Measurement of intra-abdominal pressure in intensive care units in the United Kingdom: a national postal questionnaire study†

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Background. To explore the attitudes of intensivists in the UK to intra-abdominal pressure (IAP) measurement and abdominal compartment syndrome (ACS) and to determine current practice.

Methods. A postal questionnaire study addressed to the lead clinician in the intensive care unit was sent to hospitals in the UK with a general surgical service.

Results. Completed questionnaires were received from 137 of the 207 hospitals surveyed (66.2% response rate). Only 1.5% of the respondents (n=2) had no prior knowledge of intra-abdominal hypertension and ACS. IAP had been measured on some occasion by 75.9% (n=104) of the respondents, always by the intravesical route. Among those intensive care units that measured IAP, in 93.2% (n=97) it was only measured when there was a suspicion of the development of ACS; 3.8% of units (n=4) measured IAP on all patients who had undergone an emergency laparotomy, and 2.9% (n=3) measured IAP only in those who had undergone emergency laparotomy associated with massive fluid resuscitation. There was major disparity in the frequency of IAP measurement and when to recommend abdominal decompression.

Conclusions. Despite widespread awareness of IAH and the ACS, many intensive care units never measure the IAP. When it is measured, the intravesical route is used exclusively. No consensus exists on optimal timing of measurement or when decompressive laparotomy should be performed.

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The adverse physiological consequences of a raised intra-abdominal pressure (IAP) have been recognized for many years.1–4 However, it is only relatively recently that the clinical significance of intra-abdominal hypertension (IAH) has been appreciated. In the 1980s, Kron and colleagues were the first to measure IAP in postoperative patients and use it as a criterion for decompressive laparotomy.5 They observed that decompression in patients with significantly elevated abdominal pressures and renal dysfunction resulted in immediate diuresis and physiological improvement, whereas non-intervention resulted in death.

The normal IAP at rest is ~6.5 mm Hg (range 0.2–16.2 mm Hg) and is positively related to body mass index.6 7 The exact level of IAP that defines IAH has not been established, although physiological changes can be demonstrated with pressures as low as 10–15 mm Hg.8–10 However, sustained IAPs in excess of 25 mm Hg are nearly always clinically significant.11 12 The incidence of IAH depends on the nature of the patient population studied and the abdominal pressure used to define IAH. Consequently, there is little reliable data available detailing its incidence.

IAH causes widespread physiological disturbance, with direct mechanical impairment of respiratory, haemodynamic, renal and splanchnic function. The combination of IAH and organ dysfunction has been termed the abdominal...
compartment syndrome (ACS). Without appropriate management this condition carries a high mortality, most deaths being due to multi-organ failure and sepsis. Detection of abdominal compartment syndrome requires close surveillance of IAP in patients thought to be at risk of developing IAH. Clinically, patients with ACS usually present with a tense distended abdomen, hypotension, high airway pressures, hypercapnia and oliguria. The only therapy for established ACS is decompressive laparotomy.

Despite a recent increase in the number of published articles on the deleterious effects of IAH, there remains uncertainty about the detection and management of this condition. We have conducted a national postal questionnaire survey of UK intensivists to assess: (i) knowledge of ACS; (ii) clinical utility of IAP monitoring; (iii) methods employed to measure IAP; (iii) in which patient IAP is monitored and how often; and (iv) the criteria employed to recommend surgical decompressive laparotomy.

Materials and methods
As significant IAH is most commonly seen after laparotomy, we identified all hospitals carrying out significant amounts of general surgery (four or more general surgeons) in the UK from the Directory of Operating Theatres and Departments of Surgery. Hospitals concerned solely with paediatric, obstetric, ophthalmic or dental services were excluded, as were those performing fewer than 4000 operations per year. A postal questionnaire (Appendix 1) addressed to the ‘Lead Clinician, Intensive Care Unit’ was sent along with a covering letter explaining the purpose of the study to all the hospitals (n=207).

Results
Completed questionnaires were received from 137 of the 207 hospitals surveyed (66.2% response rate).

The overwhelming majority of the respondents had prior knowledge of ACS (98.5%, n=135). IAP had been measured on some occasion by 75.9% (n=104) of respondents. The intravesical route was used exclusively. The reasons given for not measuring IAP are detailed in Table 1.

