A national analysis of invasive arterial blood pressure monitoring rates in routine anaesthesia practice

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Invasive intra-arterial monitoring allows beat-to-beat blood pressure measurements and may enable more timely detection of alterations during surgery than intermittent use of blood pressure cuffs. Guidelines advise that invasive blood pressure monitoring during surgery should be considered when there is cardiovascular disease or the surgery is urgent. However, it is not known whether these are adhered to. Here, we provide novel insight and describe arterial line monitoring rates from a UK-wide dataset during routine anaesthetic practice stratified by clinical risk. In brief, all NHS sites providing anaesthesia services were invited to record anonymised patient-level anaesthetic data for all cases during 4 days in Nov 2021 with an equal chance of starting their data period on any given day of the week. Data fields included age, surgical specialty and urgency of surgery. We calculated the Surgical Outcome Risk Tool (SORT) score for each patient from the pre-operative data provided and stratified patients into low, medium and high-risk groups (<1%, 1-5% and >5% estimated 30-day mortality risk, respectively). The project had PPIE input from conception to delivery. Arterial monitoring was used in 2140/20996 (10%) of patients in the national cohort, which included 85% of hospital sites. By age, arterial monitoring was highest in neonates as a proportion of activity in this group (10/45, 22%), lowest 1-15-year-olds with a further peak between 66-75y (560/3384, 17%) before reducing to 101/757 (13%) in patients aged ≥85y. Use was associated with increasing ASA physical status (ASA1: 110/5168, 2%; ASA2: 601/9594, 6%; ASA3: 1014/5308, 19%; and ASA≥4: 415/926, 45%). When stratified by SORT score risk, 6% of low-, 27% of medium- (1-5%) and 47% of high-risk (>5%) patients had invasive arterial blood pressure monitoring. Where the SORT predicted 30-day mortality was over 5%, all specialties with ≥ 5 patients in this category had arterial line usage of ≥ 50%, except orthopaedic trauma (16%) and urology (14%). Our data highlight inconsistencies in the use of arterial lines, particularly in those undergoing orthopaedic trauma surgery- a group with a significant burden of older frail patients. The data suggest a degree of discrimination against this group in whom inadvertent hypotension and perioperative cardiac arrest are more common. Funding (NIHR RfPB) has been secured to study whether continuous arterial blood pressure monitoring in older frail patients is beneficial.

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Background

National guidance sets minimal clinical monitoring standards during anaesthesia but additional monitoring is at the discretion of the anaesthetist.

Guidelines advise invasive arterial blood pressure monitoring in high-risk groups, including those who are older, living with frailty or when the surgery is urgent, but it is not known if this is done.

High risk cases can be identified through risk scores (e.g. Surgical Outcome Risk Tool) which predicts 30-d mortality based on pre-operative factors which includes age, comorbid status and urgency of surgery.

Here, we describe new analysis from the 7th National Audit Project (NAP7) relating objective pre-operative risk and the use of invasive arterial blood pressure monitoring in routine anaesthetic practice in the UK.

Methods Overview

416 NHS sites across 182 NHS Trusts or Boards invited over whole of the UK, 352 sites (85%) participated.

Captured anonymous individual case level information- 4-day period on each site with equal chance of starting collection on each day of the week.

24 172 cases submitted, 20 996 non-obstetric cases included in analysis.

30 d mortality estimated for each case using the Surgical Outcome Risk Tool (SORT) Score. Cases stratified into low (<1%), medium (1-5%) and high risk (>5%) groups.

Key Results

1. 2140 of 20,996 (10%) non-obstetric patients had invasive arterial blood pressure monitoring.
2. By age, arterial monitoring was highest in neonates (10/45, 22%), lowest in patients aged 1–15 y, with a further peak between 66 and 75 y (560/3384, 17%) before reducing to 101/757 (13%) in patients aged ≥85 y.
3. Use was associated with increasing ASA physical status (ASA 1 or 2: 711/14 5%; ASA 3, 1014/5308, 19%; ASA ≥ 4, 415/926, 45%).
4. When patients of ≥ ASA physical status 4 were considered alone, 62% of those aged 36–45 y had arterial monitoring vs. 25% of those aged > 85 y.
5. Patients having cardiac surgery had the highest rate of monitoring (181/212, 85%), followed by neuro- (226/424, 53%), thoracic (103/203, 51%) and vascular surgery (170/407, 42%). Notably, patients having orthopaedic trauma surgery had arterial lines in only 117/2109 cases (5%).
6. Where the SORT predicted 30-day mortality was over 5%, all specialties with ≥ 5 patients in this category had arterial line usage of ≥ 50%, except orthopaedic trauma (16%) and urology (14%, Table 1).

	SORT 30-d predicted mortality		
Specialty	**<1%**	**1-5%**	**>5%**
Spinal	49/163 (30%)	8/18 (44%)	5/5 (100%)
Cardiac surgery	96/119 (81%)	62/68 (91%)	23/25 (92%)
Transplant	11/47 (23%)	16/37 (43%)	5/6 (83%)
Neurosurgery	143/299 (48%)	50/85 (59%)	33/40 (83%)
Cardiology	37/206 (18%)	21/47 (45%)	11/15 (73%)
General surgery	301/3442 (9%)	205/617 (33%)	183/256 (71%)
Radiology	23/311 (7%)	28/76 (37%)	16/24 (67%)
Other	10/567 (2%)	9/67 (13%)	9/15 (60%)
Thoracic Surgery	46/115 (40%)	47/71 (66%)	10/17 (59%)
Vascular	53/152 (35%)	60/157 (38%)	57/98 (58%)
Plastics and burns	26/736 (4%)	7/46 (15%)	5/10 (50%)
Gastroenterology	3/205 (1%)	9/39 (23%)	7/14 (50%)
Orthopaedics - trauma	30/1279 (2%)	32/478 (7%)	55/350 (16%)
Urology	86/1835 (5%)	24/179 (13%)	3/21 (14%)
All	1065/17724 (6%)	638/2343 (27%)	429/913 (47%)

Table 1: The chance of having an arterial line by specialty and SORT 30-day predicted mortality. Non-obstetric specialties included where there were at least 5 cases in each SORT score range and all cases where the SORT score was able to be calculated. Specialties ordered by the highest use in the > 5% risk category. Data bars illustrate the relative use of arterial lines in each group.

Conclusions

There are inconsistencies in the use of arterial lines, particularly in those undergoing orthopaedic trauma surgery- a group with a significant burden of older frail patients.

The data suggest a degree of discrimination against this group in whom inadvertent hypotension and perioperative cardiac arrest are more common.

Funding (NIHR RfPB) has been secured to study whether continuous arterial blood pressure monitoring in older frail patients is beneficial.

References: Protopapa *et al.*, Development and validation of the surgical outcome risk tool (SORT). *BJS* 2014 101:1774-1783; Moppett *et al.*, Peri-operative cardiac arrest in the older frail patient as reported to the 7th National Audit Project of the Royal College of Anaesthetists. Anaesthesia 2024, 79: 810-820; Kane *et al.*, Patient characteristics, anaesthetic workload and techniques in the UK: an analysis from the 7th National Audit Project (NAP7) activity survey. Anaesthesia 2023; 78: 701-711.

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RCoA Royal College of Anaesthetists | CR&I Centre for Research and Improvement | NAP7 Perioperative Cardiac Arrest

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