

How many words would 1000 pictures be worth?

Diminishing returns of routine Chest X-rays in ICU
patients

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Outline

- History
- Current recommendations
- Clinical Question
- Evidence Review
- Conclusions and final recommendations

Chest radiograph

- Reasons?

History

- Number of reasons for chest radiographs
 - Line positioning/placement
 - Device placement
 - Fluid status
 - Diagnostics – interstitial disease, VAP, etc
 - Coordinate clinical findings
- American College of Radiology previously recommended routine daily chest X-rays in patients admitted to the ICU (2009)

History

- Observational studies have suggested benefit in performing routine chest x-rays (CXRs)
- CHEST 1985
 - 27% of routine and nonroutine CXRs revealed clinically unsuspected abnormalities
 - Nonroutine films were more likely to reveal new findings
- Crit Care Med 1997
 - 20% of routine CXRs revealed major findings leading to changes in management in 8% of cases

History

- Numerous observational studies have questioned the utility of routine chest x-rays

Arch Surg 1995

- 48% of x-rays performed in a surgical ICU were routine and only 17% impacted patient management

Crit Care Med 1991

- Of 538 routine CXRs, 8% presented new "major findings"
- 58% of these findings (25/43) were predicted with clinical/physical exam
- Meaning that only 3% (18/538) of routine x-rays discovered unanticipated findings

History

Crit Care 2001

- 6 month prospective evaluation of CXR procedures in a med-surg ICU
- 850 x-rays were performed in 198 patients
- 22% of all routine CXRs led to a change in management compared to 40% of nonroutine CXRs
- Almost half of all patients received a second CXR following a routine AM CXR
- >50% of changes to management involved adjustment to medical devices, lines or tubes

Risks

- Exposure to ionizing radiation
 - Cataracts
 - Hair loss
 - Skin reddening
 - Cancer
- The actual dose of radiation associated with chest x-rays varies but is generally very low
 - Estimated to be equivalent to about 2.5 days of normal environmental exposure
 - Risk is higher in younger patients
- <http://www.xrayrisk.com/calculator/calculator-normal-studies.php?id=1>

Risks

- Workers in the unit?
 - A study done in 1987 hooked 4 ICU nurses up with dosimeters over a 2 month period and taped dosimeters on the walls throughout the unit
 - Looked at 35 patients and 197 x-rays were taken (approx. 6/patient)
 - After the 2 month period, none of the dosimeters measured any detectable radiation doses

Boles JM, et al. Intensive Care Med. 1987

Current Recommendations

- American College of Radiology 2011 Appropriateness Criteria for Chest Radiograph in ICU patients
- *Recommendation: Routine daily chest radiographs are not indicated for patients with acute cardiopulmonary problems. In stable patients admitted for cardiac monitoring, or in stable patients admitted for extrathoracic disease only, an initial ICU admission radiograph is not recommended; follow-up radiographs should be obtained only for specific clinical indications.*

Current Practice

- Vancouver Sun January 2013:
- "St. Paul's Hospital pioneers cutting number of routine chest X-rays"
- "Stopping needless tradition spares ICU patients from radiation exposure, saves time"
- Fraser Health – "At this time, daily routine chest X-rays continue to be performed throughout all our acute care sites, particularly at the tertiary level... planning to transition to the practice currently followed by VGH and St. Paul's"

Clinical Questions

Population	Patients admitted to intensive care units
Intervention	On demand or as needed chest x-rays
Comparator	Routine chest x-rays (daily without specific indication)
Outcome	Mortality Days of mechanical ventilation ICU length of stay Hospital length of stay New diagnoses Medication prescribing Radiation exposure – patient and care providers

Search Strategy

Databases	MEDLINE, EMBASE, Cochrane, Google Scholar
Search terms	Daily chest x-ray, routine chest x-ray, nonroutine, on-demand chest x-ray, intensive care unit, ICU, critically ill, mortality, length of stay
Results	3 RCTs 2 Meta-analyses 6 Before – After comparison observational studies 1 Cross-sectional analysis 1 Conference abstract
Analyzed	Most recent meta-analysis 1 RCT not included in pooled mortality data Conference abstract

Routine chest x-rays in intensive care units: a systematic review and meta-analysis