In those intensive care units that measured IAP, the majority (93.9%, n=97) only measured IAP when there was a clinical suspicion of IAH and the ACS. A small number of intensive care units measured IAP on all patients returning to the unit after emergency laparotomy (3.8%, n=4), while 2.9% (n=3) measured IAP only in those who had undergone emergency laparotomy associated with massive fluid resuscitation.

There was no general consensus on how often IAP should be measured (Table 2).

Amongst those who measure IAP, there was no general agreement on when decompressive laparotomy should be recommended. Sixty-four per cent (n=67) would recommend surgical decompression when the IAP exceeded 25 mm Hg accompanied by signs of organ dysfunction. A further 6.7% (n=7) would recommend decompressive laparotomy if the IAP was >25 mm Hg in the absence of any organ dysfunction. However, almost 27% (n=28) would use IAPs in excess of 20 mm Hg with signs of organ dysfunction to recommend laparotomy, while fewer than 2% (n=2) would use IAPs >20 mm Hg with no signs of organ dysfunction as criteria for decompression.

Discussion
Despite recent interest in IAH and the ACS, many fundamental questions remain unanswered. These include deciding which patients should have IAP measured and how often, what is a clinically significant increase in IAP and what should be done if the IAP is elevated. ACS is also an unusual condition, the incidence being highly dependent on the case mix of the unit. Those units receiving a lot of patients with abdominal trauma will observe the highest incidence.

Our survey indicates that the vast majority of clinicians are aware of the syndrome. Detection of ACS requires close surveillance of IAP. Despite being aware of the deleterious consequences of ACS, 24% of respondents had never measured IAP. The main reason given by respondents for not measuring IAP was that they thought it was a waste of time. This supports the impression that many intensivists remain sceptical about the clinical utility of IAP monitoring. Others do not measure IAP because they are either unsure of how to interpret the results or how to physically measure the pressure in the abdomen. This most likely reflects the low incidence of clinically significant IAH observed, making it a low priority to learn about IAP monitoring or assemble the necessary equipment to enable measurement of the IAP.

All respondents who measured IAP did so by the intravesical route, reflecting recommended practice.

<table>
<thead>
<tr>
<th>Reasons</th>
<th>% of respondents who never measure IAP (n)</th>
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<tbody>
<tr>
<td>Do not know how</td>
<td>27.2 (9)</td>
</tr>
<tr>
<td>Think it is futile</td>
<td>36.4 (12)</td>
</tr>
<tr>
<td>Do not know how to interpret results</td>
<td>33.3 (11)</td>
</tr>
<tr>
<td>Never admit patients with intra-abdominal hypertension</td>
<td>3 (1)</td>
</tr>
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Table 1 Reasons cited for not measuring intra-abdominal pressure by those respondents who never measure intra-abdominal pressure

<table>
<thead>
<tr>
<th>Timing of measurement</th>
<th>% of those measuring IAP (n)</th>
</tr>
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<tbody>
<tr>
<td>0–4 h</td>
<td>15.4 (16)</td>
</tr>
<tr>
<td>4–8 h</td>
<td>26.9 (28)</td>
</tr>
<tr>
<td>12-hourly</td>
<td>10.9 (11)</td>
</tr>
<tr>
<td>Once every 24 h</td>
<td>2.9 (3)</td>
</tr>
<tr>
<td>Only when clinically indicated</td>
<td>44.2 (46)</td>
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Table 2 Frequency of intra-abdominal pressure monitoring
This technique was first described by Kron and colleagues, who used a standard Foley catheter to measure the pressure in the bladder after instillation of sterile saline. Subsequent studies have confirmed the accuracy of this technique and shown it to be a reliable method of estimating the IAP.

The majority of respondents (93%) only measured IAP in those patients judged to be at risk of developing ACS. This is contrary to recommendations which suggest that IAP measurements should be undertaken after operation in all patients who have had an emergency laparotomy. This was only performed by 3.8% of centres measuring IAP in the UK. A further 2.9% only measured IAP in those who had undergone emergency laparotomy with massive fluid resuscitation, reflecting the known association between massive intravascular fluid infusion and ACS.

