extraction and not port sites. The best systematic review on the subject by Helgstrand concludes that 5mm trocar sites have a low Incisional Hernia (IH) rate and that port sites of 10mm and greater have a reduced risk of IH formation if there is suture closure\(^1\). Single port surgery and extraction sites carry the highest risk of IH for obvious reasons.

Data is available on dramatic reduction in SSI rates after laparoscopic surgery but this is yet to be convincingly borne out in IH rates if incisions greater than 10mm are required.

TYPE OF INCISION
In terms of relative risk for the development of IH, the midline approach carries the highest risk with a Relative risk of 3.41, compared to a RR of 1.77 for transverse incisions and a RR of 1 for paramedian incisions. Despite this most surgeons continue to use this route due to its ease and speed of access and the possibility of extension and versatility.
DRAINS
There are no data to support the routine use of drains as they have not been shown to influence SSI rates at all. There are no studies looking at IH as an endpoint with drain use.

WOUND PROTECTORS
A meta-analysis looking at the use of wound protection devices in abdominal surgery have shown a dramatic reduction (RR 0.55) in SSI rates especially in the setting of sepsis and contaminated fields. There are no data looking at IH as an endpoint.

CONTINUOUS VS. INTERRUPTED CLOSURE
In the landmark meta-analysis from Diener et al., there was a significantly lower rate of incisional hernia after continuous closure (OR 0.59)\textsuperscript{2}. Van’t Riet showed no difference in the emergency surgery setting but surgeons are recommended to use continuous closure under these circumstances due to its speed\textsuperscript{3}.

PERITONEAL CLOSURE
The Cochrane review by Gurasamy shows no short-term or long-term benefit in closing the peritoneum separately\textsuperscript{4}. Therefore it should be closed en masse with the fascia to prevent adhesive complications.

MASS CLOSURE
There are no studies of significant quality on this issue but what data does exist shows no benefit in multilayer closure. A single layer fascial closure is recommended. Israelson’s important paper from the 2013 Surgical Clinics goes into some detail about the theory behind single layer fascia only closure, proposing that inclusion of subcutaneous fat in the stitch increases the ultimate fascial separation distance and inclusion of muscle predisposes to ischaemia\textsuperscript{5}.

SUTURE LENGTH: WOUND LENGTH RATIO
Work on this subject mostly comes out of the Sundsvall Swedish Unit, which quite categorically shows that a ratio of 4:1 is the minimum acceptable length ratio which can only be achieved correctly by a small bites technique\textsuperscript{5}. 
Independent risk analysis and predictive modelling shows an increased risk in ratios less than 4.2:1. Most studies fail to calculate or document this ratio making analysis more difficult.

**SMALL BITES**
There is level one evidence to suggest that smaller (5mm) bites of the rectus sheath have a lower IH rate than larger (10mm) bites, when closing midline laparotomy wounds\(^6\).

**SELF-LOCKING KNOTS**
Again Israelsson goes into some detail about self-locking anchoring knots and their tensile strength and the influence that may have on IH rates\(^5\). His technique unquestionably shows a dramatic risk reduction but the individual role of the parts has not been elucidated in all cases.

**SUTURE MATERIAL**
Diener notes a significantly higher rate of IH formation with the use of rapidly absorbable suture material for wound closure, with and odds ratio of 0.65 for the use of slowly absorbable sutures\(^2\).

There is no difference in the IH rate between non-absorbable and slowly absorbable sutures, but slowly absorbable sutures have a decreased incidence of prolonged pain and chronic sinus formation (OR 0.49)\(^2\).

It has been suggested that monofilament sutures have a lower rate of SSI and therefore may affect IH rates, but if the guidelines on the use of slowly absorbable sutures are adopted the argument becomes superfluous.

Israelsson\(^6\) used a 2/0 suture and proposes that the smallest diameter suture material necessary to achieve adequate tensile strength should be used in order to minimise potential for the sutures cutting through tissue by reducing tissue trauma. There are no comparative studies.
Diener's meta-analysis looking at five RCTs showed a significant reduction in the rate of SSI if antibiotic impregnated sutures were used for wound closure even though his own RCT showed no difference\textsuperscript{2}. There are no data on hernia.

**NEEDLE TYPE**

There is no data on this relating to hernia formation but data comparing sharp and blunt needles shows no difference in SSI rates.

**MESH AUGMENTATION**

It is fashionable at present to consider mesh augmentation for any abdominal defect closure where there is a high risk for hernia formation. It is now widely accepted that mesh should be used to augment all permanent stoma sites. There are six published RCTs on the subject of midline IH prevention.

In high-risk groups such as obese patients, those with previous hernias and patients with aneurysmal disease the risk reduction is massive with a 1.5% IH rate in the mesh group vs. 35.9% IH rate in the suture alone group (RR 0.17). No recommendations can be made at this juncture on the mesh type, mesh position or fixation technique.

**EXTRAPOLATION OF DATA**

It must be stressed that the data above is only applicable to the midline laparotomy wound in the elective setting. There is really insufficient data in the setting of emergency surgery and in the setting of non-midline wounds to draw firm conclusions. Though in the absence of robust data it seems logical to apply best practice techniques across the board until such time as these questions are answered definitively.

**CONCLUSION**

Whilst much attention is given to the technical aspects of surgery intraoperatively, the common denominators of coelomic access and complication free closure are often ignored to the detriment of the patient and cost to the funder or health care provider. Surgeons should be encouraged to adopt best practice initiatives in every case, every time, all the time.
REFERENCES