Ganpathy A, et al. Critical Care 2012. 16:R68

Study Objectives and design

- Review the available evidence evaluating the effect on clinical outcomes of abandoning routine chest x-rays
- Inclusion:
 - Randomized or quasi-randomized controlled trials
 - Observational studies if they were before after comparisons
 - Adult or pediatric ICU
 - Reported on outcomes of mortality or length of stay
- Data extracted by three authors and quality was assessed based on allocation, blinded outcomes, and losses to follow-up

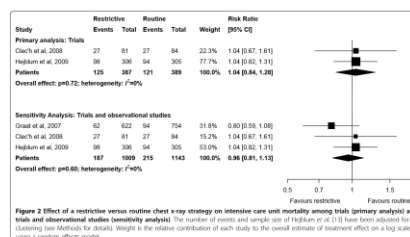
Outcomes

- Primary
 - ICU Mortality
- Secondary
 - Hospital mortality
 - ICU and hospital LOS
 - Duration of mechanical ventilation

Results

- Nine studies included – 2 RCTs, 1 quasi-randomized, 6 observational
- 39,358 x-rays done on 9,611 patients
- Two RCTs included in primary analysis
- Radiologists were not blinded in any of the studies to allocation

Results – ICU Mortality



Results – ICU length of stay

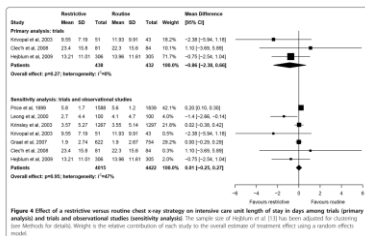


Figure 4 Effect of a restrictive versus routine chest x-ray strategy on intensive care unit length of stay among trials (primary analysis) and trials and observational studies (sensitivity analysis). The sample size of Hughson et al. (12) has been adjusted for clustering (see Methods for details). Weight is the relative contribution of each study to the overall estimate of treatment effect using a random effects model.

Results – Hospital Length of Stay

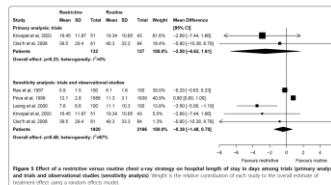


Figure 5 Effect of a restrictive versus routine chest x-ray strategy on hospital length of stay in days among trials (primary analysis) and trials and observational studies (sensitivity analysis). Weight is the relative contribution of each study to the overall estimate of treatment effect using a random effects model.

Results – Ventilator Days

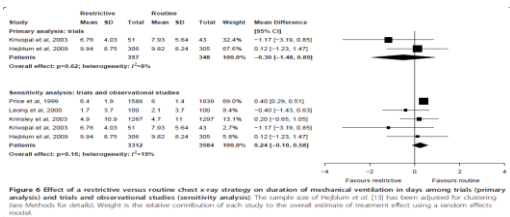


Figure 6 Effect of a restrictive versus routine chest x-ray strategy on duration of mechanical ventilation in days among trials (primary analysis) and trials and observational studies (sensitivity analysis). The sample size of Hughson et al. (12) has been adjusted for clustering (see Methods for details). Weight is the relative contribution of each study to the overall estimate of treatment effect using a random effects model.

Author's Conclusions

- "This meta-analysis did not detect any harm associated with a restrictive chest radiograph strategy. However, confidence intervals were wide and harm was not rigorously assessed. Therefore, the strategy of abandoning routine CXRs in patients admitted to the ICU remains uncertain."

Limitations

- Limited data available
- Practice varies across sites and while studies may not be heterogeneous (only 2 included in primary analysis), practice likely varies greatly across different sites
- Heterogeneous patient groups – medical, surgical, intubated/non-intubated, admitting diagnosis, etc
- High risk for bias
 - Dependant on radiologist/clinician reading the film
 - Ascertainment bias of including non-clinical outcomes
 - If clinical judgement leads to a "diagnosis", chances film disproves?

Take Away

- Data from observational studies varies greatly, trial data is more consistent
- Many limitations with conducting trials in this field
- Risk for missed diagnoses not assessed
- Overall, appears no difference in major outcomes
- Many sites/clinicians hesitant and reluctant to adopt new strategy

Missed diagnoses?