There was no consensus on the ideal frequency of IAP monitoring. Almost half of respondents who measure IAP only perform measurements when they feel that it is indicated clinically. However, this method may miss patients with clinically significant elevation in IAP as a recent study has demonstrated that clinical examination is a poor predictor of IAH. Measuring IAP 4- to 8-hourly was the next most frequent timing of measurement (27%). This has been suggested as the most appropriate time to take readings, as IAP values tend to rise slowly in the absence of severe intra-abdominal haemorrhage.

Abdominal decompression is a major undertaking. It is a hazardous procedure, and full resuscitative facilities must be immediately available. Malignant arrhythmias have been reported on decompression, presumably secondary to the sudden efflux of products of anaerobic metabolism from the abdomen. After decompression, it is usual to adopt an ‘open abdomen’ technique and a number of methods have been described to achieve temporary abdominal closure.

The management of the open abdomen is extremely challenging; early problems include infection and ongoing fluid losses, while fistulae and ventral hernias can lead to long-term complications. There is, therefore, an understandable reluctance amongst surgeons to perform this procedure.

The majority of intensivists would recommend surgical decompression when the IAP exceeds 25 mm Hg and there is organ dysfunction (64.4%, n=67). A further 27% (n=28) would use IAPs in excess of 20 mm Hg with signs of organ dysfunction to recommend laparotomy. This is the approach recommended by the majority of authors, who suggest that patients with isolated IAH should be monitored closely for signs of physiological deterioration before proceeding to abdominal decompression. Asymptomatic IAH often has a benign clinical course and does not inevitably progress to ACS. The remainder of respondents would recommend decompressive laparotomy in the presence of isolated IAH without signs of organ dysfunction. Although some authors advocate this action, most surgeons would be reluctant to perform a potentially dangerous procedure without signs of physiological deterioration. A survey of American trauma surgeons suggested that only 14% of them would perform abdominal decompression based on elevated IAP alone.

Although rare, ACS is associated with a high mortality if undetected or incorrectly managed. This survey demonstrates the disparity and uncertainty that exists within the UK towards the detection and management of this important syndrome. Unfortunately, many fundamental questions regarding the optimal management of IAH and ACS remain unanswered. This may reflect the difficulties encountered in studying an uncommon condition occurring in a heterogeneous population of critically ill patients with significant comorbidity and several potential causes of multi-organ failure. Perhaps it is time to determine clinical practice guidelines, using the best available evidence, to aid clinicians in the management of this unusual but lethal condition.

Appendix 1
Surveyed opinion of the measurement of Intra-Abdominal Pressure (IAP) in the ICU

Are you aware of the Abdominal Compartment Syndrome? Yes □ No □

Do you ever measure IAP on your ITU patients? Yes □ No □ If yes, please go to question 4

You do not measure IAP because (please tick all appropriate):
- Do not know how to □
- Feel that it is a waste of time □
- Do not know how to interpret the results obtained? □
- Never admit any patients with intra-abdominal hypertension □

What method do you most commonly use to measure IAP?
- Intra-vesical □
- Gastric route □
- Femoral route □
- Other (please specify) □

In which patients do you measure IAP?
- All post-operative ICU patients following emergency laparotomy □
- Patients exposed to massive fluid resuscitation □
- Only those patients thought likely to develop abdominal compartment syndrome □

How often do you measure IAP?
- 0–4 hourly □
- 4–8 hourly □
- 12 hourly □
- Once every 24 h □
- Only when clinically indicated □

When would you recommend surgical decompression?
- IAP persistently >25 mm Hg regardless of whether signs of organ dysfunction or not □
IAP persistently $>25$ mm Hg plus signs of organ dysfunction □
IAP persistently $>20$ mm Hg regardless of whether signs of organ dysfunction or not □
IAP persistently $>20$ mm Hg plus signs of organ dysfunction □

Many thanks for completing this survey. Please return replies in envelope provided, or fax to Dr John Hunter, Consultant Anaesthetist on (01625) 661092.

References
1 Wendt E. Ueber den Einfluss des intraabdominalen Druckes auf die Absonderungsgeschwindigkeit des Harness. Arch Physiologische Heilkunde 1876; 525–7
10 Richardson JD, Trinkle JK. Haemodynamic and respiratory alterations with increased intra-abdominal pressure. J Surg Res 1976; 20: 401–4