- One RCT in a Med-Surg ICU in France
 - 165 patients randomized to daily CXR or clinically indicated CXR
 - Excluded patients intubated for <48hr, palliative, trach, or re-intubation
 - All patients received routine CXR
 - In the restrictive group, only CXRs ordered with an appropriate indication were reviewed, non-clinically indicated CXR in this group were hidden from physicians and interpreted retrospectively
 - Outcomes: rates of new findings, rates of new findings prompting intervention, rate of delayed diagnoses in restrictive group, ICU and hospital mortality

Cle'h C, et al. Intensive Care Med. 2008

Results

- 62/94 clinically indicated CXRs indicated new findings in the restrictive group (66%)
- 53/94 required intervention (56.4%)
- Retrospective analysis showed that diagnoses could have been made 24h earlier in 6 patients had they gotten routine investigations
 - A rate of 0.7% (6 diagnoses/849 non-clinically indicated CXR)
 - The missed diagnoses were minor atelectasis not requiring intervention
- In the routine group only 64/885 CXR revealed new findings (7.2%)
- 49/885 required intervention (5.5%)
- No difference between groups for mortality, LOS, or ventilator days

Interpretation

- No difference in mortality, LOS, ventilator days
- Supports the "safety" of on-demand x-ray and highlights the general overuse and lack of benefit of routine exams
- Concerns
 - Knowing they were being evaluated, is there a chance for more comprehensive clinical exams? (unblinded)
 - Films were not read by radiologists – would more diagnoses have been found?
 - Single-centered, broad patient population questions generalizability

More recent Data

- Cross-sectional study across 104 ICUs in France (RadioDay)
- Designed to assess current practice and evaluate outcomes of practice
- 854 CXRs were performed in 804 patients
 - Systematic CXR following device/line/tube placement accounted for 17% of total CXR
 - 2/3 of ICUs employed on-demand strategy
- 710 CXRs analyzed
 - 395 (56%) were "on-demand" and 310 (44%) were routine

Lakhal K, et al. Intensive Care Med. 2012

Results

- 68% of CXRs exhibited at least one abnormality (tissue vs. device)
 - 83% in on demand vs. 50% $p<0.001$
 - New abnormality in 31% of on demand and 20% if routine ($p<0.001$)
- CXR findings were "expected and not leading to changes in care"
 - 76% routine vs. 47% on-demand ($p<0.001$)
- CXRs that led "a change that would not have occurred without the CXR"
 - 19% routine vs. 44% on-demand ($p<0.001$)

St. Paul's Data

- Goal: to reduce number of routine chest radiographs ordered for ICU patients by 25%
- Employed on-demand strategy through nurse and physician education
 - 3 month period
- Results:
 - 22% reduction in CXRs ordered
 - Did not reduce the number of CT scans or procedures
 - Suggest that at a cost of \$40/CXR and ~ 700 fewer CXR per year will result in \$28 000 in saving for SPH

Dodek PM, et al. AJRCCM Conference. 2012

Interpretation

- Cost savings are an estimation
- 3 month period may be too short to capture differences in patients
- No reports on hard outcomes
 - Has been reported numerous times that no difference is seen
- Lack of patient/diagnostic evaluation pre and post new strategy
 - May become available when (if) data is published

Conclusions

- Debate still exists on whether routine CXRs are required or if on-demand CXRs are a strategy that is as safe and effective
- Very limited data exists, most is single-centred and observational
- Current ACR guidelines recommend against routine/daily CXR in ICU patients
- Amount of radiation received from CXRs is low and unlikely to cause harm but there is a dearth of data on long term outcomes
- On-demand strategies appear effective, reduce costs, and unlikely to increase harm

Recommendations

- CXRs following the placement of central lines, ETTs, or implantable devices are warranted to ensure safety and functioning of the device
- The yield of routine x-rays is generally very low and majority of outcome data is for improperly placed tubes/lines
- Routine chest x-ray cannot replace physical and clinical assessment and very rarely offers findings beyond what is discovered/expected
- Eliminate routine x-rays and reserve for use following in-depth clinical assessment, where diagnoses remain in question

Questions?